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August 17, 2016
P2014265

RE: Pre-Design Investigation Work Plan Addendum
Operable Unit 1 (OU-1) of the Clove and Maple Ave Haverstraw MGP Site
Orange and Rockland Utilities (O&R)

Dear Ms. McCormick:

The Natural Resource Technology Team (NRT Team) is pleased to present this Work Plan Addendum for performance of additional Pre-Design Investigation (PDI) activities at Operable Unit 1 (OU1) of the Orange & Rockland (O&R) former Clove and Maple Avenues Manufactured Gas Plant (MGP) Site located in Haverstraw, New York.

The additional scope of work (PDI Addendum) will be performed in accordance with objectives, scope, rationale, quality assurance requirements, and health and safety procedures outlined in the New York State Department of Environmental Conservation (NYSDEC) - approved PDI Work Plan (PDIWP). In cases where the task is new and was not originally addressed in the PDIWP an addendum to Appendix A - Standard Operating Procedures and Appendix D - Site-Specific Health and Safety Plan is provided herein.

The PDI Addendum includes:

- Evaluation of surface soils in the swale area, including areas previously sampled. NRT will collect ten (10) surface soil samples in the drainage swale to provide updated surface soil quality data in the swale area.
- Collection of a synoptic round of water levels at the site to further characterize groundwater flow patterns and gradients at the site.
- Collection of a complete round of groundwater samples from the OU1 monitoring wells to provide updated groundwater quality data.
- Drilling, logging, and subsurface soil sampling of four (4) soil borings, advanced using sonic drilling methods, within the sloped soil bank along Maple Avenue. The purpose of this task is to evaluate the soil quality in the soil bank outside the current excavation limits to determine if soils allow for restricted residential development.
- Laboratory analysis of select surface soil, subsurface soil, and groundwater samples.
- Performing a complete data validation on all of the analytical results, including the use of data qualifiers in all cases where appropriate.
- Results of these evaluations will be incorporated into a revision of the current draft PDI Summary Report, dated December 31, 2015, as well as provide responses to the NYSDEC comments on the draft PDI Summary Report.

This PDI Addendum solely addresses OU-1.

As outlined in Section 3.3 of DER 10, specific requirements for investigation work plans are provided in the following sections:

- Section 1 describes the PDI Addendum objectives, scope, and rationale. All quality assurance/quality control procedures and protocols will remain in accordance with Section 4, Quality Assurance.
- Section 2 describes any additional health and safety protocols, including Activity Hazard Analyses (AHA)/Job Safety Analyses (JSA), required based on the tasks to be performed in the PDI Addendum.
- Section 3 presents the PDI Addendum schedule.

1.0 Pre-Design Investigation Addendum Scope and Rationale

The PDI Addendum will consist of the following activities:

- Past utility surveys will be reviewed and utility clearance will be requested to meet requirements for utility protection.
- Surface soil sampling will be performed in the drainage swale for chemical analysis to facilitate delineation of excavation limits.
- Sonic drilling will be used to collect soil samples for chemical analysis to evaluate the soil quality in the bank.
- A synoptic round of water levels will be collected at the site to further characterize groundwater flow patterns and gradients at the site.
- A complete round of groundwater samples from the OU1 monitoring wells will be collected for chemical analysis to provide updated groundwater quality at the site.
- The current Draft PDI Summary Report will be revised to address NYSDEC comments and updated to include the results of the additional investigations.

All proposed surface soil sampling locations and soil boring locations are depicted on the attached Figure 1. Actual locations will be determined during field implementation.

1.1 Utility Clearance

Underground and overhead utilities, including electric lines, gas lines, storm and sanitary sewers, and communication lines will be identified prior to initiation of drilling and other subsurface work. This will be performed consistent with the results of the Level B Utility Survey previously performed for the PDI. Underground utility location will be accomplished as follows:

- All boring locations will be flagged or marked out with survey stakes and/or marking paint.
- Dig Safely New York ((800) 272-4480) will be contacted to initiate the locating activities. New York State law requires that Dig Safely New York be notified at least two working days, and not more than 10 working days, before subsurface work is conducted.
- Participating companies with subsurface utilities present will locate and mark out all respective subsurface utility lines.
- Precautions regarding safe distance from the overhead electrical lines will be reviewed and equipment offset distances flagged and marked out in accordance with the O&R required clearances.
- Prior to advancement of boreholes, the locations will be pre-cleared to a depth of five feet using a combination of manual methods (i.e., hand clearing) or using vacuum extraction to either expose the

subject utilities or confirm area is void of utilities.

