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UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT
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6 March 2024

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SUBJECT: Final Revision 2 of the Background Study Workplan for the Former Seneca Army Depot in Romulus, NY; EPA Site ID# NY0213820830 and NY Site ID# 8-50-006

Dear Ms. Treinen, Ms. Sweet, and Mr. Sergott:

On behalf of the Army, please find attached for your records the Final Revision 2 of the Background Study Work Plan for the Former Seneca Army Depot, This document incorporates the edit requested by USEPA on 22 February to update a SOP reference in Table 28.10. The document is considered finalized and associated field work is currently planned to resume the week of 11 March 2024.

If you have any questions about the attached document, please call me at 917-575-1819.

Sincerely,

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BACKGROUND STUDY WORK PLAN
FINAL, REVISION 2

Former Seneca Army Depot, Romulus, New York

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CONTRACT NO. W912DY22D0131
TASK ORDER NO. W912DY22F0374

March 2024

FINAL, REVISION 2

WORK PLAN

FOR THE SENECA BACKGROUND STUDY SENECA ARMY DEPOT ACTIVITY, ROMULUS, NEW YORK

Prepared for:

U.S. ARMY, CORPS OF ENGINEERS, ENGINEERING AND SUPPORT CENTER
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U.S. ARMY, CORPS OF ENGINEERS, NEW YORK DISTRICT
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Contract Number W912DY22D0131
Task Order No. W912DY22F0374
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March 2024

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
bgs	below ground surface
COPC	Chemicals of Potential Concern
DO	Dissolved Oxygen
DoD	Department of Defense
DQO	Data Quality Objective
ELAP	Environmental Laboratory Accreditation Program
ES	Engineering Science
ft	feet
ID	identification
LTM	Long-term Monitoring
mg/L	milligram(s) per liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquids
NTU	Nephelometric Turbidity Unit
NY	New York
NYSDEC	New York State Department of Environmental Conservation
Parsons	Parsons Federal
PFAS	Per-and Polyfluoroalkyl Substances
QA/QC	Quality Assurance/Quality Control
QSM	Quality Systems Manual
RQD	Rock Quality Designations
SEAD	Seneca Army Depot site designation
SEDA	Seneca Army Depot Activity
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
U.S.	United States
µg/L	micrograms per liter
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

SEDA Background Study – Work Plan

Section 1 Objectives

This work plan presents the approach for the collection of selected environmental parameters in soil, groundwater, surface water and sediment to document background concentrations within the Seneca Army Depot Activity (SEDA or Depot). The selected parameters are chemicals related to former uses at areas of concern (AOCs) within SEDA. The goal is to develop a database of recent background concentrations in an anthropogenic setting which can be accessed through the administrative record. The study is purposefully designed to avoid sampling areas, or downgradient of areas, of known or suspected contaminant releases. This document is a streamlined work plan and includes references to the SEDA Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP), which includes the relevant laboratory standard operating procedures (SOPs) and project action limits.

The primary objectives of the proposed investigation activities are as follows:

- Assess the presence of naturally occurring and anthropogenic substances (chemicals of potential concern [COPCs]) in soil, shallow overburden and deeper bedrock groundwater, surface water, and sediment in areas of the former SEDA that are not impacted by Army-related activities but have similar on-site conditions (e.g., similar soil type or waterbody) as would be found in identified AOCs (i.e., SEADs).
- The background study will include sampling of all media for per- and polyfluoroalkyl substances (PFAS)[1], volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals (including mercury, CrIII and CrVI), perchlorate, explosives, total and dissolved phosphorus, and orthophosphate.
- Collect dynamic media (groundwater, surface water and sediment) during different seasons to address temporal variability.
- Evaluate and present the data distribution and basic statistics for each medium. Data will be classified by location to determine if a statistical difference exists between samples (e.g., on-base versus off-base impacts or locations representing off-base impacts versus those representing general basewise anthropogenic background).

Section 2 Site Background

2.1 SITE HISTORY

Seneca Army Depot Activity (SEDA or Depot), a 10,634-acre former military facility located in Seneca County near Romulus, New York, is located between Seneca Lake and Cayuga Lake in Seneca County and is bordered by New York State Highway 96 to the east and New York State Highway 96A to the west. Sparsely populated farmland surrounds the former Depot. The site is located in an uplands area between the two lakes at an elevation ranging from approximately 760 ft in the southeast corner to a minimum of approximately 600 feet along the western

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[1] The PFAS background sampling is covered under a separate contract, W912DY-20-D-0017, but the samples will be collected and reported as part of the background study field effort. The PFAS background dataset will be incorporated into the SEDA PFAS RI Report and risk assessments.

boundary. The facility was wholly owned by the United States Government and was operated by the Department of the Army between 1941 and 2000; since 2000, portions of the Depot have been transferred to other parties for reuse. The primary mission of SEDA was the receipt, storage, maintenance, and supply of military items.

2.2 GEOLOGY AND HYDROLOGY

2.2.1 GEOLOGY

SEDA geology is characterized by gray Devonian shale with a thin weathered zone where it contacts the overlying mantle of Pleistocene glacial till. This stratigraphy is consistent over the entire SEDA facility. The predominant surficial geologic unit present at the Site is dense glacial till. The till is distributed across the entire facility and ranges in thickness from less than 2 feet to as much as 15 feet. The till is characterized by brown to gray-brown silt, clay and fine sand with few fine-to-coarse gravel-sized inclusions of weathered shale. Larger diameter weathered shale clasts (as large as 6-inches in diameter) are more prevalent in basal portions of the till and are probably rip-up clasts created during the last glaciation. The bedrock underlying the northwestern half of the Site is composed of the Ludlowville Formation of the Devonian age, Hamilton Group; gray-black, calcareous shale that is fissile and exhibits parting (or separation) along bedding planes. The southeastern half of the Site is composed of the younger Moscow Formation also of the Devonian age, Hamilton Group. The lower beds, which underlie most of SEDA, are soft gray calcareous shale with an abundance of fossils. Coring performed within bedrock underlying SEDA show that the upper 5 to 8 ft of bedrock exhibit low rock quality designations and suggest a distinct weathered zone beneath the till before competent bedrock is encountered (Mozola, 1951; Parsons, 2022a; USGS, 2021).

As described in historical literature, a conjugate joint set and a set of strike joints are predominant within the sedimentary rocks of Seneca County (Mozola, 1951). The conjugate joint set has orientations of N15-30°E and N30-45°W and the strike joints trend N60-70°E. Joint planes are typically steep with dips ranging from 46° to vertical. The strike joints are typically parallel, narrow and spaced 1-inch to 4 feet apart. Most of the joints and fractures within shale formations are filled with clay or fine silt.

A similar joint orientation pattern was observed by Merin (1992) in outcrops in Ithaca, NY approximately 30 miles southeast of the site. This study observed jointing up to 152ft bgs (the maximum depth of their investigation was 175ft bgs). Mineralization of joint surfaces tended to be related to depth. Joints in cores less than 21 feet bgs were stained with ferric oxide minerals; joints between 21 to 38 ft bgs lacked mineral staining or fill; and joints greater than 38ft bgs were partially calcite-filled. Bedding plane fracture was apparent in this location with fracture frequency per foot decreasing with depth. The fracture frequency described for depths within the target screen (~45-60ft bgs) zone of the background study ranges from four fractures per foot to zero fractures per 3 feet (at depths beginning ~55ft bgs). Bedding plane fractures below 55ft bgs were confined to intensely fractures zones less than 2 feet thick and spaced greater than 3 ft apart. These zones displayed fissility and were thought to be lithologically controlled. The maximum depth bedding fractures were observed was 145 ft bgs; however, 36 ft of unfractured rock was observed above this depth therefore bedding fracture below the maximum drilling depth (175ft) are possible.

During the Remedial Investigations at the Ash Landfill and at SEAD 25 two predominant fracture orientations were observed during a bedrock fracture trace investigation: N75°E and N30°W. These orientations agree with the regional strike joints and conjugate fracture sets reported in the historical literature. During coring at both sites, except for the upper few feet of the competent shale, the fractures were generally free of silt and clay although some fractures were filled with a calcium carbonate material. Bedding plane fractures were present and tended to follow the frequency and spacing patterns observed by Merin (1992). Bedding plane fractures tended to be filled with silt and clay.

2.2.2 HYDROGEOLOGY

Regionally, four distinct hydrologic units were identified within Seneca County. These include two distinct shale formations, a series of limestone units, and unconsolidated beds of Pleistocene glacial till. Overall, the groundwater in the county is very hard, of poor quality, and quality is minimally acceptable for use as potable water (Mozola, 1951).

The geology beneath the Site is a thin mantle of glacial till overlying shale bedrock. The overburden consists of a thin layer of high fines content soils (where undisturbed) underlain by glacial till (unsorted clay, silt, sand and gravel) a few feet thick to approximately 15 feet in thickness that drains poorly. Bedrock is shale bedrock of the Ludlowville (northwestern half of SEDA) and Moscow Formations (southeastern half of SEDA). The shale has poor intergranular porosity and the flow of groundwater is expected to move through millimeter scale horizontal and vertical zones of porosity (bedding plane fractures and joints) on a localized scale (inches to several feet) (Merin, 1992; Parsons ES, 1994a&b). The upper 10 feet of the bedrock typically has low rock quality designations (RQD) of less than 30%. RQD increased in the 30 to 50 ft depth range in most cores with bedding plane fracture frequency decreasing with depth (Parsons, 1998; 2022a).

Groundwater is found seasonally in the overburden/weathered bedrock zone (subject to precipitation); however, the water in the wells is not potable due to low well yield. Recharge of the underlying shallow saturated zone is dependent on precipitation. Rainwater or snow melt slowly infiltrates into the till/weathered bedrock water bearing zone; however, during larger precipitation events, the infiltration rate is likely not high enough, and overland flow transports excess precipitation to local drainage ditches and low areas.

The regional recharge of precipitation through the upper (till/weathered bedrock) water-bearing zone to the underlying lower water-bearing zone (shallow bedrock) is poor and strongly affected by drought conditions. Vertical groundwater interaction between the upper and lower water bearing zones is not expected to be as significant as preferential groundwater flow within the shallow fractured and weathered bedrock zone along the top of bedrock. Within the bedrock, the predominant groundwater flow is expected to be along bedding planes and parallel to the regional jointing directions. Regional groundwater flow is predominantly westward towards Seneca Lake; in proximity to surface water features, localized groundwater flow may be towards the surface water body.

Surface drainage from SEDA flows to five primary creeks which discharge to the west into Seneca Lake (**Figures 1** and **2**). Local flow in the northeast portion of SEDA collects in Duck Pond and discharges to Kendig Creek. Kendig Creek flows north and discharges in the Seneca – Cayuga Canal. Surface water flow from precipitation events throughout SEDA is controlled by man-made drainage features which flow towards local creeks and wetland areas. In general, the topography of the area slopes west and most of the surface water will eventually discharge into one of the westerly flowing creeks. Streams and ponds are generally gaining except during periods of dry weather when they are losing. Within the exception of a tributary of Indian Creek along the southern SEDA boundary, surface water bodies do not flow from off-site into SEDA.

2.2.3 SOILS

Soils within SEDA are dominated by the Darien-Angola association. The soils formed in glacial till where the main rock constituent is the soft, dark underlying shale with minor limestone and igneous erratics. The soils are described as deep and moderately deep, somewhat poorly drained with silty clay loam and clay loam subsoil. The areas with these soils are suitable for farming as well as industrial development where somewhat poorly drained soils are not a limitation and shallow bedrock provides stability to structures. Spatially, Darien silt loam, 0 to 3 percent slopes (DaA) overlies much of SEDA with minor other soil types including: Darien-Danley-Cazenovia silt loams, 3 to 8 percent slopes (DdB); Angola silt loam, 0 to 3 percent slopes (AnA); Angola silt loam, 3 to 8 percent slopes (AnB); Ilion silty clay loam (Is); and Romulus silty clay loam (Ro) (USDA, 1972; USDA, 2021).

Section 3 Description of Work

The key elements of the Background Survey sampling approach are presented below. The field activities and methods herein are modified to prevent cross-contamination and to avoid the introduction of external PFAS contaminant sources. The sampling program will adhere to the PFAS guidance provided by NYSDEC (2022). The PFAS analytical method will be EPA Method 1633 which is required by the DoD (OSD, 2021) and is now required by NYSDEC. SOP ENV-01 in **Appendix A** includes a summary of prohibited and acceptable items for PFAS sampling and PFAS standard operating procedures.

- **Monitoring Well Installation** – Groundwater wells will be installed at the locations shown on **Figures 1** and **2**. Five new wells will be installed in the upper water bearing zone (till / weathered bedrock) and two new wells will be installed in the lower water bearing zone (shale bedrock).
- **Groundwater Sampling.** Eight wells (five new and three existing, upper water bearing zone monitoring wells) will be sampled. Four (two new and two existing) lower water bearing zone wells will be sampled. Sampling will be conducted using low flow sampling methods. Two rounds of sampling will be conducted in different seasons.
- **Surface Water Sampling.** Surface water samples will be collected from a variety of surface water bodies including streams, drainage ditches, and ponds to evaluate a range of surface water conditions throughout SEDA. Locations of proposed surface water samples are shown in **Figures 1** and **2**. Two rounds of sampling will be conducted in different seasons.
- **Sediment Sampling.** If sediment is present at a surface water sample location, a sediment sample will be collected at the same location and analyzed for the same analytical suite as soil. Two rounds of sampling will be conducted in different seasons.
- **Soil Sampling.** Soil samples will be collected from areas outside and upgradient of former AOCs and in areas away from historical operations. Soil will be collected from two depths at each location: 1) between a depth of 6 to 24 inches and, 2) just above the water table, or if groundwater is not present, in the 1-foot interval above weathered or competent bedrock, or at a maximum of ten feet below ground surface, whichever depth is less.
- **Analytical**. All samples will be sent to a Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) and New York State certified laboratory. The analytical list will include VOCs, SVOCs, explosives, perchlorate, metals, phosphorous, orthophosphate, and PFAS. The analytical methods are identified in **Table 4** in **Section 3.6**. The UFP-QAPP worksheets include this analytical list.
- **QAPP.** QAPP worksheets were prepared to document the requirements of the sampling approach and analytical methods (**Appendix C**).

Additional details for implementation of the background survey investigation activities are provided in the appendices to this document:

- **Appendix A – Standard Operating Procedures (SOPs)**
- **Appendix B – Well Logs for Existing Monitoring Wells**
- **Appendix C – UFP–QAPP**

3.1 MONITORING WELL INSTALLATION

Figures 1 and **2** and **Table 1** show and describe the locations for the proposed groundwater wells. Shallow wells will target the upper till/weathered bedrock water bearing zones and will be installed to a total depth dependent on auger refusal (typically 10 to 15 feet bgs). The shallow well screen will be 5 to 10 feet in length, depending on well depth, and will extend across the till and weathered bedrock interval. Deep wells will be drilled into competent rock and will have a 20-foot screen. The top of the deep well screen will be set at 30-40 feet below the top of competent rock, with a total depth of approximately 50-60 feet below the top of competent rock. Exact drilling depths will be determined in the field and documented in the field forms.