- Once clear, site preparation, excavation, and drilling activities will proceed slowly and carefully for the top ten (10) feet of each investigation location.
- Proposed sampling locations may be shifted to avoid subsurface and overhead utilities as appropriate.

1.2 Site Survey

Following completion of the PDI, all sampling and investigation locations will be surveyed for elevation and location using a licensed New York surveyor. This information, as well as previous sample locations throughout the project area, will be incorporated on the site base map.

1.3 Surface Soil Sampling

Surface soil sampling will be performed to evaluate the potential for changed conditions in the drainage swale area since the drainage swale is subject to periodic high surface water flow events. The surface soil sampling will also provide a better distribution of data from locations on either side of the centerline of the drainage swale.

To investigate surface soil conditions in the drainage swale, surface soil samples will be collected in the grassed areas, from below the root zone of the vegetative cover. Surface soils will be characterized by collecting samples distributed along the length of the drainage swale and on both sides of the centerline of the swale (Figure 1). Surface soil samples will be collected following procedures outlined in the attached Standard Operating Procedure (Attachment 1). The vegetative cover including root zone will be removed and a soil sample will be collected from the remaining top two (2) inches. Samples will be analyzed for Volatile Organic Compounds (VOC), Semi-Volatile Organic Compounds (SVOC), Target Analyte List (TAL) Metals, and total and Weak Acid Dissociable (WAD) cyanide. Laboratory analytical methods will be the same as described in the approved PDIWP (Table 2).

1.4 Delineation Borings

The purpose of this task is to evaluate the soil quality of the soil bank outside the current excavation limits to determine if soils allow for restricted residential development. Utility mark outs and vacuum excavation will be performed for all boring locations and Rockland County Department of Health (RCDOH) permits will be acquired prior to drilling activities. These borings will be advanced using sonic drilling methods given site conditions. The general locations of the four (4) additional delineation borings (DB-14, DB-15, DB-16, and DB-17) are shown in Figure 1. Drilling activities include:

- All additional borings to be drilled at the site will require a permit from the RCDOH. The NRT Team will complete the permit application form and identify boring locations, drilling contractor, property owner, scope of work, and permit conditions.
- Air monitoring prior to and during drilling activities will adhere to the NYSDEC-approved Community Air Monitoring Plan (CAMP), which is provided in Appendix B of the NYSDEC-approved PDIWP.
- Perform subsurface soil sampling within the sloped soil bank west of boring/existing monitoring well SB/MW-4, SB/MW-5 and SB/MW-6 and along a line parallel to Maple Avenue and approximately midway up the slope. Target depth of these borings will be approximately 25 to 30 feet. The boring will be terminated at the greater of 25 feet below ground surface (bgs) or after 2 feet of apparently unimpacted glacial till has been encountered.
- At each soil boring, one (1) surface soil sample and one (1) subsurface soil sample will be collected

for chemical analysis. Subsurface samples will be collected from a depth biased high based on field observations and field screening information. Subsurface soil samples collected from the sonic drill rig will be via procedures outlined in the attached Standard Operating Procedure (Attachment 1).

- Samples will be analyzed for VOCs, SVOCs, TAL Metals, Total cyanide, and WAD cyanide using the methods from Table 2 of the NYSDEC-approved PDIWP.
- Access will be from Clove Avenue and will include the removal of up to 40 trees (up to 24" diameter) and excavation within the slope and placement of stone to provide a level area. Further details of site preparation are provided in Section 1.4.1, Site Preparation.
- Any drill cuttings generated will be containerized in labeled drums for disposal, as stipulated in Section 3.2.11 of the approved PDIWP, and the boreholes will be backfilled with bentonite. It is assumed that existing waste disposal data will be sufficient to establish a waste profile and that the drill cuttings will be handled as Industrial, Non-Hazardous Solid Waste.

The borings will be continuously logged, recording the presence of fill material or subsurface obstructions, the nature of each geologic unit encountered, observations regarding moisture content, the PID readings, and visual and olfactory observations regarding the presence of hydrocarbon-like residuals. Samples will be collected from borings and selectively submitted for chemical laboratory analysis. If no source material is observed in a boring, then a confirmatory sample will be collected from the interval exhibiting the highest evidence of contamination based on visual, olfactory or PID evidence. If no evidence of contamination is observed a sample will be collected from approximately 15 to 22 feet bgs, to correspond to a depth where the majority of impacts have been observed on OU-1. If source material is observed, a sample will be collected from the non-impacted interval beneath the MGP-impacted material or from 15 feet bgs, whichever is deeper to confirm the vertical extent of impacts. Samples will be placed in appropriate lab-certified clean containers with preservatives, if appropriate, prepared by the laboratory, placed in coolers and preserved on ice. Samples will be submitted for laboratory analysis of VOCs, SVOCs, TAL Metals, Total cyanide, and WAD cyanide via standard turnaround time. Laboratory analytical methods are summarized in Table 2 of the NYSDEC-approved PDIWP.

1.4.1 Site Preparation

The NRT Team Site Preparation Contractor, Enviroscapes, Inc., will perform clearing and grading to allow access to four (4) boring locations for a Cascade 200C compact sized sonic drill rig or equivalent, as directed by NRT, detailed as follows:

- Enviroscapes will access the site from Clove Avenue. NRT will provide access to the site via the locked vehicle gate entrance.
- Enviroscapes will clear tall grass on the site currently with an ambusher attachment to create access and allow for staging areas for stone and cut tree trunks and large limbs.
- The Cascade 200c requires a roughly 28 foot by 16 foot area to operate, depending on the actual access path, approximately 40 trees ranging in diameter from 6 inches to 24 inches may be removed using chain saws to facilitate access to the drill rig locations.
- Enviroscapes proposes working within the tree drip lines and excavating out the soils from the drip line to the soil boring location to create a path. Enviroscapes will remove any tree stumps that are encountered. The excess soils and imported ¾-inch blended clean stone will be spread beyond the soil boring location approximately five to eight feet. Using up to thirty-two precast concrete blocks, measuring two feet by two feet by eight feet, Enviroscapes proposes to use the blocks to build up and support a working pad for the sonic drill rig. The area will be levelled as reasonably as possible and the legs of the drill rig will further help to stabilize the drill rig at each drilling location.

- All cut trees and branches will be cut into manageable sizes and chipped on the level grassed area (central portion) of site.
- Utilize approximately 114 tons of ¾-inch blended clean stone to help provide a stabilized entrance and area for the sonic drill rig to operate. The stone will be tamped using a plate tamper.
- Drilling locations will be restored at the end of the drilling program

1.5 Groundwater Characterization

All eleven monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, and MW-18), two (2) observation wells (OW-1 and OW-2), and one (1) pumping well (PW-1) will be gauged for depth to water, depth to product, product thickness, and total depth.

Groundwater samples will be collected from these fourteen (14) locations and will be analyzed for VOCs, SVOCs, TAL Metals, total cyanide, and WAD cyanide. Unfiltered metals samples will be collected. Laboratory analytical methods are summarized in Table 2 of the NYSDEC-approved PDIWP. Groundwater samples will be collected following procedures outlined in the attached Standard Operating Procedure (Attachment 1).

Groundwater samples will be collected from monitoring wells using low-flow purging and sampling techniques as specified in United States Environmental Protection Agency (USEPA) Ground Water Issue EPA/540/S-95/504, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (USEPA, April 1996). Low-flow purging and sampling techniques are designed to provide samples representative of groundwater quality in the aquifer formation being sampled and involves the purging and collection of samples from the screened interval of the monitoring well at a low rate of flow through the sampling device. Flow should be between 0.1 and 0.5 liter per minute, with the goal being to sample at the lowest sustainable rate. During purging, water quality will be monitored using in-line real-time field monitoring equipment (flow cell). Parameters to be monitored include pH, temperature, specific conductance, oxidation reduction potential (ORP), dissolved oxygen (DO), and turbidity. The water level will also be monitored during purging and the sampling rate can be adjusted to minimize drawdown (< 0.1 meter), to the extent possible based on rate of recharge to the monitoring well. Readings for real-time parameters and water level are recorded every three to five (3 to 5) minutes during well purging. Wells are purged until parameters stabilize, indicating that flow patterns have been established, bringing water from the sampled formation through the well screen and into the sampling inlet. In order to be considered stabilized, parameters must fall within the following guidance ranges for three (3) consecutive readings:

pH	± 0.1
Conductivity	± 3%
ORP	± 10mv
Turbidity	± 10%
Temp (°C)	± 3%
DO	± 10%

Following stabilization of the field parameters, the tubing will be disconnected from the flow cell and the groundwater sample will be collected. Samples will be collected at the mid-point of the well screen if the water level at the time of sampling exceeds the top of the well screen, or the mid-point of the water level at the time of sampling and the bottom of the well screen, if the water level at the time of sampling is within the well screen.