3.1.1 RATIONALE FOR PROPOSED MONITORING WELL LOCATIONS

The Army is proposing the installation of five new upper water bearing zone and two lower water bearing zone (bedrock) groundwater wells to supplement the existing background groundwater wells installed during the 2021 OD Grounds groundwater characterization (Parsons, 2022a). The locations of the new wells were selected to provide additional coverage upgradient of the locations of former AOCs and buildings within SEDA. The two new deep locations will be paired with shallow well locations (**Figures 1** and **2**). The deeper wells will be installed to assess background/baseline groundwater quality in the deeper competent bedrock water bearing zone and will be screened from approximately 30 to 60 feet below the top of bedrock. Potential vertical gradients between the shallow and the deep-water bearing zones will be assessed by comparing water levels at well pairs consisting of one shallow overburden well and one deep bedrock well.

Table 1 provides a rationale for each proposed well location.

Table 1: Monitoring Well Locations and Rationale

WELL ID(S)	RATIONALE
MW45-BG1, MW45-BG2, MW25-24	Existing till / weathered bedrock wells installed during the OD Grounds groundwater investigation as background wells. Monitoring well MW25-24 will not be sampled for PFAS as part of the background study as this well is part of an active PFAS investigation.
MW45-BG1D, MW45-BG2D	Existing bedrock wells installed during the OD Grounds groundwater investigation as background wells. These wells are paired with MW45-BG1 and MW45-BG2.
BGMW-01	Proposed till / weathered bedrock well located along northeast boundary road, east of Duck Pond. Upgradient of SEADs and buildings. Upgradient sources are agricultural.
BGMW-02 / BGMW-02D	Proposed till /weathered bedrock well paired with bedrock well. This well pair is along the eastern SEDA boundary and is approximately 6,000 feet east (upgradient) of the MW45-BG2/2D well pair. A cemetery is immediately upgradient. The Town of Romulus is approximately 0.5 mile upgradient.
BGMW-03	Proposed till / weathered bedrock well located east of the Warehousing area. Upgradient of SEADs and buildings. Upgradient sources are agricultural and possible anthropogenic (Rt-96).
BGMW-04	Proposed till /weathered bedrock well located southeast of Seneca County Jail. Upgradient of SEADs and buildings. Upgradient sources are agricultural and possible anthropogenic (Rt-96).
BGMW-05 / BGMW-05D	Proposed till /weathered bedrock well paired with bedrock well. Located in southeastern border of SEDA upgradient of all former activities. Upgradient sources are agricultural.

3.1.2 DRILL METHODS

Hollow stem auger and air rotary/air hammer drilling will be used to advance the boreholes for permanent monitoring well installation. Both drilling methods typically allow for the advancement of borings through most soil types including denser soils (e.g., glacial till) and bedrock. Details of the sampling and installation are provided in the SOPs (**Appendix A**).

- Shallow borings will be advanced to auger refusal which is interpretated as the top of competent rock.
    - If refusal is encountered at depths less than approximately 15 feet bgs, than the boring will be advanced with a roller bit or air rotary approximately 3 to 5 feet beyond the top of competent bedrock to allow for proper well construction. This also allows for a larger water column such that proper development and sampling may be conducted.
- Deeper borings will be advanced to approximately 40 feet below the top of competent bedrock.
- Well locations will be screened within the unconsolidated upper water bearing zone (i.e., glacial till and weathered bedrock) and within the lower water bearing (shale bedrock) zone by a competent field geologist experienced in drilling and well installation at SEDA.
- Drilling equipment will be decontaminated between each boring in accordance with SOP ENV-06 (**Appendix A**).

3.1.3 PERMANENT MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring well borings will be advanced using the methods described above. During boring advancement, soil descriptions will be collected at continuous intervals (e.g., 2-foot core runs with split spoon) depending on the drilling method used. A well completion log will be completed for each well installed.

Permanent monitoring wells will be installed per Part 360 requirements as detailed below. Deviations from Part 360 requirements will be discussed with NYSDEC prior to installation.

Monitoring wells will be constructed with 2-inch ID, threaded, flush-joint, PVC casings and 0.010-inch slotted well screens with stick-up well completion. The well screen, plug, and riser will be new well materials purchased from the manufacturer. Well pipe joints and end caps will be threaded. No Teflon tape, solvents, or glues will be used to connect well sections. In general, the shallow and deep well screens will be 10 and 20 feet long, respectively, unless a different length is required to meet project objectives.

The annulus around the screens will be backfilled with clean silica sand. The filter pack will be installed in increments as the augers are withdrawn to enable monitoring of progress and to prevent bridging. If bridging occurs, the bridge will be broken before proceeding with installation. The filter pack should extend a minimum of 6 inches below the bottom of the screen and 2 feet or 20% above the top of the screen, whichever is greater unless conditions warrant less. If vertical space allows, a finer grained “choke” sand (100% passing a No. 30 sieve and less than 2% passing the No. 200 sieve) will be installed between the sand pack and the bentonite seal described below.

A bentonite chip or pellet seal with a minimum thickness of 2 feet will be placed above the filter pack. The seal will be manually hydrated using potable water. The remainder of the annular space will be filled with cement-bentonite grout to ground surface using a tremie pipe. The grout will be allowed to set before wells are developed.

Soil cuttings generated during the advancement of the monitoring well borings will remain onsite and used as backfill around the monitoring wells. Details of the well construction are provided in SOP ENV-06 (**Appendix A**).

All new wells will be surveyed by a licensed land surveyor.

3.1.4 MONITORING WELL DEVELOPMENT

After installation, monitoring wells will be developed to remove fine silt-clay material which may have settled within the filter pack and monitoring well casings to improve/restore the hydraulic communication with the surrounding formation. Monitoring well development will be performed or overseen by a field geologist. New monitoring wells will be developed no sooner than 48 hours following installation. Development will be performed by surging and purging the well, as appropriate, using a surge block and pump. Groundwater parameters will be recorded before, during, and after well development. Parameters will include turbidity, pH, temperature, and specific conductance. Following development, the monitoring wells will be allowed to equilibrate for a minimum of 72 hours prior to groundwater sampling.

Specific details on development procedures are included in the SOP ENV-05 (**Appendix A**).

3.1.5 MONITORING WELL ABANDONMENT

There may be occasions when monitoring wells will require abandonment. Upon approval from the project team and regulators, the abandonment approach for permanent monitoring wells, depending on the site-specific subsurface geologic conditions and nature of contamination, will be in accordance with NYSDEC CP-43 – Groundwater Monitoring Well Decommissioning Policy (NYSDEC, 2009). Details regarding the well abandonment will be documented on the Well Decommissioning Records provided in CP-43.

3.2 LOW FLOW GROUNDWATER SAMPLING

Groundwater samples will be collected using low-flow sampling techniques (**Appendix A** – SOP ENV-03). Sampling procedures, sample handling and custody, holding times, and collection of field parameters are to be conducted in accordance with the UFP-QAPP (**Appendix C**) and SOP ENV-03 (**Appendix A**). The selected laboratory will have the capability to conform to the project QAPP and have a current DoD ELAP certification in which the laboratory demonstrated its competency and document conformance to the current DoD Quality Systems Manual for Environmental Laboratories (DoD QSM). PFAS samples will be collected in accordance with PFAS-specific collection procedures to prevent cross-contamination and to avoid the introduction of external contaminant sources.

Groundwater elevations and groundwater quality parameters listed below will be measured and recorded prior to sample collection and a groundwater sample will be collected once parameters have stabilized. The stabilization criteria are consistent with SOP ENV-03 in Appendix A:

- Turbidity: Three readings within 10% of the prior reading for values greater than 10 nephelometric turbidity unit (NTU); if three turbidity values are less than 10 NTU, consider the values as stabilized.
- Dissolved oxygen (DO): Three readings within 10% of the prior reading.
- Specific Conductance: Three readings within 3% of prior reading.
- Temperature: Three readings within 3% of the prior reading.
- pH: ± 0.2 pH units of prior reading.
- Oxidation-reduction potential: Three readings within 10% of the prior reading

Prior to sample collection, field parameters will be measured approximately every five minutes in order to assess when the well is adequately purged, and the groundwater conditions have stabilized with the surrounding formation water. Two rounds of groundwater samples will be collected from the monitoring wells.

3.3 SURFACE WATER SAMPLING AND SEDIMENT SAMPLING

Surface water and sediment sampling will be conducted at various locations throughout SEDA to gain a broad representation of surface water and sediment conditions throughout the Depot which could be used for comparison against Site conditions (**Figures 1** and **2**). Surface water locations are proposed in natural creeks, man-made drainage ditches, and ponds (**Table 2**). Except for one location, no upgradient surface water bodies flow onto SEDA. The proposed locations were selected to be outside of former SEADs and away from known areas of former use to the extent practicable. Two rounds of surface water and sediment samples will be collected.

Sampling will be conducted using grab sampling methods from a central location on the waterway. Field parameters will be collected during sampling using a peristaltic pump and a water quality meter. If the laboratory containers used to collect the sample contain preservative, a peristaltic pump will be used instead of dipping the sample container. If a waterbody is sampled in more than one location, samples downstream will be collected prior to upstream samples, whenever possible, and sediment will always be collected after the collection of surface water samples from the same location. In the event that the proposed sample locations are inaccessible or are too dry to sample, secondary sample locations will be chosen. PFAS samples will be collected in accordance with PFAS-specific collection procedures to prevent cross-contamination and to avoid the introduction of external contaminant sources.

Samples from the proposed locations will be collected in accordance with SOP ENV-04 (**Appendix A**). If sediment is present at the sampling location, a sediment sample will be collected after the surface water sample following SOP ENV-04.

Table 2: Surface Water / Sediment Locations and Rationale

WELL ID(S)	RATIONALE
BGSWSD-01	Headwaters of Silver Creek. Flows west. Downgradient of former range areas (SEAD 007-R-01 and SEAD 003-R-01)
BGSWSD-02	Reeder Creek. Flows north/northwest. Downgradient of OD Grounds, previously sampled.
BGSWSD-03	Reeder Creek. Flows north. Upgradient of OD Grounds, previously sampled.
BGSWSD-04	Reeder Creek. Flows north. Upgradient of OD Grounds, within Igloo Area.
BGSWSD-05	Reeder Creek. Flows north. Upgradient of OD Grounds, within Igloo Area. Previously sampled.
BGSWSD-06	Reeder Creek. Flows north. Upgradient of OD Grounds, within Igloo Area. Previously sampled.
BGSWSD-07	Drainage ditch tributary of Reeder Creek. Flows west. Sampled 200ft upgradient of previously sampled location.
BGSWSD-08	Outfall of Duck Pond into Kendig Creek. Flows north. No immediate upgradient sources.
BGSWSD-09	North end of northern Duck Pond. Pond environment. No immediate upgradient sources.
BGSWSD-10	South end of northern Duck Pond. Pond environment. No immediate upgradient sources.
BGSWSD-11	Outfall of southern Duck Pond. Pond environment. No immediate upgradient sources.
BGSWSD-12	Headwaters of Wilcox Creek. Flows west. No immediate upgradient sources.
BGSWSD-13, 14, 15	Headwaters of Kendaia Creek. Flows west. #13 downgradient of SEAD-24 (former powder burning pit). #14 & #15 within igloo area.
BGSWSD-16	Indian Creek. Flows south. Wooded area upgradient. Further upgradient is igloo area.
BGSWSD-17	Tributary of Indian Creek. Flows west. Wooded areas upgradient.
BGSWSD-18	Tributary of Indian Creek. Flows west. Flow from wooded area/farmland coming from off-SEDA onto SEDA.
BGSWSD-19	Unnamed drainage ditch. Wooded area upgradient. Flows north off the Depot.
BGSWSD-20	Unnamed pond. Downgradient of SEAD-26 / SEAD-64A, warehousing area. A PFAS background sample will not be collected at this location, but will be identified as below.
SWSD25-03	A PFAS only sample will be collected from the drainage ditch upgradient of SEAD-25 as the pond (above) is receiving PFAS impacted groundwater from SEAD-26.

3.4 SOIL SAMPLING

Thirty background soil samples are proposed for locations outside of former AOCs and in areas that were not used for historical operations (**Figures 1** and **2**). Locations were selected to have similar physical, chemical, and geological characteristics as the AOCs that will be potentially investigated (**Table 3**). The objective of the spatial spread of the locations is to identify common naturally occurring elements in addition to common anthropogenic compounds that may be related to historical use of SEDA for approximately 50 years. Historical records, maps and aerial photos (1954, 1963, 1983, 1994, 2002, 2015, 2018, 2020) were reviewed to place sample locations away from known sources of potential contamination (e.g., SEADs, disturbed areas, former septic systems, filled areas). Soil samples will be collected approximately 30 feet or more from roadways, where practical, away from roadway drainage ditches and from two depths at each location: 1) between 6 and 24 inches and 2) just above the water table, or if groundwater is not present, in the 1 foot interval above the weathered or competent bedrock, or at a maximum of ten feet below ground surface, whichever depth is less. During the field event, if fill is encountered during sampling, the field team will notify the project manager and move the sample location within a 30-foot radius of the original location. If an area without fill cannot be found, the project team will be notified. Samples from the proposed locations will be collected in accordance with SOP ENV-02 (**Appendix A**). PFAS samples will be collected in accordance with PFAS-specific collection procedures to prevent cross-contamination and to avoid the introduction of external contaminant sources.

Table 3: Soil Locations and Rationale

WELL ID(S)	RATIONALE
BGSO-01 to BGSO-05	Located along northeastern patrol road, northeast of Duck Ponds. Potential nearby sources include agriculture and former use (e.g., vehicle use) of the patrol road. Soil type: DaA, Is
BGSO-06 to BGSO-10	Located along a wooded stretch of the eastern SEDA boundary, north of the former Admin area. Former sources may include previous use of the road (e.g., vehicles). Soil type: DaA, Is
BGSO-11 to BGSO-13	In former historically undisturbed portion of Admin Area. Potential sources include former vehicle use. Soil type: DdB, DaA
BGSO-14 to BGSO-15	Located in an historically undisturbed area northwest of OD Grounds. Potential sources may include former use of the land for agriculture. Impacts from OD Grounds are not expected. Soil type: DdB, DaA
BGSO-16 to BGSO-20	Northeast of former reservoir in historically undisturbed area. Potential sources include former road use. Soil type: DaA.
BGSO-21 to BGSO-25	Northeast of former warehousing area. Potential sources include minor former road use on Depot and Rt 96. Soil type: DaA
BGSO-26	To be collected during installation of BGMW-01. Soil type: DaA
BGSO-27	To be collected during installation of BGMW-02. Soil type: DaA
BGSO-28	To be collected during installation of BGMW-03. Soil type: DaA
BGSO-29	To be collected during installation of BGMW-04. Soil type: DaA
BGSO-30	To be collected during installation of BGMW-05. Soil type: Is
Soil Types: Predominant soil throughout the Depot is DaA (Darien silt loam, 0 to 3 percent slopes). Ilion silty clay loam (Is), Darien-Danley-Cazenovia silt loams, 3 to 8 percent slopes (DdB) are minor components mapped within the Depot.	