Samples will be placed in appropriate lab-certified clean containers with preservatives, if appropriate, prepared by the laboratory, placed in coolers and preserved on ice.

Purge water will be containerized in 55-gallon drums for disposal, as stipulated in Section 3.2.11 of the NYSDEC-approved PDIWP. It is assumed that existing waste characterization data will be sufficient to establish a profile and that the groundwater will be handled as Industrial Non-Hazardous Waste.

1.6 Reporting

The NRT Team will prepare and submit an updated PDI Summary Report that summarizes the results of the PDI Addendum data collection and compilation activities, including a description of sampling methodology, results, discussion, and conclusions. Appended to the PDI Summary Report will be a summary table of water level measurements/groundwater elevations, a groundwater contour map, summary tables of validated analytical results (surface soil, subsurface soil, and groundwater), and laboratory reports with chain of custody forms. The updated PDI Summary Report will document that required data for the design criteria and specifications has been collected. NRT anticipates that the PDI Summary Report will be submitted to NYSDEC approximately 30 days after the completion of the field work.

2.0 PDI Addendum - Health and Safety Procedures

A number of environmental investigations have been performed at the site between 1996 and 2009. These investigations were documented in the RI Report (CMX, 2009), which concludes that coal tar is present in subsurface soils and groundwater at the site.

There are physical hazards that may be present at the site associated with existing conditions and with investigation activities. Potential physical hazards include the following:

- Traffic - Requires care when entering and leaving the site.
- Overhead and underground utilities - Overhead power lines near Maple Avenue. Potential underground utilities during drilling and subsurface soil sampling.
- Mechanical equipment including site clearing equipment and sonic drill rig.
- Slips, trips, and falls - General site hazards. Debris along work area(s), debris inside and outside of offsite buildings, and rough or steeply sloped surfaces.
- Exposure to hazardous wildlife and plants.

All NRT Team personnel will be bound by the provisions of the Site-Specific Environmental Health and Safety Plan (EHASP) and O&R's standard contractor H&S requirements. All field staff will be required to participate in a preliminary project safety meeting to familiarize themselves with the anticipated hazards and respective onsite controls. The discussion will cover the entire EHASP subject matter, putting emphasis on critical elements of the plan; such as the emergency response procedures, personal protective equipment, site control strategies, and monitoring requirements. In addition, daily tailgate safety meetings will be held to discuss: the anticipated scope of work, required controls, identify new hazards and controls, incident reporting, review the results of inspections, any lessons learned or concerns from the previous day.

Attendance rosters from all safety meetings will be signed by all present and incorporated into the project records. NRT subcontractors will formally agree to sign off on the NRT Team's EHASP. If the subcontractor has additional or more stringent requirements, they will be submitted to NRT and O&R for review. Further detail on Health and Safety protocols for the site is presented in the amended Site-Specific EHASP is provided in Attachment 2.

3.0 Schedule

The primary PDI Addendum activities will begin upon NYSDEC approval of this PDI Addendum Work Plan. It is O&R's intention to begin utility clearance work prior to NYSDEC approval of the PDI Addendum Work Plan. The field portion of the work is expected to require one to three weeks of onsite activities. This will begin as soon as practicably possible after approval of the PDIWP, but will be dependent on subcontractor scheduling.

O&R will inform NYSDEC at least 10 calendar days prior to conducting the work. The PDI Summary Report will be submitted to the NYSDEC approximately 30 days after the completion of the field work.

Our schedule assumes the following:

- Week 1: NRT modifies EHASP and PDI Addendum Work Plan (PDI Addendum).
- Week 2: O&R reviews EHASP and PDI Addendum;
- Week 3: NRT finalizes EHASP and PDI Addendum and submits to NYSDEC and NYSDOH for review.
- Week 4: NYSDEC and NYSDOH reviews EHASP and PDI Addendum;
- Week 5: NRT finalizes EHASP and PDI Addendum, assuming receipt of NYSDEC and NYSDOH comments. O&R/ConEd approves Final EHASP and PDI Addendum and submits to NYSDEC and NYSDOH.
- Week 6: NYSDEC and NYSDOH approve Final EHASP and PDI Addendum.
- Week 7: Utility mark out, initiate utility clearance (vac), site preparation, surface soil sampling, collect water levels, and groundwater samples; CAMP.
- Week 8: Complete vacuum clearance and perform sonic drilling at the four (4) slope borings to investigate soil quality between the eastern excavation limits and Maple Avenue; survey sampling and boring locations, and complete staging of IDW.
- Week 9: Removal of IDW.
- Week 10: Receive preliminary results for groundwater analytical data; Certified Data Validator issues DUSR.
- Week 11: Receive preliminary results for subsurface soil analytical data; Certified Data Validator issues DUSR.
- Week 12: NRT revises PDI Summary Report
- Week 13: O&R approves PDI Summary Report and NRT finalizes for submittal to NYSDEC.

As of the date of this proposal, the schedule is in Week 3, which would result in submittal of the PDI Summary Report to NYSDEC on 10/21/16. The NRT Team will make efforts to expedite activities where possible. Also note that the schedule is pending contractor availability.

Should you have any questions or comments please call me at (609) 975-2900. Thank you again for the opportunity to support this project.

Sincerely,

The NRT Team

John Magee, PE
Project Manager

Attachments

Attachment 1 Additional Standard Operating Procedures (Surface Soil Sampling, Subsurface Soil Sampling using Sonic Drilling Equipment, and Groundwater Sampling)

Attachment 2 Updated Site-Specific EHASP

cc: Roger Pennifill, O&R
Jennifer Hagen, NRT
Mark Williams, Sterling
Tim Silar, SSi

DRAWN BY: DMD DATE: 08/19/15
CHECKED BY: JRR DATE: 08/19/15
APPROVED BY: MAW DATE: 08/20/15
DRAWING NO: 2254-4-B03 Site Plan With Topo
REFERENCE: .

PDI ADDENDUM SAMPLE AND BORING LOCATIONS MAP

PDI SUMMARY REPORT
ORANGE & ROCKLAND UTILITIES
CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2254/4.0

FIGURE NO.
1

Aug 10, 2016 2:41pm PLOTTED BY: cad SAVED BY: cad
S:\Sterling\Projects\2015 Projects\Clove & Maple Ave - NRT - 2015-03\2254-4-B03 Site Plan With Topo.dwg Layout1
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XREFS: X:\Mapping\Projects\22\2254\CAD\5-0\Xref\Xref - Boxboard 2254-5.dwg

ATTACHMENTS

ATTACHMENT 1

Appendix A (rev.): Additional Standard Operating Procedures

(Additional Standard Operating Procedures (Surface Soil Sampling, Subsurface Soil Sampling using Sonic Drilling Equipment, and Groundwater Sampling)

SOP – SURFACE SOIL SAMPLING USING MANUAL METHODS

SCOPE AND APPLICATION

This document describes procedures for surface soil sampling using hand tools.

PERSONNEL QUALIFICATIONS

NRT personnel directing, supervising, or leading soil sampling activities should have a minimum of 2 years of previous environmental soil sampling experience. NRT personnel providing assistance to soil sample collection and associated activities should have a minimum of 6 months of related experience or an advanced degree in environmental sciences.

EQUIPMENT LIST

The following materials will be available, as required, during soil sampling activities:

- Personal Protective Equipment (PPE), as specified by the site Health and Safety Plan (HASP);
- Stainless steel bowls;
- Stainless steel spoons; ·
- Stainless steel spades; ·
- Stainless steel hand augers; ·
- Indelible ink pens; ·
- Engineer's ruler or survey rod; ·
- Sealable plastic bags (e.g., Ziploc®); ·
- Equipment decontamination materials ·
- Sample bottles and preservatives appropriate for the parameters to be sampled for laboratory analysis, if any; ·
- Transport container with ice (if sampling for laboratory analysis); ·
- Appropriate sample containers and forms; and · field book. Documentation forms and notebooks to have on hand include: soil sample log forms, chain-of-custody forms, sample labels and seals, field logbook.

CAUTIONS / HAZARDS

Task specific Job Safety Analysis (JSAs) must be developed to identify site hazards associated with the investigation and reviewed by all field crew members prior to the start of work. Safe Performance Self-Assessment (SPSA) to be performed by employees before performing a new task. Underground utilities will be cleared per the NRT Utility Location Policy and Procedure.