3.5 DECONTAMINATION OF SAMPLING EQUIPMENT

Non-disposable sampling equipment will be decontaminated between uses in accordance with the procedures in the applicable SOPs (**Appendix A**). The general procedure will be as follows; donning a new pair of nitrile gloves, equipment will be 1) rinsed with a Alconox® (or similar PFAS free) cleaning solution, 2) rinsed with deionized water. For groundwater sampling, the flow-through cell and any non-dedicated equipment (i.e., water-level probe, multi-parameter instrument probe) that contacts well water will be decontaminated between uses. Larger equipment such as drill rigs will be cleaned using a high-pressure washer or a steam cleaner.

3.6 ANALYTICAL REQUIREMENTS

All samples will be sent to laboratories with DoD Environmental Laboratory Accreditation Program (DoD ELAP) and New York state certifications. The laboratories will use the latest DoD Quality Systems Manual (QSM). Soil, surface water, sediment, and groundwater samples will be submitted for the following analyses:

Table 4: Analytical Program

LABORATORY	ANALYSIS	METHOD
SGS North America Inc., Orlando, FL	Volatile Organic Compounds (VOCs)	SW8260C
	Semi-Volatile Organic Compounds (SVOCs)	SW8270D
	Metals	SW6020B
	Mercury	SW7470A
	CrVI / CrIII	SW7196 and calculation
	Perchlorate	SW6850
	Explosives	SW8330B
Katahdin Analytical Services, Scarborough, ME	Total and Dissolved Phosphorus	AQ: EPA 365.2 (low-level) Solid: EPA 365.4
	Orthophosphate	SM 4500PE
Eurofins Lancaster Laboratories Environment Testing, LLC (ELLE)	PFAS	EPA Draft Method 1633

Notes: Metals will include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

The PFAS sampling is covered under a separate contract, W912DY-20-D-0017, but is being performed as part of the background study field effort.

The bottle types, preservation requirements, and holding times are presented in the UFP-QAPP. Quality Assurance/Quality Control (QA/QC) samples will be collected to monitor accuracy, precision, and the presence of field contamination. QA/QC sample will include equipment blanks (when reusable equipment is used), field duplicates, and MS/MSDs (quantities as specified in the QAPP). Equipment blanks will be collected once per week per medium (when reusable equipment is used) and analyzed for non-PFAS analytes. A separate daily equipment blank will be collected per medium and analyzed for PFAS. When collecting PFAS samples, a field blank will be collected once a day per medium and analyzed for PFAS. Field water quality parameters will include water temperature, pH, dissolved oxygen, salinity, oxidation-reduction potential, turbidity, and conductivity. Additional analytical requirements are listed in the UFP-QAPP.

3.7 DATA QUALITY OBJECTIVES

The UFP-QAPP for this background investigation ensures that environmental data are collected scientifically sound, are of known and documented quality, and are suitable for their intended purposes. The UFP-QAPP includes monitoring methods, analytical services, data management and validation procedures, and field and laboratory SOPs.

Project-specific data quality objectives (DQOs) were developed based on the Conceptual Site Model and these are described on **Worksheet #11** of the UFP-QAPP (**Appendix C**). These DQOs include a design for obtaining data to support the sampling design.

3.8 WASTE MANAGEMENT PLAN

Soil (or sediment) generated during drilling is expected to be minimal. Any disturbed soil will be used as backfill surrounding the installed well location. Water generated during drilling equipment decontamination, well development groundwater sampling, and surface water sampling will be returned to the ground surface in the vicinity of the associated well. The water will not be transported across the ground surface away from the point of withdrawal or into nearby surface water features. No free product, NAPL or grossly contaminated soil are expected at any of the investigation sites. However, if grossly contaminated soil or water are encountered, these assumptions will be reevaluated. Containerized waste will be stored on wooden pallets in a plastic-lined containment area or in other approved secondary containment structures pending characterization and disposal. If PFAS is designed as a hazardous substance, impacted waste will be sent off for disposal using a DoD and EPA approved method.

3.9 SCHEDULE

The following schedule is approximate and is based on normal working conditions:

- February 2024
  - Drilling and Well Installation
  - Soil Sampling Collocated with Monitoring Wells (BGSO-26 through BGSO-29)
  - Well Development
  - Professional Survey
- March 2024
  - Groundwater Elevation Gauging
  - Round 1 - Groundwater Sampling
  - Soil Sampling (BGSO-01 through BGSO-25)[(a)]
  - Surface Water / Sediment Sampling (Round 1)
- September 2024
  - Surface water / Sediment Sampling (Round 2)
  - Groundwater Elevation Gauging
  - Round 2 – Groundwater sampling
- October 2024
  - Evaluate data
- October 2025
  - Final Letter Report

(a) Soil sampling for BGSO-01 through BGSO-25 is scheduled to take place in March, contingent upon the snow melting and the subsequent suitability of direct-push sampling techniques.

Section 4 References

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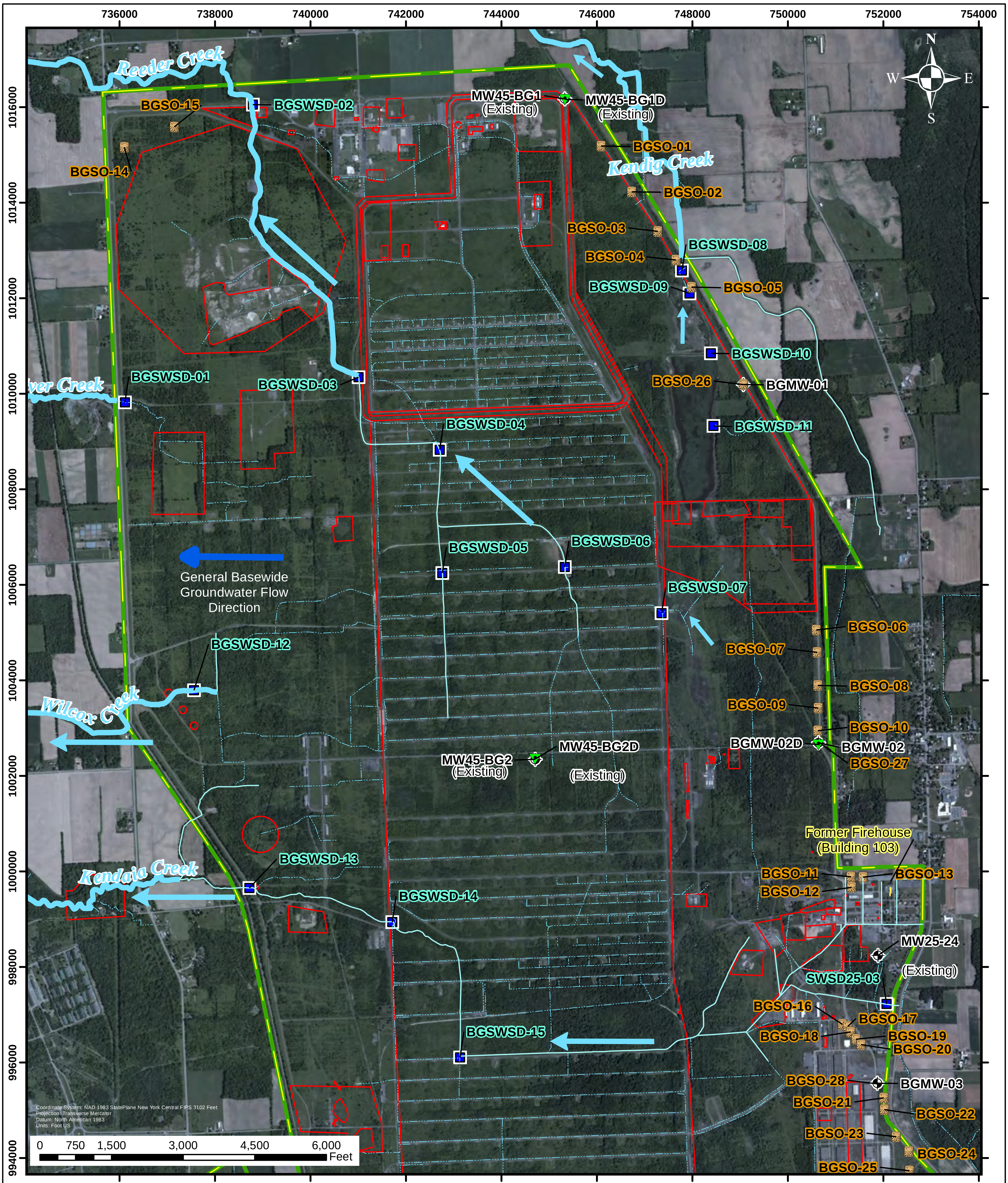
List of Figures

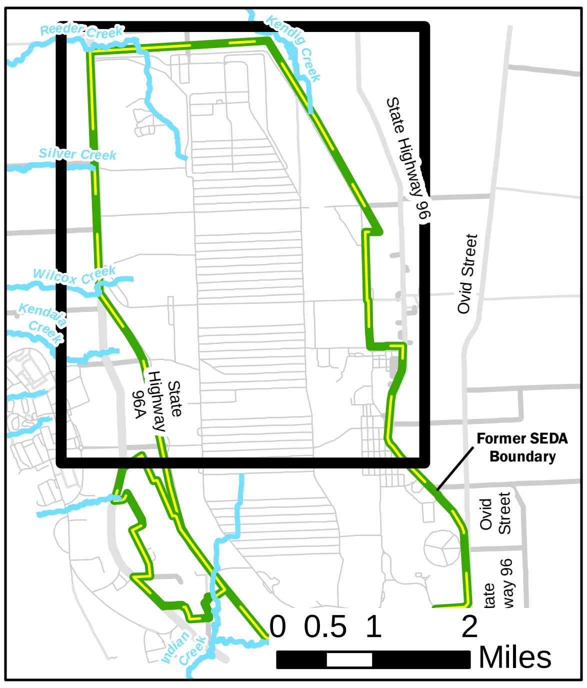
Appendix A – Standard Operating Procedures (SOPs)

Appendix B – Well Logs from Existing Monitoring Wells

Appendix C – UFP-QAPP

FIGURES





Legend

Surface Water

─	Major Drainage
┈	Minor Drainage
━	Stream
⊕	Proposed Shallow Well
▼	Proposed Bedrock Well
▨	Proposed Soil Sample
■	Proposed Surface Water / Sediment Sample
🟥	SEAD Boundary
🟩	Former SEDA Boundary
→	Predominant Groundwater Flow Direction
→	Surface Water Flow Direction

Notes:
1) Five new wells will be installed in the upper water bearing zone (till / weathered bedrock) and two new wells will be installed in the lower water bearing zone (shale bedrock).
2) Three existing till / weathered bedrock and two existing bedrock wells will be sampled.
3) Two rounds of sampling will be conducted for groundwater, surface water and sediment locations.
4) Soil samples will be collected from two depth intervals: 6 to 24 inches and from just above the water table, top of competent bedrock, or ten feet below ground surface, whichever is encountered first.
5) Soil samples will be collected during well installation at locations noted below.
6) Locations are subject to adjustment dependent on field conditions.
7) Regional groundwater flow is towards the west. Localized flow direction may be influenced by nearby water bodies or bedrock topography.
8) Major streams flow west and discharge to Seneca Lake. The exception is Kendig Creek which flows north and discharges into the Cayuga-Seneca Canal.

Well Installations with Soil Samples
BGMW-01 / BGSO-26
BGMW-02 / BGSO-27
BGMW-03 / BGSO-28

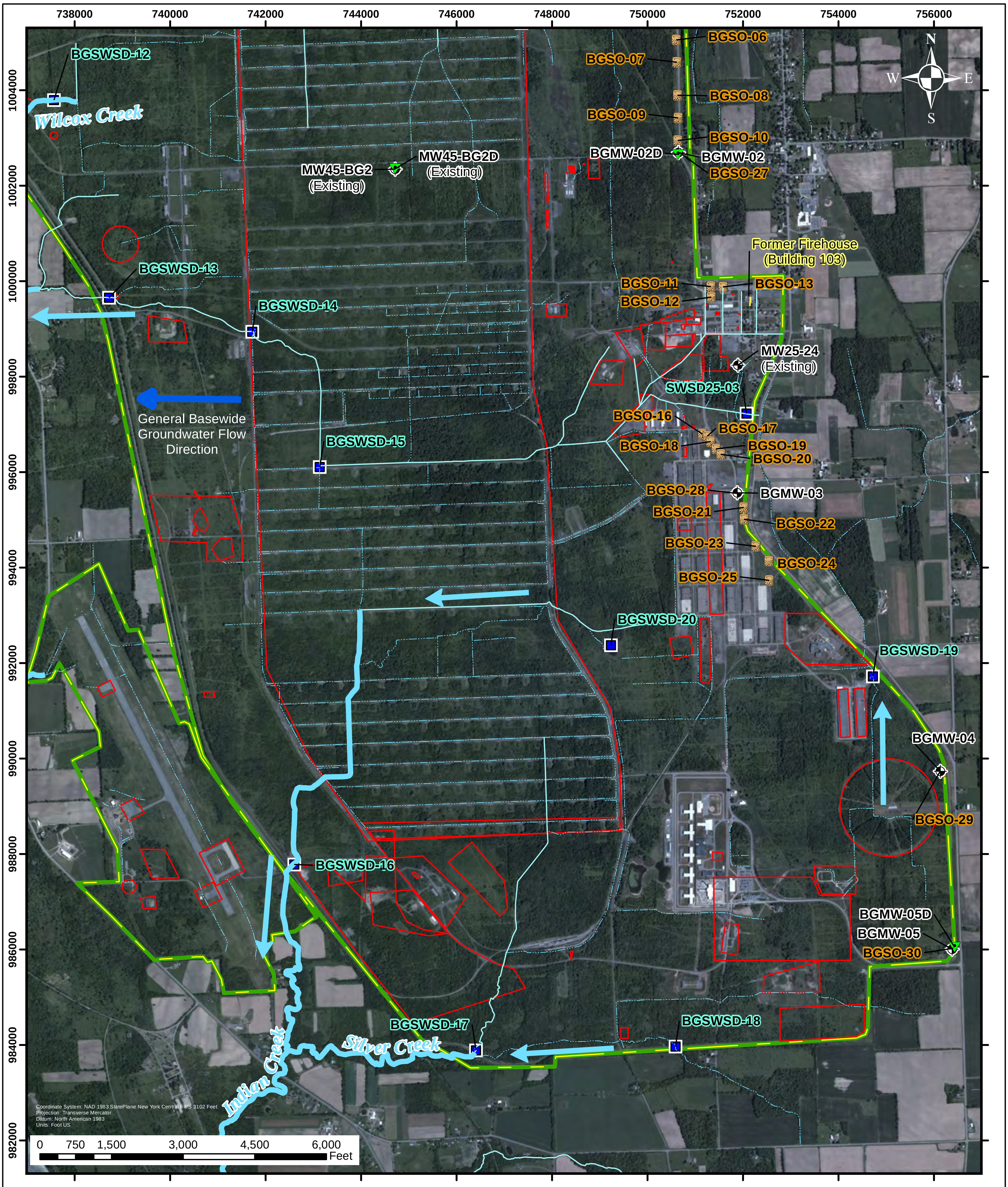
Paired Shallow / Deep Monitoring Wells
MW45-BG1 / MW45-BG1D (Existing)
MW45-BG2 / MW45-BG2D (Existing)
BGMW-02 / BGMW-02D (new)

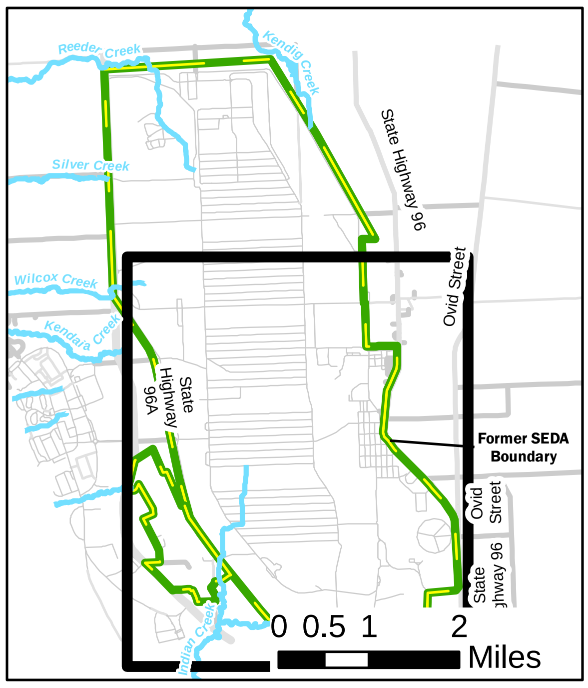
SENECA ARMY DEPOT ACTIVITY
BACKGROUND STUDY

FIGURE 1 - PROPOSED BACKGROUND LOCATIONS, NORTH DEPOT

1 inch = 2,000 feet	MARCH 2024

Path: \\Mabos07fs01\pit\Projects\Huntsville WERS\Seneca LTM, TO 23102 - GIS\Background\Maps\BG_WP_Prop_Locs_North_100523_v2.mxd





Legend

Surface Water

Major Drainage
Minor Drainage
Stream
⌖ Proposed Shallow Well
▼ Proposed Bedrock Well
▨ Proposed Soil Sample
■ Proposed Surface Water / Sediment Sample
🟥 SEAD Boundary
🟩 Former SEDA Boundary
→ Predominant Groundwater Flow Direction
→ Surface Water Flow Direction

Notes:
1) Five new wells will be installed in the upper water bearing zone (till / weathered bedrock) and two new wells will be installed in the lower water bearing zone (shale bedrock).
2) Three existing till / weathered bedrock and two existing bedrock wells will be sampled.
3) Two rounds of sampling will be conducted for groundwater, surface water and sediment locations.
4) Soil samples will be collected from two depth intervals: 6 to 24 inches and from just above the water table, top of competent bedrock, or ten feet below ground surface, whichever is encountered first.
5) Soil samples will be collected during well installation at locations noted below.
6) Locations are subject to adjustment dependent on field conditions.
7) Regional groundwater flow is towards the west. Localized flow direction may be influenced by nearby water bodies or bedrock topography.
8) Major streams flow west and discharge to Seneca Lake.

Well Installations with Soil Samples
BGMW-02 / BGSO-27
BGMW-03 / BGSO-28
BGMW-04 / BGSO-29
BGMW-05 / BGSO-30

Paired Shallow / Deep Monitoring Wells
MW45-BG2 / MW45-BG2D (Existing)
BGMW-02 / BGMW-02D (new)
BGMW-05 / BGMW-05D (new)

SENECA ARMY DEPOT ACTIVITY
BACKGROUND STUDY

FIGURE 2 - PROPOSED BACKGROUND LOCATIONS, SOUTH DEPOT

1 inch = 2,000 feet
MARCH 2023

Path: \\Mabos07fs01\pit\Projects\Huntsville WERS\Seneca LTM, TO 23102 - GIS\Background\Maps\BG_WP_Prop_Locs_South_100523_v2.mxd

APPENDIX A: STANDARD OPERATING PROCEDURES (SOPS)

STANDARD OPERATING PROCEDURES (SOPS)

CHEM-01	**Chemistry Data Review and Management**
ENV-01	**PFAS Sampling Guidance**
ENV-02	**Soil Sampling**
ENV-03	**Groundwater Sampling**
ENV-04	**Surface Water and Sediment Sampling**
ENV-05	**Monitoring Well Development**
ENV-06	**Soil Borings and Monitoring Well Installation**
MEC-03	**MEC Avoidance and Escort**

Procedure # CHEM-01	Title: CHEMISTRY DATA REVIEW AND MANAGEMENT	Revision # 01
Effective Date: 02/24/2020	**Approved By:** Maryanne Kosciewicz, Project Chemist	**Last Revised:** 07/27/2018

1. PURPOSE

The purpose of this SOP is to describe the general procedures involved in analytical chemistry data review and management. The elements described in this SOP include data verification, data validation, data usability assessment, data validation qualifiers, electronic data deliverables, and data archiving.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Ensures laboratory analytical data are provided, reviewed, validated, managed, and stored in accordance with project requirements. Responsible for documenting data validation procedures, details, and issues found in a comprehensive data validation report.
Data Manager	Verifies laboratory electronic data deliverables are provided in the correct format, error free, and meet all project requirements. Ensures electronically submitted data is managed and maintained in accordance with project requirements.

3. RELEVANT DEFINITIONS

Term	Definition
Data Verification	The first step in the data review process. Data verification is a completeness check to determine whether the analytical laboratory has provided the information required to perform adequate data validation and review.
Data Validation	Data validation is the systematic process of evaluating whether data comply with pre-defined, project-specific requirements and criteria, also known as measurement quality objectives (MQOs). Elements of data validation include precision, accuracy, representativeness, completeness, and comparability.
Data Usability Assessment	The final step in the data review process. The usability assessment is an evaluation of whether data is of sufficient quality to meet the project Data Quality Objectives (DQOs). Data usability includes evaluation of data qualified as a result of data validation, data gaps, systematic issues, and analytical sensitivity.
Data Qualifiers	Standardized notations applied to individual analytical results that provide the data user with a qualitative assessment of the data (e.g., estimated, biased low, biased high, rejected, etc.). Data qualifiers are also referred to as “flags”.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
None	Not applicable.

5. PROCEDURE

5.1. Overview

The Project Chemist will ensure all data generated by the analytical laboratory is reviewed and managed in accordance with project-specific requirements, as detailed in the approved Quality Assurance Project Plan (QAPP) and/or work plan, and as required by the laboratory subcontract. Data verification, data validation, and assessment of data usability are the three steps of the data review process by which data compliance, quality, and usability are examined and evaluated. These procedures and the various levels of data validation are detailed in the sections below.

5.2. Data Verification

The Project Chemist or designee will perform data verification on project data as the first step in the data review process. Data verification consists of conducting a completeness check to determine whether the analytical laboratory has provided the required data deliverables and to ensure that requested data is included in those deliverables. The project-specific work plan and/or QAPP provide details regarding the specific type and content of the data deliverables necessary to meet project DQOs. If any required data are missing, corrective action must be taken to resolve the omission. This may include revision of the data package, resampling, and/or documentation of issues that cannot be resolved.

5.3. Data Validation

Following verification, the Project Chemist or designee will perform data validation at the level or levels required by the project. Data validation is the systematic review of laboratory data to identify sampling and analytical uncertainty. Data validation consists of evaluating whether the data comply with the pre-defined requirements and criteria (i.e., MQOs) for the project with regard to precision, accuracy, representativeness, completeness, and comparability. Based on the laboratory data deliverables and data validation requirements identified in the project QAPP, the analytical data validation may be performed at a level from “Stage 1” through “Stage 4”, or any combination of these. The level of data validation required is based on the project DQOs. Laboratory data deliverables provided should meet or exceed the minimum requirements to perform the designated stage of data validation. The level of data validation required for the project and the project-specific validation criteria to be used are described in the project-specific work plan and/or QAPP. The stages of data validation, as defined by the USDOD/USDOE Environmental Data Quality Workgroup “General Data Validation Guidelines” are detailed in the sections below.

5.3.1. Stage 1

Stage 1 consists of verification and evaluation of the completeness and compliance of sample specific information and field quality control (QC) samples. **Table 1** summarizes the steps included in Stage 1.

Procedure # **CHEM-01**	**Title:** **CHEMISTRY DATA REVIEW AND MANAGEMENT**	**Revision #** **01**
Effective Date: 02/24/2020	**Approved By:** Maryanne Kosciewicz, Project Chemist	**Last Revised:** 07/27/2018

TABLE 1
ELEMENTS OF STAGE 1 VALIDATION

Item	Activity
Data Package	Verify the data package includes a Cover Page, Table of Contents, Case Narrative, and all supporting documentation to complete Stage 1 validation.
Field Samples	Verify sample IDs, analyses performed, and target analyte lists reported match those listed on the chain-of-custody and associated project documents.
Sample Receipt Information	Verify sample receipt conditions are documented, including temperature, preservation, and any issues that might compromise sample integrity.
Holding Times	Verify all holding times were met for the required analyses.
Limits and Units	Verify the reported concentrations and units for limits of detection and quantitation met project requirements.
Field QC	Verify field QC samples were collected and analyzed at the frequency required by the project.

5.3.2. Stage 2A

Stage 2A includes all elements of Stage 1 plus the evaluation of preparation and analytical batch QC results. **Table 2** summarizes the steps included in Stage 2A. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 2
ELEMENTS OF STAGE 2A VALIDATION

Item	Activity
Case Narrative	Verify the method-specific case narrative includes a discussion of all significant issues encountered during analysis, including hold time exceedances, QC failures, and any problems encountered that may have adversely impacted sample integrity or data quality.
Methodology	Verify all batch QC required by the analytical methods were performed, including preparation and cleanup when needed.
Sample results	Determine which result should be used to make project decisions if multiple analyses were performed for any analyte.
Batch QC	Evaluate all sample-related batch QC samples against designated acceptance criteria for spike list, frequency, accuracy, and precision as applicable. Batch QC includes but is not limited to, method blanks, laboratory control samples, matrix spikes, surrogate spikes, analytical duplicates, serial dilutions, and post digestion spikes.

5.3.3. Stage 2B

Stage 2B includes all elements of Stage 2A plus the evaluation of instrument related QC elements and results. **Table 3** summarizes the steps included in Stage 2B. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 3
ELEMENTS OF STAGE 2B VALIDATION

Item	Activity
Instrument Elements	Verify the method required instrument performance checks were performed and met criteria. These include, but are not limited to, instrument tunes, breakdown standard checks, peak tailing factors, interference check standards, etc.
Calibration	Verify all calibration criteria were met, including frequency, response factors, and fit criteria.
Calibration Verification	Verify initial and continuing calibration verifications were performed at the required frequency and met all criteria.
Internal Standards	Verify internal standard response and retention time criteria were met.
Instrument Blanks	Verify instrument blanks were performed at the required frequency and met criteria.
Confirmation Analyses	For applicable methods, verify confirmation analysis was performed for all positive results using a secondary column or detector. Verify the percent difference between original and confirmation results met applicable criteria.

5.3.4. Stage 3

Stage 3 includes all elements of Stage 2B plus the re-quantification and recalculation of selected results. **Table 4** summarizes the steps included in Stage 3.

TABLE 4
ELEMENTS OF STAGE 3 VALIDATION

Item	Activity
Recalculation of data	Select results will be recalculated from raw instrument response at the frequency designated by the project specific work plan and/or QAPP. Recalculated results shall encompass field samples, batch QC data, and instrument QC elements. The percentage of data that must be recalculated shall be designated in the project QAPP. At a minimum, one sample result and one QC-related result shall be recalculated for each method performed for every ten (10) field samples analyzed.

5.3.5. Stage 4

Stage 4 includes all elements of Stage 3 plus qualitative review of non-detect, detected, and tentatively identified compounds (TICs) from instrument outputs. **Table 5** summarizes the steps included in Stage 4. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

Procedure # CHEM-01	Title: CHEMISTRY DATA REVIEW AND MANAGEMENT	Revision # 01
Effective Date: 02/24/2020	**Approved By:** Katherine LaPierre, Project Chemist	**Last Revised:** 07/27/2018

TABLE 5
ELEMENTS OF STAGE 4 VALIDATION

Item	Activity
Chromatograms	Review chromatograms for peak integration, baseline anomalies, matrix interferences, etc. Verify manual integrations were correctly performed, justified, and documented.
Mass Spectra	Review mass spectra for signal to noise ratios, presence of qualitative mass ion, relative ion abundances for required secondary and tertiary ions, etc.
Retention Times	Ensure retention times or relative retention times meet method requirements for analyte identification.

5.3.6. Data Validation Qualifiers

This section provides an overview of the standard data validation qualifiers applied by the data validator during the data review process. The data qualifiers presented in **Table 6** below should be used, as applicable, unless other data qualifiers are specified in the project related work plan or QAPP. If qualifiers other than those listed in **Table 6** are used, a detailed explanation of those qualifiers should be included in the data validation report. Data qualifiers are applied in accordance with the data validation guidance required by the project work plan and/or QAPP. In the absence of project-specific guidance, the USEPA National Functional Guidelines (most current version) will be used for data review. All qualifiers added, removed, or changed as a result of the data review process should be documented, along with the reason for the change, in the data validation report. All documented data qualifier changes must be appended to the electronic data deliverable to ensure all data queries, data tables, and project databases include the final applicable data qualifiers.

TABLE 6
DATA VALIDATION QUALIFIERS

Qualifier	Definition
U	The analyte was not detected or was changed to non-detect because of blank related contamination. The value reported for DOD/DOE projects must be “<” the Limit of Detection (LOD). The reported LOD has been adjusted for sample-specific factors, including aliquot used, dilution, etc.
J	The reported result was an estimated value with an unknown bias.
J+	The reported result was an estimated value that may be biased high.
J-	The reported result was an estimated value that may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a “tentative identification.”
NJ	The analyte has been “tentatively identified” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD (or as defined by the project). However, the reported numerical value is approximate.
Q	The sample result was affected by serious deficiencies in the ability to analyze the sample and meet method and/or project QC criteria. The presence or absence of the analyte cannot be verified. The project team should decide whether the result is ultimately usable.
R	The project team concluded that the data point is rejected an unusable for the purposes of the project.

5.4. Data Usability Assessment

Data usability is an evaluation of the data set with respect to the overall goals of the project, as outlined in the DQOs. Following the completion of data validation, usability of the data may be assessed. **Table 7** summarizes the elements of evaluating data usability. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 7
ELEMENTS OF DATA USABILITY

Validation Step (Review Items)	Validation requirement
Patterns and Trends	Review project data for patterns and trends in the sample and/or QC data that may indicate systematic issues/bias across the entire data set.
Data Gaps	Review reported data for potential data gaps, including samples that were not collected, samples that were compromised during shipment or after receipt at the laboratory, data qualified “Q” or “R” that potentially may not be usable, etc.
Qualified Data	Review qualified data to evaluate the impact biased data may have with regard to the comparison to project action limits (PALs). For example, results qualified “J-“ as estimated with low bias that fall just below the PAL may need to be further evaluated due to the limitations of the analytical process.
Laboratory Sensitivity	Evaluate laboratory sensitivity by comparing detection limit (DL), LOD, and limit of quantitation (LOQ) values to those required by the project work plan and/or QAPP. Verify that the reported DL, LOD, and/or LOQ values were below the required PALs listed in the project work plan and/or QAPP (as applicable). Determine whether analyte-specific and overall sensitivity of the data set were sufficient to meet project requirements.
Deviations from Project Requirements	Review any deviations from planned activities (e.g. work plan and/or QAPP deviations, method deviations, deviations from planned sampling activities, etc.) and the impact these deviations may have had on data usability.