HEALTH AND SAFETY

Soil sample collection will be performed in accordance with a site-specific Health and Safety Plan (HASP) and task specific JSA forms, copies of which will be present onsite during such activities.

PROCEDURE

Soil samples may be collected at intervals from the ground surface to various depths. Sample locations will be identified using stakes, flagging, or other appropriate means, and will be noted in a field logbook, and/or soil sampling logs. Sample points will be located by surveying, use of a global positioning system (GPS), and/or measurements from other surveyed site features.

1. Equipment that will come in contact with the soil sample should be cleaned in accordance with the appropriate equipment decontamination SOP(s), or else new, disposable equipment should be used. Collect equipment blanks in accordance with the Project Quality Assurance Project Plan (QAPP).
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris.

3. Use a spade, spoon, scoop, or hand auger to collect a sample of the required depth interval.

4. Use an Engineer's ruler to verify that the sample is collected to the correct depth and record the top and bottom depths from the ground surface.

5. To collect samples below the surface interval, remove the surface interval first; then collect the deeper interval. To prevent the hole from collapsing, it may be necessary to remove a wider section from the surface or use cut polyvinyl chloride (PVC) tubing or pipe to maintain the opening.

6. Collect samples for volatile organic compounds (VOCs) as discrete samples using Encore® samplers.

7. Homogenize samples for other analyses across the required interval or mix them with other discrete grab samples to form a composite sample (see Compositing or Homogenizing Samples SOP).

8. Place sample in clean sample container; label with sample identification number, date, and time of collection; and place on ice (if obtained for laboratory analysis). Prepare samples for packaging and shipping to the laboratory in accordance with the Chain-of-Custody Handling, Packing, and Shipping SOP.

9. Backfill sample holes to grade with native material or with clean builder's sand or other suitable material.

WASTE MANAGEMENT

Waste soils will be managed as specified in the Work Plan, and according to state and /or federal requirements. Personal Protective Equipment (PPE) and decontamination fluids will be contained separately and staged at the Project Site for appropriate disposal. Waste containers must be a sealed and labeled at the time of generation. Labels will indicate date, sample locations, site name, city, state, and description of the matrix (e.g., soil, PPE).

DATA RECORDING AND MANAGEMENT

Field documentation such as logbook entries and chain-of-custody records will be transmitted to the NRT PM or Task Manager each day unless otherwise directed. The Field Team Leader will retain all site documentation while in the field and add to Project files when the field mobilization is complete.

QUALITY ASSURANCE

Quality assurance samples (rinse blanks, duplicates, and MS/MSDs) will be collected at the frequency specified in the NYSDEC-approved QAPP and depending on the project quality objectives. Reusable soil sampling equipment will be cleaned prior to use following the equipment cleaning SOP. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Any deviations from the SOP will be discussed with the Project Manager prior to changing any field procedures.

SOP - SUBSURFACE SOIL SAMPLING USING SONIC DRILLING EQUIPMENT

Purpose and Applicability

This Standard Operating Procedure (SOP) describes the basic techniques and general considerations to be followed for collecting subsurface soil samples using sonic drilling equipment. Subsurface soil samples may be obtained using this system for purposes of determining subsurface soil conditions and for obtaining soil samples for physical and/or chemical evaluation. The purpose of this SOP is to provide a description of a specific method or procedure to be used in the collection of subsurface soil samples using the sonic drilling method. Sonic drilling is used primarily for deep borings that may penetrate bedrock. This SOP describes procedures for drilling unconsolidated soils. Subsurface soil is defined as unconsolidated material which may consist of one or a mixture of the following materials: sand, gravel, silt, clay, peat (or other organic soils), and fill material. Subsurface soil sampling, conducted in accordance with this SOP will promote consistency in sampling and provide a basis for sample representativeness. The sampling methods covered in this SOP are applicable to unconsolidated soil/fill materials. Sample recovery is somewhat dependent on grain size as very coarse gravel, cobbles, and boulders will occasionally cause premature refusal of the sample tooling. It is generally preferable to have some prior knowledge of site soil conditions if sampling activities are proposed where equipment limitations may become a factor. It is expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be noted in specific Work Plans or on Field Modification Forms as appropriate and will be approved in advance by the Project Manager. Deviations from the SOP will be documented in the Project records.