5.5. Electronic Data Deliverables (EDD)

5.5.1 The Data Manager or designee shall import and store electronic analytical data in a project-specific database using electronic processing as a means to maintain and assure the accuracy, consistency, and integrity of the data. Electronic data will be reviewed using validation software to ensure that electronic data comply with pre-defined project requirements. The Data Manager shall ensure that the electronic data match that reported in the laboratory data package. The electronic data validation and resulting qualifiers shall be compared to the manual validation to ensure all final data validation qualifiers match between the electronic data and those documented in the data validation reports. The Data Manager shall use the validated data to generate data summary tables that include the final validation flags, as required by the project.

5.5.2 The required EDD format and government database submittal deliverables are specific to the project and are described in the project-specific work plan and/or QAPP. The Data Manager is responsible for ensuring data are uploaded to required government databases in accordance with project requirements.

5.6. Data Archive

Electronic project files, such as laboratory data packages (in PDF format), electronic data deliverables, data validation reports, project database, and data tables shall be stored and maintained as described in the project-specific work plan and/or QAPP. All Department of Defense project related laboratory and validation documents shall be stored for minimum of seven years from the date the data are accepted by the client. Data shall be stored, maintained, and archived in accordance with all federal laws and regulations.

6. REFERENCES

Reference Title (Author)	Description
Uniform Federal Policy for Quality Assurance Project Plans Part 1: UFP-QAPP Manual, Final Version 1 March 2005. (Intergovernmental Data Quality Task Force)	Provides Federal departments, agencies, and programs with policy and guidelines for developing QAPPs for management of environmental data collection and use.
General Data Validation Guidelines, October 2017 (Environmental Data Quality Workgroup)	Provides guidance on the validation of environmental data generated in support of the Department of Defense (DoD)/Department of Energy (DOE) projects.
National Functional Guidelines for inorganic Superfund Methods Data Review, January 2017 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for inorganic parameters, including metals, mercury, and cyanide.
National Functional Guidelines for Organic Superfund Methods Data Review, January 2017 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for organic parameters, including volatiles, semivolatiles, pesticides, and aroclors.
National Functional Guidelines for High Resolution Superfund Methods Data Review, April 2016 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for high resolution parameters, including dioxins, furans, and congeners.

7. EXHIBITS

None.

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	05/20/15	Initial Release	n/a
01	07/27/18	Significant revisions throughout to reflect current definitions and guidelines regarding data review procedures.	Previous version out-of-date based on new DoD/DOE guidance.

Procedure # **SOP PFAS ENV-01**	**Title:** **PFAS SAMPLING GUIDANCE**	**Revision #** **01**
Effective Date: 12/6/2018	Approved By: Daniel R. Griffiths, PG, CPG	Last Reviewed/Revised: 12/12/2022

1. PURPOSE

Many materials used during an environmental investigation can potentially contain per- and polyfluoroalkyl substances (PFAS). There is limited published research or guidance on how certain materials used by field staff may affect sample results. Therefore, a conservative approach will be the default when conducting field investigations during this program.

2. RESPONSIBILITIES

Role	SOP-Specific Responsibilities
Field Staff Sampling for PFAS Compounds	Guidance for all field staff performing activities related to the sampling of PFAS.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	per- and polyfluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Field Equipment used during PFAS Investigations	All field equipment used during PFAS investigations should follow the guidance outlined in this standard operating procedure (SOP). Equipment deviating from this guidance should be discussed with the supplier and/or producer. The equipment should be tested with a rinse blank analysis prior to use to determine if it may be a source of PFAS cross-contamination.

5. PFAS PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The health and safety of the field team is paramount. If the safety of the field crew becomes an issue (e.g., use of insect repellant; inclement weather) an alternative course of action will be discussed with the project team and the result will be noted on the daily PFAS checklist (**Exhibit 4**).

5.2. PFAS Cross-Contamination

5.2.1. Material Avoidance

5.2.1.1. Basic materials that will be avoided during the field investigation:

- Teflon®, polytetrafluoroethylene (PTFE);

- waterproof coatings containing PFAS;
- food containers;
- anything with fluoro in the name;
- fluorinated ethylene propylene (FEP);
- ethylene tetrafluoroethylene (ETFE);
- low density polyethylene (LDPE); and,
- polyvinylidene fluoride (PVDF).

5.2.1.2. The field team will be aware that many waterproof coatings contain PFAS (e.g., water-resistant clothing, shoes, waterproof papers) and these materials will be avoided. If a waterproof material is necessary, alternatives include polyurethane, rubber, or polyvinyl chloride (PVC) and these options will be discussed with the project team prior to use. Due to the ubiquitous nature of PFAS, the sampling crew will review all materials used to avoid contamination. A conservative list of items to avoid and permitted items is provided below in **Exhibit 1** and **Exhibit 2**. General precautions to follow and products to avoid while on-site are outlined in the following subsections (Note that this is not an exhaustive list and any materials to be used on-site should be reviewed with the project team prior to use.)

5.2.2. Field Equipment

- Avoid Teflon® lined tubing or sampling existing wells with dedicated Teflon® tubing.
- Avoid waterproof field notebooks.
- Bladder pumps must use disposable polyethylene bladders.

5.2.3. Food Related

- Paper food packaging is often treated with PFAS to resist wetting. As such, personnel should avoid paper bags, paper food packaging, paper wrapping (e.g., sandwich wrap), paper beverage cups, as well as other coated papers.
- Aluminum foil should not be used on site.
- Food that has been fried in a frying pan due to the potential for contamination from Teflon-coated cooking surfaces.
- Coated textiles of any type should not be used on site.
- Snacks and meals should not be eaten in the field vehicle or in the work area. Field personnel should step-away from the work area by a minimum of 10 meters (downwind whenever possible) when taking breaks for food and beverages.

5.2.4. Field Gear / Clothing

- Water resistant, waterproof, or stain treated clothing such as Gore-Tex should not be worn by field personnel. Clothing worn during field sampling should be made of natural fiber such as cotton or wool.
- Clothing made of synthetic fibers. Clothing worn during field sampling should be made of natural fiber such as cotton or wool.
- Field clothing should ideally be old and well laundered.
- Field clothing should be washed using a minimal use of unscented detergent and no fabric softener or other additives. Once clean the clothing should be washed again in water only before drying. No fabric conditioner or dryer sheets should be used while drying.
- Rite in the Rain field notebooks/paper and similar products are not to be used. Field records should be recorded on loose uncoated paper or electronic forms.

- Field notes, records, and sample labels should be made in pencil or using Rite in the Rain pens (confirmed to be PFAS-free from the manufacturer). Ballpoint pens and markers are not to be used for notes. Sample labels may also be pre-printed by the laboratory; if pencil is used to write on the sample labels, those bottles will be double bagged using LDPE bags (e.g., Ziploc®) that do not come into direct contact with the sample media and do not introduce cross-contamination with samples may be used).
- Clipboards should be made of Masonite or aluminum. Plastic clipboards, binders, and spiral bound notebooks are not acceptable.
- Safety toe boots made from synthetic fibers and treated for water resistance are acceptable for use in order to maintain personnel protection. However, all contact with the boots is to be made at least 10 meters away from the work area. New gloves are to be donned prior to making contact with the boots and are to be disposed immediately afterwards. Boots containing Gore-Tex and/or Tyvek are not to be used on site.
- Disposable, powderless, nitrile gloves must be worn at all times. A new set of gloves will be donned prior to conducting any of the following activities at each sample location:
  - Equipment decontamination,
  - Contact with bottleware and/or PFAS free water containers,
  - Insertion of anything into the well (e.g., samplers, tubing, etc.),
  - Insertion of silicone tubing into peristaltic pump,
  - Completion of well purge, prior to sample collection,
  - Collection/handling of quality control/quality assurance (QA/QC) samples,
  - Following handling any non-dedicated field equipment, contact with non-decontaminated surfaces, and
  - When deemed necessary by field personnel.
- Vehicle seating is often treated with stain resistant products. Therefore, direct contact with vehicle seats should be avoided by covering each seat with a well laundered cotton sheet for the duration of the sampling event.
- Samples should be kept on ice using only regular water ice double-bagged in LDPE bags (e.g., Ziploc®). No chemical ice packs (blue ice) are allowed.

5.2.5. Personal Hygiene

- On the day of sampling, field personnel should not use shampoo, conditioner, body gel, cosmetics, or cosmetic/hand/body creams as part of their personal hygiene routine. The use of bar soap is acceptable; however, bar soaps containing additional moisturizers should be avoided.
- It is recommended that field personnel shower the night before the sampling event and rinse with water only the morning of the sampling event.
- Cosmetics, moisturizers, sunscreens, insect repellant, and dental floss, except for those in **Exhibit 2 and 3**, shall not be used on or off site throughout the duration of the field sampling program.
- For restroom breaks, field personnel shall move at least 10 meters from the work area before removing gloves and overalls. Personnel should wash their hands as normal allowing for extra time for rinsing after soap use. It is preferred to dry hands after washing using a hand dryer rather than paper products whenever possible.

5.2.6. *Site Visitors*

- All visitors to the site are to be asked to remain a minimum distance of at least 10 meters from all sampling areas.

5.2.7. *Rain Events*

- The use of rain gear treated with a waterproof coating is not permitted while sampling. Alternatively, PVC rain suits may be worn.
- The use of a pop-up tent is acceptable for use to provide shelter from the rain if the schedule does not allow for work to stop during rain. The gazebo should be erected directly over top of the sampling area taking precautions that water running off the tent does not enter into work areas. Since a waterproof pop-up tent may be treated with PFAS containing materials cross-contamination precautions should be taken when using them. Gloves should be donned whenever contact with the gazebo is made and the gloves should be disposed of immediately following contact.

5.2.8. *Material Screening*

If alternative materials must be used, screening of the material should include a review of Safety Data Sheets (SDSs). Make sure the review uses current SDSs, because the actual composition of a particular item or material may have changed over time without changing the actual item or material name. All products from the United States or abroad should be screened. Text fragments such as “perfluoro,” “fluoro,” or “fluorosurfactant” may identify the use of PFAS in specific items or materials (MDEQ, 2018). If after review, there is still concern the sampler will contact the manufacturer.

5.3. PFAS Sampling Procedures

5.3.1. *Sample Containers, Handling, and Collection*

5.3.1.1. All bottles used for PFAS sampling should come from the laboratory that will also be performing the PFAS analysis, as defined by the Quality Assurance Project Plan (QAPP), and be verified by the laboratory to be PFAS-free. Typically, polypropylene or high-density polyethylene (HDPE) bottles with unlined plastic caps are used.

5.3.1.2. Before sampling, staff may come into contact with textiles and fabrics treated with PFAS, such as carpets and car interiors. Staff should be aware that these materials, and any other surfaces that repel water and are stain resistant, have the potential of being treated with PFAS. Although these are materials that do not come into contact with the sample, field personnel should be aware of the possibility for PFAS presence and sample containers and equipment that will be used for sampling should not be stored on or come into contact with materials suspected to contain PFAS.

5.3.1.3. For all environmental media, hands should be well washed before sampling. Clean powderless nitrile gloves must be put on before sample collection, handling of sample containers, and handling sampling equipment. The sample container must be kept sealed at all times and only open during the sample collection. The sampling container cap or lid should never be placed on any surface unless it is PFAS-free. The sampling container cap or lid must never be placed directly on the ground.

5.3.1.4. If published analytical reference methods, other than Environmental Protection Agency (EPA) Draft Method 1633 are used, follow the guidelines or requirements in those methods for sample storage, preservation, and hold times. Otherwise, EPA Draft Method 1633 requires that samples must be protected from light and stored and shipped at 0 to 6 °C. When received by the laboratory, sample temperature must be 0 to 6 °C. Once received by the laboratory, the samples must be stored at less or equal to -20 °C until sample preparation.

5.3.2. *Shake Test*

The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after a sample is collected and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.3.3. *Sample Shipment*

In general, for all environmental media sampled for PFAS, samples must be kept on ice from the time of sample collection to the arrival at the laboratory. The following procedures should be used for sample shipment:

- Regular ice should be used to cool and maintain the sample at or below the proper temperature.
- Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- The samples, ice, and chain of custody (CoC) should always be bagged in LDPE (e.g., Ziploc®) bags.
- Chain of Custody and other forms should be single bagged in LDPE resealable storage bags and taped to the inside of the cooler lid.
- The cooler should be taped closed with a custody seal and shipped by overnight courier.
- Samples should be shipped as soon as possible (e.g., overnight) to ensure the samples arrive within the analytical holding time specified by the lab.

5.4. General Equipment Decontamination Procedures

5.4.1. *PFAS-Free Water*

5.4.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2018). **Note:** The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.4.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.4.2. *Decontamination Procedures*

5.4.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.4.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean PFAS-free water;
4. Second rinse in a bucket of clean PFAS-free water;
5. Final triple rinse with PFAS-free water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e., those that foam during shaking, see Section 5.3.3) will be cleaned as per above in triplicate.

5.4.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.4.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment rinsate blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
Denly, E. et al., (2019). Per- and polyfluoroalkyl substances in environmental sampling products: Fact or fiction? Remediation. 2019;29:65–76.	Guidance on prohibited materials.
Interstate Technology Regulatory Council (ITRC), 2018. PFAS Fact Sheets. Accessed 11/07/18. https://pfas-1.itrcweb.org/fact-sheets/	PFAS guidance on sampling and avoiding cross contamination.
Michigan Department of Environmental Quality (MDEQ). 2018. PFAS Sampling Guidance. Accessed 11/07/18. https://www.michigan.gov/pfasresponse/investigations/sampling-guidance	PFAS guidance and PFAS-free health and safety products.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1:	Summary of Prohibited and Acceptable Items for Sampling of PFAS
Exhibit 2:	Prohibited Field Clothing and PPE Brand and Product Names
Exhibit 3:	Approved Sunscreen and Insect Repellants
Exhibit 4:	PFAS Sampling Checklist

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	12/6/2018	Initial Release	n/a
01	12/12/2022	Sample storage temperature per EPA Draft Method 1633	Release of EPA Draft Method 1633

EXHIBIT 1: SUMMARY OF PROHIBITED AND ACCEPTABLE ITEMS FOR SAMPLING OF PFAS

PROHIBITED ITEMS	ACCEPTABLE ITEMS
FIELD EQUIPMENT	
Teflon® containing materials (**Exhibit 2**)	High-density polyethylene (HDPE), polypropylene, silicone
Low density polyethylene (LDPE)	Acetate liners LDPE bags (e.g., Ziploc®) that do not come into direct contact with the sample media and do not introduce cross-contamination with samples may be used.
Aluminum foil	Silicon tubing
Waterproof field books	Loose paper (non-waterproof), Electronic forms
Plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or Masonite
Ball point pens	Rite in the Rain pens®
Post-It Notes	
Re-usable Chemical (blue) ice packs	Regular ice in polyethylene bags (double bagged)
FIELD CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)	
New cotton clothing or synthetic water resistant, waterproof, or stain- treated clothing, clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferable cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex™ Tyvek®	Boots made with polyurethane and polyvinyl chloride (PVC), or PVC over boots Synthetic or natural fibers (cotton preferred)
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	Reference **Exhibit 3**. Sunscreens and insect repellants should not be applied near the sample collection area. Hands should be well washed after application or handling of these products, and afterwards, powderless nitrile gloves should be worn.
SAMPLE CONTAINERS AND TUBING	
LDPE or glass containers and lined lids	HDPE
Teflon®-lined caps	Unlined polypropylene caps
RAIN EVENTS	
Waterproof or resistant rain gear	PVC Rain Gear and/or tent that is only touched or moved prior to and following sampling activities
EQUIPMENT DECONTAMINATION	
Decon 90	Alconox®, Liquinox® and/or 7th Generation Free & Clear Dish Soap
Water from an on-site well Untested potable water from municipal drinking water supply	Tested potable municipal water (for steam cleaning or initial cleaning) PFAS-free deionized water (small sampling equipment)
FOOD CONSIDERATIONS	
All food and drink, with exceptions noted on the right	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area

EXHIBIT 2: PROHIBITED FIELD CLOTHING AND PPE BRAND AND PRODUCT NAMES

PROHIBITED MATERIALS (DEPA, 2015)	
Advanced Dual Action Teflon® fabric protector.	Release Teflon®
Repel Teflon® fabric protector	High-Performance Release Teflon®
High performance Repel Teflon® fabric protector	Ultra Release Teflon®
NK Guard S series	GreenShield®
Tri-Effects Teflon® fabric protector	Lurotex Protector RL ECO®
Oleophobol CP®	Repellan KFC®
Rucostar® EEE6	UnidyneTM
Bionic Finish®	RUCO-GUARD®
RUCOSTAR®	RUCO-COAT®
RUCO-PROTECT®	RUCOTEC®
RUCO®	Resist Spills™
Resists Spills and Releases Stains™	Scotchgard™ Fabric Protector

EXHIBIT 3: APPROVED SUNSCREEN AND INSECT REPELLANTS

ALLOWABLE INSECT REPELLANTS	
PHOTOS	**INSECT REPELLENT SPRAY**
 	• OFF Deep Woods • Sawyer Permethrin
ALLOWABLE SUNSCREENS	
PHOTOS	**SUNSCREENS**
  	• Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30 • Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Stick SPF 50 • Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50 • Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30 • Coppertone Sunscreen Stick Kids SPF 55 • L'Oréal Silky Sheer Face Lotion 50+ • Meijer Sunscreen Lotion Broad Spectrum SPF 30 • Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30
MATERIALS THAT REQUIRE SCREENING	
• Sunscreens: Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, and baby sunscreens that are "free" or "natural."	
• Insect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, Baby Ganics	
• Sunscreen and Insect Repellent: Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion.	
1) This table is not considered to be a complete listing of allowable materials and materials that require screening. All materials should be evaluated before use during sampling. Some of the sunscreen and insect repellent testing has been performed using a PFAS screening Method known as Particle Induce Gamma-Ray Emission (PIGE). The use of approved gloves should always be used, and the sample should never come into contact with any of the sunscreen or insect repellent products. An Equipment Blank sample could also be collected to verify the product as PFAS-free.	

EXHIBIT 4: PFAS SAMPLING CHECKLIST

Site Name: ____________________ Task: ____________________

Weather (temp/precip):____________________ Date: ____________________

***Field Clothing and PPE*:**

- ☐ Powder-Free Nitrile Gloves ONLY
- ☐ No clothing or boots containing Gore-Tex™
- ☐ No clothing or boots treated with water-resistant spray
- ☐ Safety boots made from polyurethane and PVC, or leather boots covered with overboots
- ☐ No materials containing Tyvek®
- ☐ Field crew has not used fabric softener on clothing
- ☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products this morning
- ☐ Field crew has not applied unauthorized sunscreen or insect repellant
- ☐ Samplers don fresh nitrile gloves for each sample collected

***Field Equipment*:**

- ☐ No Teflon® or LDPE containing materials other than QED brand LDPE
- ☐ All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene, QED brand LDPE
- ☐ No waterproof field books, waterproof paper or waterproof bottle labels, waterproof markers/Sharpies®
- ☐ No plastic clipboards, binders, or spiral hard cover notebooks
- ☐ No Post-It Notes®
- ☐
- ☐ Coolers filled with regular ice only; no chemical (blue) ice packs in possession
- ☐ No aluminum foil

***Sample Containers*:**

- ☐ Containers for PFAS shipped in separate cooler from other sample analyses
- ☐ Sample containers made of HDPE or polypropylene
- ☐ Caps are unlined and made of HDPE or polypropylene

***Wet Weather (as applicable)*:**

- ☐ Wet weather gear made of polyurethane and PVC only

***Equipment Decontamination*:**

- ☐ "PFAS-free" water on-site for decontamination of sample equipment; no other water sources to be used
- ☐ Alconox® or 7th Generation Free & Clear Dish Soap to be used as decontamination cleaning agents

***Food Considerations*:**

- ☐ No food or drink on-site with exception of bottled water and/or hydration drinks (*i.e.*, Gatorade® and Powerade®) that is available for consumption only in the staging area

***Vehicle Considerations*:**

- ☐ Avoid utilizing areas inside vehicle as sample staging area

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If any applicable boxes cannot be checked, the field team leader shall describe the deviations on the back and work with field personnel to address issues prior to commencement of work.

Sampling Equipment and Supply Summary (include brand names and serial numbers where available)

Decontamination Fluid Source(s): ______________________________
Soap and other fluids used: ______________________________
Gloves:______________________________
Rope: ______________________________
Sampling Equipment: ______________________________
Field Team Names: ______________________________
Field Team Leader Signature:______________________________

Procedure # SOP ENV-02	Title: SOIL SAMPLING	Revision # 00
Effective Date: 04/22/2022	Approved By: Todd Belanger	Last Revised:

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting surface or subsurface soil samples for analysis during environmental investigations where PFAS compounds are a part of the subject of investigation. The **SOP PFAS ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Surface soil samples collected during the sampling program are expected to be discrete. Subsurface soil samples may be collected using hand augers or a drilling method. This procedure also applies to the collection of dry sediment samples.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of soil samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	Stainless steel bowls and scoops/spoons, hand auger
Sample containers	Appropriate, pre-cleaned, sample bottles [verified PFAS-free, as appropriate] provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof field books.
GPS Unit	To record sample coordinates.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP PFAS ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, soil type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form. The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, QAPP and **SOP PFAS ENV-01 PFAS Sampling Guidance**. The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.3. Sample Analysis and Quality Control Samples

5.2.3.1. Collected soil samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event.

5.2.3.2. **Shake Test**: The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after the groundwater sample is collected and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated with elevated concentrations of PFAS. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.3. Sampling Methods for Surface Soil

5.3.1. Preparation for Surface Soil Sampling

The following steps shall be completed when preparing for collection of surface soil samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).

3. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
4. The Sampling Team shall don clean, powder free nitrile gloves, as required.
5. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area.

5.3.2. Discrete Sampling Method for Soil (or Dry Sediment)

5.3.2.1. The discrete sampling method is best suited to identifying localized contamination. Discrete sampling may be used to collect a sample from a biased area of soil (e.g. stained soil, within a known area of concern, the bottom of an excavation). Discrete sampling is also used when collecting IDW samples from drums or spoils piles to characterize waste.

5.3.2.2. Following the preparatory actions (Section 5.3.1), the Sampling Team shall complete the following steps to collect discrete surface soil samples:

1. Collect the sample using an approved sampling tool (e.g., stainless steel, trowel, or scoop).
2. Screen the collected sample with a photoionization detector (PID) for the presence of VOCs.
3. Transfer the collected soil from the sample tool directly into the sample container(s). If VOCs are to be collected, they shall be collected first prior to homogenization or compositing.
4. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
5. After sampling is completed, backfill the hole with remaining soil to return the site to as close to original condition as possible.
6. Perform post-sampling activities (Section 5.3.3).

5.3.3. Post Sampling Activities for Surface Soil Sampling

The following steps shall be completed once surface soil sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.4. Preparation for Subsurface Soil Sampling

5.4.1. Preparation for Subsurface Soil Sampling

The following steps shall be completed when preparing for collection of subsurface soil samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Sampling Team Leader will obtain any necessary excavation permits and, if necessary, contact a local underground utility locating service to perform a utility clearance for all subsurface sample locations.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1 and **SOP ENV-07 Drilling and Monitoring Well Installation**).

4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powder free gloves, as required.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the borehole. All equipment entering the borehole shall be decontaminated and shall be PFAS-free as per **SOP PFAS ENV-01 PFAS Sampling Guidance**.
7. The Sampling Team shall calibrate any required equipment and document the calibration on an equipment calibration form.

5.4.2. Boring or Hand Auger Method for Subsurface Soil

5.4.2.1. This section provides procedures for subsurface soil sampling using a drilling rig (e.g., Geoprobe® or hollow stem auger) or hand auger. Similar procedures apply for other drilling methods. If a drilling rig is used, it shall be operated by an appropriately licensed driller.

5.4.2.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect soil samples from the soil borings advanced by hand augering or direct push rig:

1. Spread clean HDPE or polyethylene plastic sheeting or a clean, washed cotton sheet on the ground or table at each sampling location to keep sampling equipment clean and prevent cross-contamination.
2. Advance the hand auger or drill tooling to the desired sample depth.
3. Immediately after opening the sampling device (e.g., split-spoon), screen the collected sample with a PID for the presence of VOCs.
4. Collect the sample using an approved sampling tool (e.g., stainless steel trowel or scoop) and scoop the soil from the auger bucket, acetate liner/split spoon/sample bag (as applicable) from the drilling rig starting at representative depth ranges as detailed in the work plan/QAPP. For hand augering, use a new, clean, decontaminated auger bucket once the top of the sampling depth is reached.
5. If VOCs are to be collected, they shall be collected first prior to homogenization or compositing.
6. Transfer the sample from the auger bucket or trowel into a large stainless-steel bowl and mix the combined soil thoroughly to ensure a representative sample.
7. Collect suitable quantities with the approved sampling tool and transfer directly into the sample container(s).
8. Repeat these steps as necessary to obtain sufficient sample volume.
9. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
10. After sampling is completed, backfill the hole with remaining soil to return the site to as close to original condition as possible.
11. Perform post-sampling activities (Section 5.4.3).

5.4.3. Post Sampling Activities for Subsurface Soil Sampling

The following steps shall be completed once subsurface soil sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.

4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.5. Sampling Equipment Decontamination

5.5.1. PFAS-free Water

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with distilled water.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse with distilled water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e. interface probe) that comes into contact with well water should be decontaminated between uses.

5.5.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.5.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ASTM D4700-15 Soil Sampling from the Vadose Zone	This guide covers procedures that may be used for obtaining soil samples from the vadose zone (unsaturated zone)
ASTM D6640-01 Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations	This practice covers procedures for obtaining soils from core barrel samplers for chemical and physical analysis, with an emphasis on the collection and handling procedures that maintain the representativeness of the chemical contaminants of concern.
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1: Soil Sampling Form

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/22/2022	Initial Release	n/a

PARSONS
SOIL SAMPLING RECORD

SITE NAME: ______
PROJECT NUMBER: ______
SAMPLING DATE / TIME: ______
WEATHER: ______
SAMPLERS: ______ of ______
______ of ______

SAMPLE ID: ______
SAMPLING METHOD: ______
DEPTH OF SAMPLE: ______

DESCRIPTION OF SAMPLING POINT

LOCATION: ______
PHYSICAL APPEARANCE: ______
VEGETATION: ______
DRAINAGE DIRECTION: ______

SAMPLE DESCRIPTION

TEXTURE: ______
COLOR: ______
ODOR: ______
OTHER: ______

FIELD TESTS

TEMPERATURE: ______ OTHER: ______
pH: ______ OTHER: ______
CONDUCTIVITY: ______ OTHER: ______

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: ______
QA/QC SAMPLE ID: ______
ANALYZE QA/QC SAMPLES FOR: ______
DATE/TIME REFRIGERATED: ______
CHAIN OF CUSTODY NUMBER: ______
SHIPPED VIA: ______
LABORATORY: ______

COMMENTS / MISCELLANEOUS

______
______
______

Procedure # **SOP ENV-03**	**Title:** **GROUNDWATER SAMPLING**	**Revision #** **01**
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting groundwater samples for analysis during environmental investigations where PFAS compounds are the subject of investigation or there is the potential for future investigation of PFAS compounds. This SOP also applies to the collection of groundwater for analysis of other chemical suites (e.g., metals). The **SOP ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Proper collection procedures are necessary to assure the quality and integrity of the PFAS samples or future PFAS sampling. Low-flow techniques to be used when groundwater sampling.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan/QAPP. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	[PFAS-free when applicable] Measuring cups/graduated cylinder, peristaltic pump, PFAS-free bladder pump (stainless steel with disposable polyethylene bladders), PFAS-free submersible pump, clean HDPE or silicon tubing, PFAS-free polypropylene rope, purge buckets, HDPE or cotton sheeting, sampling bottles.
Sample containers	Appropriate, pre-cleaned, verified PFAS-free (if applicable) sample bottles provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof field books when sampling for PFAS compounds.

Procedure # **SOP ENV-03**	**Title:** **GROUNDWATER SAMPLING**	**Revision #** **01**
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

Equipment	Brief Description of Function and Purpose
GPS Unit	To record sample coordinates.
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Water Level Meter	To measure depth to static water level and total depth of well.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. When sampling for PFAS compounds, any health and safety products or PPE will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance.**

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, sample type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form. The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

5.2.2.1. The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, UFP-QAPP, and **SOP ENV-01 PFAS Sampling Guidance** (when applicable). The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.2.2. Sample purge water and equipment decontamination water may be required to be containerized as investigation-derived waste (IDW) and analyzed. The Sample Team Leader will review the requirements in the Waste Management Plan (included as a part of the work plan) for chemical analysis and proper disposal of IDW.

5.2.3. Sample Analysis and Quality Control Samples

5.2.3.1. Collected samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event. Typical QC samples collected include the following:

Procedure # SOP ENV-03	Title: GROUNDWATER SAMPLING	Revision # 01
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

5.2.3.2. **Equipment Blank**: Typically collected weekly when sampling for non-PFAS analytes. A daily equipment blank will be collected if sampling for PFAS. A common method to verify that the device is “clean” and acceptable is to analyze a sample (equipment blank) that has been soaked in or passed through the sampling device, or both, to check for the background levels that may result from the sampling materials or from field conditions.

5.2.3.3. **Field Blank (when collecting PFAS samples only)**: Typically collected daily. A field blank is a PFAS sample bottle pre-filled at the laboratory with laboratory verified PFAS-free water and sent with the sample bottles. Prior to sampling, open the PFAS field blank bottle provided by the laboratory and place adjacent to the sample collection area. Gloves should be changed prior to handling other PFAS sample bottles. After the PFAS sample is collected, close the PFAS field blank bottle and return it to the cooler. This sample will be analyzed in the same manner as the normal samples and can indicate whether or not PFAS were introduced during sample collection/handling, as well as if additional factors may exist, such as introduction of contaminated air particulate.