General Principles

Soil sampling using the sonic drilling method requires use of a sonic drilling rig to advance the core barrel vertically into the undisturbed soil ahead of the outer casing. The core barrel is then extracted from the outer casing to recover the sample. The typical sonic sampling method consists of a 4-inch diameter by 10-foot long open-ended steel core barrel that fits through a 6-inch diameter outer casing. The core barrel is attached to drill stem and vibrated ahead of the outer casing. Once the core barrel is removed from the ground, the soil is vibrated out of the core barrel and into a plastic sleeve, exposing the soil to be evaluated. This sampling tool is most often used for soil profiling and collection of soil samples.

PERSONNEL QUALIFICATIONS

Field Staff

It is the responsibility of the field staff to conduct subsurface soil sampling in a manner which is consistent with this SOP. Field staff will observe all activities pertaining to subsurface soil sampling to ensure that the SOP is followed, and to record all pertinent data into a digital capture device, onto a boring log or into a field logbook. It is also the responsibility of field staff to indicate the specific targeted sampling depth or sampling interval to the drilling subcontractor. Field staff will collect representative environmental or stratigraphic characterization samples once the sampling device has been retrieved and the sample is placed in the plastic sleeve. Additional sample collection responsibilities include labeling, handling, and storage of samples until further chain of custody procedures are implemented. Field personnel must be health and safety certified as specified by the Occupational Safety and Health Administration (OSHA) (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials may be present. 2.2 Drilling Subcontractor It is the responsibility of the drilling subcontractor to provide the necessary tooling for obtaining subsurface soil samples. This generally includes the sonic drilling rig and one or more core barrels in good operating condition, and other necessary equipment for borehole preparation and sampling. Equipment decontamination materials should also be provided by the subcontractor and should meet project specifications. Drilling personnel must be health and safety certified as specified by OSHA to work on sites where hazardous waste materials may be present.

HEALTH AND SAFETY

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, are addressed in the site specific Health and Safety Plan (HASP). All work will be conducted in accordance with the HASP. Subsurface soil sampling by sonic drilling methods may involve physical and/or chemical hazards associated with exposure to soil, water, or materials in contact with either soil or water. When soil sampling is performed, adequate health and safety measures must be taken to protect field personnel. These measures are addressed in the Project HASP.

SOP - GROUNDWATER SAMPLING

Introduction

The objective of this written procedure is to establish guidelines for the sampling of groundwater monitoring wells utilizing non-dedicated bladder pumps and low flow/low volume purging and sampling methods.

Equipment

- Geotech Model 0710 Bladder Pump or Equivalent;
- 12-Volt Deep Cycle Battery;
- Disposable polyethylene discharge line;
- YSI 556 or equivalent water quality meter (with pH, temperature, conductivity, dissolved oxygen probes);
- Horiba or equivalent flow through cell and discharge lines;
- Solinst Model 101 Water Level Indicator or equivalent;
- Cooler with ice and thermometer;
- Waterproof field notebook and Groundwater Sampling Record sheets;
- Chain-of-custody forms;
- Black ballpoint pens;
- Calculator;
- Disposable, powder-free vinyl gloves;
- Plastic bags (including sealable bags for samples);
- Paper towels;
- Non-phosphate laboratory grade detergent (e.g. Liquinox™);
- Distilled water;
- Monitoring well key;
- PPE (as required by the Project Health and Safety Plan);
- Sample containers (per Project Sampling and Analysis Plan);
- Sample container labels, and;
- Calibrated buckets.

Procedures

Before initiating groundwater sampling a complete round of synoptic water levels should be obtained for the site. Record depths to water in the available monitoring wells. Synoptic water level data should be recorded on the Monitoring Well Gauging Form.

1. The number and frequency of groundwater samples to be collected and the associated analytical parameters are summarized in the Pre-Design Investigation (PDI) Addendum Work Plan. This procedure does not apply to the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples.

2. Groundwater sampling following this procedure shall be performed using non-dedicated bladder pumps fitted with polyethylene discharge tubing.

3. The sample pump intake shall be positioned within the well's screened section. For wells screened across the water table, the pump should be set in the lower one-third of the screened interval.

4. Disposable, powder-free gloves shall be worn by personnel during any contact with compressor, generator or associated fuel.

5. Clean, disposable gloves shall be worn when handling any dedicated or decontaminated sampling equipment, sample containers, and during the collection of samples.

6. All non-dedicated sampling and measuring equipment must be decontaminated before use. At a minimum, equipment should be disassembled (when appropriate) and scrubbed in a non-phosphate, laboratory grade detergent and distilled water solution, then rinsed with copious amounts of distilled water.