5.2.3.4. **Trip Blank**: One per cooler. Trip blanks will be supplied by the laboratory and will be analyzed only for VOC compounds.

5.2.3.5. **Shake Test (when collecting PFAS samples only)**: The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after the groundwater sample is collect and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.2.4. Field Instrument Calibration and Sample Analysis

5.2.4.1. When water samples are being collected, the water quality meter and dissolved oxygen (DO) sensor will be checked at the beginning of each day. The Sampling Team Leader or designee shall bump check the water quality meter to ensure the sensors are within 5 percent of the calibration standards (or as specified in the work plan) for: pH 4, pH 7, pH 10, Zobell’s ORP Solution (or similar), Turbidity 0 NTUs, and Conductivity Standard 1.413 µS. If any parameter is outside 5 percent, that parameter will be calibrated and checked again.

5.2.4.2. If specified in the work plan, the photo ionization detector (PID) will be used to screen the breathing zone around the open well casing. Air monitoring data shall be recorded on a field form or in the field notebook.

5.2.4.3. Collected groundwater samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan. The Sample Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan to ensure proper QC review of each sampling event.

The following steps shall be completed when preparing for collection of groundwater samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample (e.g., peristaltic pump, bladder pumps, PFAS free submersible pumps), unless already specified in the work plan.

3. Decontaminate rental equipment prior to use (e.g., water level meter, bladder pumps, submersible pumps).
4. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
5. When sampling for PFAS compounds, the Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.

   (a) If PFAS is not the subject of the ongoing investigation, but the wells may become the subject of a PFAS investigation in the future, PFAS best-practices will be practices (e.g., Teflon-free tubing and PFAS-free equipment will be used.)

6. The Sampling Team shall don clean, powderfree nitrile gloves before each sampling event. Gloves should be changed between each discrete task in the well purging and sampling process.
7. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment entering the well shall be decontaminated prior to use. Groundwater sampling setup should be placed on HDPE or cotton sheeting on the ground or on a table, if available.
8. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.2.5. Low Flow Techniques for Groundwater

5.2.5.1. This sampling method is designed to ensure that a representative groundwater sample is collected while minimizing the volume of purge water generated. This method dictates that pre-sample purging (the removal of standing water from a well and filter pack immediately prior to sample collection) be done at very low flow rates. Low flow purging and sampling involves the use of a submerged (for water depths greater than approximately 15 feet bgs) or peristaltic pump that can be adjusted to deliver groundwater to the surface at rates from less than 100 ml per minute to a maximum of 1 liter per minute. The purpose of this technique is the recovery of representative samples of the water from the soil formation adjacent to the well screen. Stagnant water above the screen and below will not usually be purged or sampled. This technique eliminates the need for collection and costly disposal of several well volumes of groundwater as investigative derived waste (IDW) from wells containing contaminated water.

5.2.5.2. During low flow purging and sampling the pump intake is placed within the lower depths of the screened interval and the water pumped from the well is monitored for a number of water quality parameters using a flow through cell and field instrumentation. The water level will also be monitored to ensure that draw down is kept to a minimum as specified in the approved work plan. Sampling commences when the measured parameters have stabilized and turbidity is at an acceptable and constant level. Specific procedure for conducting groundwater sampling using low flow techniques are as follows:

5.2.5.3. Preparation: The steps listed in Section 5.3.1 shall be completed prior to sample collection using low flow methods.

5.2.5.4. Groundwater Sampling: Following the preparatory actions described above, the Sample Team shall complete the following steps to collect low flow groundwater samples:

1. Open well and measure depth to static water level and total depth of the well to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing using a decontaminated electronic water level meter. Record these measurements into the project specific log or electronic form or application.

2. Lower pump or tubing slowly into the well to a depth at the middle of the saturated screen section of the well. Consult the well construction log and the total measured water column in step 1 to determine depth.
3. Allow water column to equilibrate then measure static water level again, use this measurement as the reference point for drawdown.
4. Begin purging the well. Using a graduated cylinder (or similar), establish the maximum flow rate that does not cause drawdown of the well (commonly a rate between 100ml and 300ml per minute) or as specified in the approved work plan/QAPP.
5. Connect tubing through the water quality meter, record initial water quality parameters, then continue recording readings every 3 to 5 minutes, or as specified in the approved work plan/QAPP. If using an electronic form or groundwater sampling application (e.g., In-Situ low flow test) ensure all required information has been entered prior to starting the flow to the meter.
6. Monitor groundwater parameters as listed below or as specified in approved work plan. The well will be considered properly purged when all measured parameters have stabilized. Stabilization requirements will be specified in the approved work plan/QAPP or as listed below:

(a) pH:	± 0.2 pH units of prior reading
(b) Specific Conductance:	± 3% of prior reading
(c) Dissolved Oxygen:	± 10% of prior reading
(d) Eh or ORP:	± 10% of prior reading
(e) Turbidity:	± 10% of prior reading (< 10NTU)
(f) Temperature:	± 3% prior reading

7. Pumping wells dry will be avoided whenever practicable; however, if a well is pumped dry at the lowest consistent flow rate the sampler can establish, then the well is considered properly purged regardless of monitored groundwater parameters. In this case, groundwater samples will be collected when 80% of the initial well water volume is recharged.
8. Prior to collecting the sample, the flow-through cell will be disconnected from the tubing and nitrile gloves will be changed. Groundwater will be allowed to flow from the tubing into the sample container carefully to limit aeration of the sample. If preservative is present in a container, the container will not be overfilled.
9. Label each sample container with sample ID, date, time, analysis, and other information required on the sample label. Samples should be double bagged using resealable low-density polyethylene (LDPE) bags (e.g., Ziploc®). Immediately place the filled containers in the coolers(s) on ice.
10. Change gloves prior to closing the PFAS field blank bottle, if applicable.
11. Perform shake test (Section 5.2.3.5), if applicable.
12. Record sample types, amounts collected, time, and date of collection on the field form and on the monitoring well purge and sample log (**Exhibit 1**).
13. Perform post-sampling activities (Section 5.3.5).

5.2.6. Post Sampling Activities for Groundwater Sampling

The following steps shall be completed once groundwater sample collection is complete:

1. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
2. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
3. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.4 or as specified in the approved work plan/QAPP.
4. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2). One trip blank per cooler is required for VOC and PFAS samples. One temperature blank per cooler is required. Other

QC samples will be collected as specified in the approved work plan/QAPP and the cooler checked for their presence.

5.3. Sampling Equipment Decontamination

5.3.1. PFAS-free Water (applicable when sampling for PFAS compounds)

5.3.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.3.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project. If PFAS compounds are not the subject of investigation, distilled water will be used for decontamination purposes.

5.3.2. Decontamination Procedures

5.3.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. If applicable, use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment; otherwise use distilled water. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water (when applicable) or distilled water. When applicable, potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water (when applicable) or distilled water immediately before use.

5.3.2.2. Decontamination of reusable sampling equipment:

Upon donning a new pair of nitrile gloves, equipment will be:

1. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
2. Rinsed in a bucket of clean potable water;
3. Second rinse in a bucket of clean potable water;
4. Final rinse with laboratory-provided, "PFAS-free" water (when sampling for PFAS), or distilled water (when not sampling for PFAS);
5. All rinsate should be collected in a sealed pail for disposal.
6. For groundwater sampling, the flow-through cell and any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
7. Field equipment used at locations that are suspected of containing AFFF (i.e., those that foam during shaking) will be cleaned as per above in triplicate.

Procedure # **SOP ENV-03**	**Title:** **GROUNDWATER SAMPLING**	**Revision #** **01**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** 09/15/22

5.3.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
ASTM D6771 – 18: Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. 01 September 2018.	This practice covers the method for purging and sampling wells and devices used for ground-water quality investigations and monitoring programs known as low-flow purging and sampling.
New York State Department of Environmental Conservation (NYSDEC), 2022. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. November 2022.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1: Typical Low-Flow Groundwater Purge and Sample Logs

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a
01	09/15/22	Changed use of peristaltic pump to 15ft or less. Updated NYSDEC PFAS guidance reference.	Army request and new guidance document.

SAMPLING RECORD - GROUNDWATER

SENECA ARMY DEPOT ACTIVITY	**PARSONS**	**WELL #:**

PROJECT:
LOCATION:

DATE:
INSPECTORS:
PUMP #:
SAMPLE ID #:

WEATHER / FIELD CONDITIONS CHECKLIST (RECORD MAJOR CHANGES)

TIME (24 HR)	TEMP (APPRX)	WEATHER (APPRX)	REL. HUMIDITY (GEN)	WIND VELOCITY (APPRX)	(FROM) DIRECTION (0 - 360)	GROUND / SITE SURFACE CONDITIONS

MONITORING INSTRUMENT	MONITORING DETECTOR

WELL VOLUME CALCULATION FACTORS

DIAMETER (INCHES):	0.25	1	2	3	4	6
GALLONS / FOOT:	0.0026	0.041	0.163	0.367	0.654	1.47
LITERS/FOOT	0.010	0.151	0.617	1.389	2.475	5.564

ONE WELL VOLUME (GAL) = [(POW - STABILIZED WATER LEVEL) X WELL DIAMETER FACTOR (GAL/FT)]

HISTORIC DATA	DEPTH TO POINT OF WELL (TOC)	DEPTH TO TOP OF SCREEN (TOC)	SCREEN LENGTH (FT)	WELL DEVELOPMENT TURBIDITY	WELL DEVELOPMENT pH	WELL DEVELOPMENT SPEC. COND
DATA COLLECTED AT WELL SITE	PID READING (OPENING WELL)	DEPTH TO STATIC WATER LEVEL (TOC)		DEPTH TO STABILIZED WATER LEVEL (TOC)	DEPTH TO PUMP INTAKE (TOC)	PUMPING START TIME
RADIATION SCREENING DATA	PUMP PRIOR TO SAMPLING (cps)			PUMP AFTER SAMPLING (cps)		

MONITORING DATA COLLECTED DURING PURGING OPERATIONS

TIME (min)	WATER LEVEL	PUMPING RATE (ml/min)	CUMULATIVE VOL (GALLONS)	DISSOLVED OXYGEN (mg/L)	TEMP (C)	SPEC. COND (umhos)	pH	ORP (mV)	TURBIDITY (NTU)

SAMPLING ORDER			PRESERVATIVES		BOTTLES		SAMPLE NUMBER	TIME	CHECKED BY/ DATE
					COUNT/ VOLUME	TYPE			

COMMENTS: (QA/QC?)

IDW INFORMATION:

Procedure # **SOP-ENV-04**	**Title:** **SURFACE WATER AND SEDIMENT SAMPLING**	**Revision #** **00**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** n/a

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting surface water and wet sediment samples for analysis during environmental investigations where PFAS compounds are part of the subject of investigation. The **SOP PFAS ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Surface water samples are collected using discrete sampling methods. At each surface water sample location, a flow measurement profile will be collected from the stream channel. Wet sediment samples are collected using discrete methods including scoop/trowel method, hand sediment corer method, PVC pipe method, and grab sampler method (e.g., Ponar®). This procedure does not apply to the collection of dry sediment samples, which are collected using soil sampling methods (see **SOP ENV-02, Soil Sampling**).

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan/QAPP. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	<ins>Surface water sampling</ins>: water quality meter, peristaltic pump, clean HDPE tubing, sampling bottles. <ins>Sediment sampling</ins>: stainless steel spoon/trowel/scoop, PFAS-free sediment corer, PVC pipe (2-inch) and cap, stainless steel bowls, grab sampler (e.g., Ponar) with winch and steel cable.
Sample containers	Appropriate, pre-cleaned, sample bottles (verified PFAS-free, when appropriate) provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.
GPS Unit	To record sample coordinates.

Equipment	Brief Description of Function and Purpose
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.
Water Flow Meter	To collect flow velocity and water depth.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP PFAS ENV-01 PFAS Sampling Guidance**. Additional PPE may be required for sampling personnel such as waders and personal floatation devices. Ensure that these materials that will come in contact with the sampling media do not consist of water-resistant coatings or other PFAS containing materials or substances.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, sample type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form (**Exhibits 2 and 3**). The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, QAPP and **SOP PFAS ENV-01 PFAS Sampling Guidance**. The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.3. Sample Analysis and Quality Control Samples

Collected samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event.

5.2.4. Field Instrument Calibration and Sample Analysis

When surface water samples are being collected, the water quality meter and dissolved oxygen (DO) sensor will be checked at the beginning of each day. The Sampling Team Leader or designee shall bump check the water quality meter to ensure the sensors are within 5 percent of the calibration standards (or as specified in the work plan) for: pH 4, pH 7, pH 10, Zobell's ORP Solution (or similar), Turbidity 0 NTUs, and Conductivity Standard 1.413 µS. If any parameter is outside 5 percent, that parameter will be calibrated and checked again.

5.3. Sampling Methods for Surface Water

Surface water includes all water on the surface of the ground directly exposed to the atmosphere, including, but not limited to, lakes, ponds, reservoirs, artificial impoundments, streams, rivers, springs, seeps, and wetlands.

Surface water samples may be collected using various sampling equipment dependent upon the type of surface water being sampled. For pond and lake sampling a pond sampler may be required to collect the sample two to three feet from the bank. Pond samplers generally comprise of a large stainless steel scoop or dipper bolted to a pole. For sampling in a stream or river the sampler can wade to the location and use a stainless steel bowl or the laboratory provided bottleware (if no preservative is present). If wading is not permitted a pond sampler or peristaltic pump may be used from the bank.

If collecting paired surface water/wet sediment samples the surface water sample shall be collected before the wet sediment sample, unless otherwise specified in the work plan. Surface water/wet sediment samples shall also be collected beginning at the location furthest from the contamination source (e.g., downstream) and working to most likely contaminated location to prevent cross contamination of samples by sediments suspended during sample collection.

5.3.1. *Preparation for Surface Water Sampling*

The following steps shall be completed when preparing for collection of surface water samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample (e.g., stainless-steel dipper, pond sampler), unless already specified in the work plan.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powderfree nitrile gloves before each sampling event.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment utilized shall be decontaminated prior to use.
7. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.3.2. *Collection of Surface Water Samples*

Following the preparatory actions (Section 5.3.1), the Sampling Team shall complete the following steps to collect surface water samples:

1. With minimal surface disturbance, submerge the appropriate sample collection container. The mouth of the container will be facing upstream (if applicable).

  (a) The sample location in the water column should consider the potential stratification of PFAS in solution and their tendency to accumulate at the air/water interface. If possible, the transfer container will be lowered sufficiently below the water surface but above the bottom sediments. Sampling of foam should be avoided unless it meets project objectives.
  (b) Transfer containers, such as beakers or dippers, which may be attached to extension rods, should be used if sample containers have preservatives. Sampling by direct sample container immersion is not recommended.