7. All sample vials and containers shall be stored in a clean carrying case. Remove the sample containers only when needed.

8. Purge water shall be contained in accordance with methods specified in Section **Error! Reference source not found.**.

9. Field analysis equipment (pH, conductivity, temperature, turbidity and dissolved oxygen probes) shall be calibrated in accordance with the manufacturer's procedures. All calibration methods, procedures and results shall be documented in the calibration log and field notebook.

10. Document the date, well identification and unusual occurrences in the field logbook and on the Groundwater Sampling Record. Document all field measurements on the Groundwater Sampling Record.

11. Inspect the protective casing and general well condition and document any items of concern in the appropriate area on the Groundwater Sampling Record.

12. Unlock the protective casing. Refer to the appropriate Health and Safety Plan for air monitoring or other health and safety requirements.

13. Measure the depth to water (DTW) from the measuring point (MP) located on the well (inner) casing using an electronic measuring device. Record the DTW from the MP (DTWMP) measurement on the Groundwater Sampling Record. As required, the water level measuring device can be left in the well for additional measurements during well purging.

14. Purge Volume Determination:

    a. Minimum Purge Volume: A minimum of two times the volume of the discharge tubing shall be purged prior to the sampling of the well. The calculation for determining this volume of water to be removed from the pump and tubing is as follows:

       PVmin = (TL x TF) x 2

       where:

       PVmin = The minimum volume of watcr to be purged from a well.
       TL = Tubing Length
       TF = Tubing Factor which is 0.0102 gal/ft (39 ml/ft for tubing diameter of 3/8 inch) or 0.0159 gal/ft (60 ml/ft for tubing diameter of 5/8 inch).

    b. Maximum Purge Volume: The maximum purge volume from most wells will be 0.25 (1/4) of one well casing volume. For some shallow wells, the PVmin may be greater than 0.25

casing volume, in these eases, the PVmin shall be purged followed by the measurement of field water quality parameters and collection of samples. The maximum purge volume (PVmax) is calculated as follows:

PVmax = (DTBLS - DTWLS) Fc x 0.25

where:

PVmax = One quarter of one well casing volume gal).
DTBLS = Depth to Bottom from Land Surface (feet)
DTWLS = Depth to Water from Land Surface (feet)
Fc = Casing factor (gal/ft)

15. Begin purging the well according to the manufacturer's instructions for operating the pump. The purge rate should be kept to a minimum, no greater than 500 milliliters per minute. Variation in the purge rate should be minimized.

16. Following the removal of the minimum purge volume, begin monitoring the field water quality indicator parameters (i.e., temperature. specific conductance, pH, dissolved oxygen and turbidity). It is recommended that the water quality meter be attached to a flow-through cell to allow for continuous readings. Monitor the indicator parameters approximately once every 5 minutes and record the results on the Groundwater Sampling Record. (Note: A minimum of 500 ml of purge water is required to fully exchange the water in the flow-through cell between measurements.) The well shall be considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings.

    If one or more key indicator parameters fail to stabilize after purging 0.25 well casing volume (the maximum purge volume), purging will be discontinued, and sampling will be initiated. In cases where the calculated minimum purge volume is greater than 0.25 casing volume, monitor the indicator parameters following the removal of PVmin approximately every two minutes (approximately every 0.5 gal.) for a maximum of six minutes (i.e., three sets of readings). Any parameters that fail to achieve stabilization should be noted on the Groundwater Sampling Record.

17. Turn pump off and disconnect the flow-through cell. Turn pump on and reduce the pump discharge rate to between 100 and 250 milliliters per minute. Collect the appropriate samples from the pump discharge hose. Label all sample containers and immediately place samples in a laboratory-supplied cooler with bagged ice sufficient to cool samples to 4°C.

18. Upon the completion of sampling, decontaminate all non-dedicated sampling and measuring equipment. Properly discard all non-cleanable materials such as gloves, hoses and rope.

19. Secure and lock the well.

20. Deliver samples to the appropriate analytical Laboratory. Record all final field water quality data on the Field Data Summary Sheet.

21. Chain-of-custody procedures will be followed as outlined in the QAPP (Section 4.0 of the NYSDEC-approved PDI Work Plan).

22. Well sampling data will be recorded in the field logbook and on the Monitoring Well Sample Data Form.

ATTACHMENT 2

Appendix B (rev.): Updated Environmental Health and Safety Plan