2. The sampler, if wading, will remain downstream of the sample collection point. Downstream samples will be collected prior to upstream samples.
3. Care will be taken not to disturb bottom sediments. Allow the device to fill slowly and continuously. If disturbed, wait until the sediment settles.
4. Fill sample containers directly from the sampling device.
5. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
6. Once sample has been collected, submerge a water quality meter in the sample location and record the water parameters including temperature, pH, conductivity, ORP, DO, and turbidity or as specified in the work plan/QAPP.
7. Perform post-sampling activities (Section 5.3.3).

5.3.3. *Post Sampling Activities for Surface Water Sampling*

The following steps shall be completed once surface water sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.3.4. *Open Channel Flow Measurement*

The volume rate of flow of water in open channels can be determined using the flow velocity and cross-sectional area and computing the discharge therefrom. The following steps shall be completed once surface water sampling is complete. Test methods will follow ASTM D3858:

1. Using an outstretched measuring tape, the field team shall set up a horizontal profile across the length of the surface water body where the surface water sample was collected.
2. Using a velocity flow meter (e.g., OTT® electromagnetic current meter), stream flow will be measured at various distances along the horizontal profile and at various depths within the stream channel (as defined in ASTM D3858 or as calculated in real-time by the field instrument).
3. The Sampling Team Leader shall download stored data from the flow meter.
4. Alternatively, if the water depth is too shallow or velocities to slow, the float-area method can be used to determine stream discharge.

5.4. Sampling Methods for Wet Sediment

Wet sediment is defined as material of organic or mineral origin that is transported by, suspended in, or deposited from water. This SOP applies to the collection of sediment samples only in surface water bodies such as streams, rivers, ditches, ponds, lagoons, and wetlands. Sediment samples will only be collected as discrete samples.

Sediment samples may be collected using a variety of methods and equipment depending on the depth of water above the sediment and the type of sediment being collected. Sediments may range from very soft to dense. Hand corer method is best used for firm sediment, soft sediment can be collected using the PVC tube method, and very soft sediment can be collected using a stainless steel scoop or PVC/HDPE disposable trowel. For sediment being collected from a boat in deeper water (e.g. a lake or pond) PONAR or Van Veen type grab samplers can be used.

Most core and grab sampling devices are constructed of stainless steel. Some core samplers include an HDPE sleeve inserted in the core barrel to retain the sample.

If collecting paired surface water/wet sediment samples the surface water sample shall be collected before the wet sediment sample, unless otherwise specified in the work plan. Surface water/wet sediment samples shall also be collected beginning at the location furthest from the contamination source (e.g., downstream) and working to most likely contaminated location to prevent cross contamination of samples by sediments suspended during sample collection.

5.4.1. Preparation for Wet Sediment Sampling

The following steps shall be completed when preparing for collection of wet sediment samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample, unless already specified in the work plan.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powder free nitrile gloves before each sampling event.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment utilized shall be decontaminated prior to use.
7. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.4.2. Collection of Wet Sediment Samples – Scoop/ Trowel Method

5.4.2.1. The scoop/trowel method is best suited for sample collection in shallower water with easy access to sediments. If wading to the sample location, care shall be taken to not stir up the sediment in the collection area. The preferred sampling tools for this method are stainless steel or disposable spoons, trowels, or scoops.

5.4.2.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect wet sediment samples using the scoop/trowel method:

1. If collecting the sample in a stream, stand downstream of the sample location. Insert the sampling tool 6-inches and gently scoop the sample out of the water.
2. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan/QAPP, the sample will be homogenized in a bowl prior to placement into sample containers.

3. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
4. Perform post-sampling activities (Section 5.4.6).

5.4.3. Collection of Wet Sediment Samples – Hand Corer Method

5.4.3.1. The hand corer method is best suited to the collection of firm sediment samples. The preferred sampling tool for this method is a stainless steel sediment corer. Using these in conjunction with disposable acetate sleeves is preferred because this facilitates removal of the sample from the corer, though this is not required.

5.4.3.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the hand corer method:

1. Gently push the corer into the sediment with a smooth continuous motion to a depth of approximately 6 inches (or as specified in the work plan/QAPP).
2. Twist the corer to detach the sample, and then withdraw the corer in a single smooth motion.
3. Remove the top of the corer and slowly decant excess water; however, take care to avoid the loss of collected fine sediment.
4. Remove the nosepiece and deposit the sample into a stainless-steel bowl.
5. Decant again if necessary, again taking care to avoid the loss of collected fine sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan/QAPP (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.4. Collection of Wet Sediment Samples – PVC Pipe Method

5.4.4.1. The PVC pipe method can be used for to collect samples of loose sediment where water is too deep for the scoop/trowel method to be used. The preferred sampling tool for this method is a 2-inch diameter PVC pipe with air-tight cap.

5.4.4.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the PVC pipe method:

1. Gently push the PVC tube into the sediment with a smooth continuous motion to a depth of approximately 6 inches (or as specified in the work plan/QAPP).
2. Tightly secure the cap on the end of the pipe extruding from the water. This forms an airtight seal that when the tube is gently pulled from the sediment, causes a vacuum to hold the sediment in place.
3. Once the tubing is out, tilt the bottom into an upright position. Slowly and carefully decant excess water; however, take care to avoid the loss of collected fine sediment.
4. Deposit the sample into a stainless-steel bowl.
5. Decant again if necessary, again taking care to avoid the loss of collected fine sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.5. Collection of Wet Sediment Samples – Grab Sampler Method

5.4.5.1. Sediment grab samplers (e.g., Ponar and Van Veen - see **Exhibit 1**) can be used to collect wet sediment samples in deeper waters where other methods are unsuitable. These samples are collected by sampling teams in boats or from locations adjacent to the waterbody (e.g., jetties or other platforms). Grab samplers most commonly use a set of spring-loaded jaws that snap shut when lowered into the sediment. They are often equipped with mesh screens and rubber flats that cover the jaws, limiting the wash out and loss of fine sediments from the sample. Sediment grab samplers can be attached to a winch and lowered through the water to the sediment on steel cables or they can be manually lowered using ropes or cables.

5.4.5.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the grab sampler method:

1. Position the grab sampler above the sample location.
2. Make sure the sampler is in locked position (jaws open) and slowly lower down until the sampler triggers. Take care to keep the line tight to prevent an early trigger of the jaw caused by a slack line. (The device will be retrieved and reset if the jaw mechanism triggers early.)
3. Slowly retrieve the sampler by retracting the line by hand or using a hand winch. The grab sampler shall be retrieved at a steady rate to minimize the loss of fine sediments from the sample.
4. Once out of the water, rotate the grab sampler slowly over the deck of the boat and deposit the sample into a large stainless-steel or disposable bowl.
5. If necessary, decant surface water from the bowl; however, take care to avoid the loss of collected sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel or disposable spoon, trowel, or scoop). If specified in the work plan (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.6. Post Sampling Activities for Sediment Sampling

The following steps shall be completed once wet sediment sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.5. Sampling Equipment Decontamination

5.5.1. PFAS-free Water

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water, as appropriate;
6. Final rinse with deionized or distilled water;
7. All rinsate should be collected in a sealed pail for disposal.
8. For surface water sampling, the flow-through cell and any non-dedicated equipment (i.e., interface probe) that comes into contact with water should be decontaminated between uses.

5.5.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

EXHIBIT 1

PONAR AND VAN VEEN GRAB SAMPLERS

Ponar Sediment Sampler

Van Veen Sediment Sampler

Exhibit 2: Surface Water Sampling Form (attached)

Exhibit 3: Sediment Sampling Form (attached)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a

PARSONS
SURFACE WATER SAMPLING RECORD

SITE NAME: __________
PROJECT NUMBER: __________
SAMPLING DATE / TIME: __________
WEATHER: __________
SAMPLERS: __________ of __________
__________ of __________

SAMPLE ID: __________
SAMPLING METHOD: __________
DEPTH OF SAMPLE: __________

DESCRIPTION OF SAMPLING POINT

LOCATION: __________
PHYSICAL APPEARANCE: __________
DEPTH TO BOTTOM: __________
DRAINAGE DIRECTION: __________
UPSTREAM FROM: __________
DOWNSTREAM FROM: __________

SAMPLE DESCRIPTION

COLOR: __________
ODOR: __________
SUSPENDED MATTER: __________
OTHER: __________

FIELD TESTS

TEMPERATURE:		REDOX:	
pH:		DISSOLVED O2:	
CONDUCTIVITY:		OTHER:	

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: __________
QA/QC SAMPLE ID: __________
ANALYZE QA/QC SAMPLES FOR: __________
DATE/TIME REFRIGERATED: __________
CHAIN OF CUSTODY NUMBER: __________
SHIPPED VIA: __________
LABORATORY: __________

COMMENTS / MISCELLANEOUS

PARSONS
SEDIMENT SAMPLING RECORD

SITE NAME: __________
PROJECT NUMBER: __________
SAMPLING DATE / TIME: __________
WEATHER: __________
SAMPLERS: __________ of __________
__________ of __________

SAMPLE ID: __________
SAMPLING METHOD: __________
DEPTH OF SAMPLE: __________

DESCRIPTION OF SAMPLING POINT

LOCATION: __________
PHYSICAL APPEARANCE: __________
DEPTH OF WATER: __________
DRAINAGE DIRECTION: __________
UPSTREAM FROM: __________
DOWNSTREAM FROM: __________

SAMPLE DESCRIPTION

TEXTURE: __________
COLOR: __________
ODOR: __________
OTHER: __________

FIELD TESTS

TEMPERATURE:		REDOX:	
pH:		DISSOLVED O2:	
CONDUCTIVITY:		OTHER:	

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: __________
QA/QC SAMPLE ID: __________
ANALYZE QA/QC SAMPLES FOR: __________
DATE/TIME REFRIGERATED: __________
CHAIN OF CUSTODY NUMBER: __________
SHIPPED VIA: __________
LABORATORY: __________

COMMENTS / MISCELLANEOUS

Procedure # **SOP ENV-05**	**Title:** **MONITORING WELL DEVELOPMENT**	**Revision #** **00**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** n/a

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when developing monitoring wells prior to groundwater sample collection. Proper development procedures are necessary to assure the quality and integrity of the samples. If the wells are to be sampled for PFAS or suspected to be sampled in the future for PFAS, the **SOP ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Site Manager	Responsible for ensuring that the work is performed in conformance with this procedure and that the field personnel understand and perform activities in accordance with this SOP.
Field Geologist or Environmental Scientist	Responsible for continuous monitoring of development activities, collecting water quality data and determining that the development is complete.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Development Tools	PFAS free submersible pump, HDPE tubing, and surge block/swabbing tool.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.
GPS Unit	To record well coordinates.
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Water Level Indicator	To measure depth to static water level and total depth of well.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Field Geologist or designee shall complete the attached well development log (**Exhibit 1**) or project-specific form. Information to document includes:

1. Total depth of well and the static water level from top of the well casing, before and immediately after pumping/development.
2. Method used for well development including description (size, type, make, etc.) of all equipment used during development.
3. Time spent developing the wells by each method and typical pumping rate(s).
4. Volume and physical characteristics of the purged water including written descriptions of water clarity, color, particulates, and odor.
5. Readings of turbidity, pH, conductivity, and temperature taken before, during, and after well development.

5.2.1.2. The Field Geologist or designee shall record daily activities, instrument bump check and/or calibration activities, groundwater parameters, and any other notable details in the Field Sampling Form and/or project specific forms. The Field Geologist or designee shall also record the sample locations using a GPS unit (e.g., Trimble® GeoXT™ or similar) and document sample coordinates in the Field Sampling Form. The Field Geologist or designee shall record other information as specified in the approved work plan/QAPP.

5.3. Well Development

Monitoring wells are developed to remove or minimize the near-well-bore formation damage caused by drilling and the addition of well drilling fluids, and to remove fines from the filter pack. New wells shall not be developed before 48 hours after completion when a cement bentonite grout is used to seal the annular space, but shall be developed within seven days of well installation or as otherwise specified in the approved work plan/QAPP. Following development, the monitoring wells will be allowed to equilibrate for a minimum of 72 hours prior to groundwater sampling.

5.3.1. Preparation for Well Development

The following steps shall be completed when preparing for well development:

1. The Field Geologist shall review the applicable section(s) of the work plan to confirm the details of the activity to be conducted.
2. The Field Team shall don clean gloves before each sample.
3. The Field Team shall calibrate all necessary equipment and document the calibration(s) on an equipment calibration form.

4. The Field Team shall arrange the required sampling equipment for convenient use. If onsite decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the wellhead. All equipment entering the well will be decontaminated.

5.3.2. Well Development

The following steps shall be completed when during well development:

1. Open well and collect PID reading (if required in approved work plan/QAPP). Measure depth to static water level and total depth of the well using an electronic water level meter. Record these measurements into the project specific log or electronic form or application.
2. Calculate three well volumes of standing water in the well bore using the following:
   - (a) **4-inch diameter wells**: well bore water column height (ft.) x 0.65 x 3 (volumes) = gallons of water to be removed.
   - (b) **2-inch diameter wells**: well bore water column height (ft.) x 0.16 x 3 (volumes) = gallons of water to be removed.
   - (c) **Volume of water in the filter pack**: 3 volumes x well bore column water height from the top of sand pack to the bottom of screen (ft.) x (R1-R2) x 3.14 x 0.3, where R1 is the borehole radius and R2 is the well screen radius. This assumes 30 percent porosity.
   - (d) **If water was added during the drilling process**: 3 times the volume of water during drilling within the vertical interval that starts at the top of the sand pack and ends at the bottom of the screen should be removed from the well during development.
   - (e) **If the filter pack was installed as a slurry**: 3 times the amount of water used in the slurry should be removed from the well.
   - (f) All calculations shall be recorded on the well development log.
3. If light non-aqueous phase liquids (LNAPLs) are suspected, use a clear bailer to collect water from the surface of the well. If the well contains LNAPL, measure and record it using an oil-water interface meter. The monitoring well will not be developed if separate phase liquids are present.
4. Begin development by pumping/bailing and swabbing (using a loose fitting surge block) to surge the water to pull sediment into the well.
5. If excessive turbidity is expected, use a bottom-opening bailer to remove water and to reduce the turbidity level. Once turbidity level has been lowered to an appropriate level begin pumping using a submersible pump.
6. Start the pumping from the bottom of the well, but periodically move it up and down within the screened zone to ensure adequate development of the entire filter pack. Keep the pumping rate constant and record and collect drawdown measurements.
7. Record water quality parameters (temperature, pH, conductivity, and turbidity or as specified the work plan/QAPP) at the start of the development and after every borehole volume removed from the well.
8. Continue development until the water is clear (turbidity ≤50 NTUs) or three consecutive turbidity readings are within 10% and the other field parameters (temperature, pH, and conductivity) have stabilized (pH ±0.2 units, temperature± 1° Centigrade, and conductivity 10%).
   - (a) If the well goes dry during development, it will be allowed to recharge to 80% of initial water level and pumped or bailed again. The well will be considered developed after pumping the well dry three times.
9. If field parameters have not stabilized after five borehole volumes of water have been removed, the Field Geologist will contact the Site Manager to determine further action.

10. Record the final water level and note the drawdown rate and pumping rate used. If static water level not recovered to the initial water level, another static water level measurement should be collected in 24 hours.
11. Development water will be discharged to the ground surface unless contamination of the groundwater is known to be present, in which case alternate disposal methods will be considered. Well development water should be directed away from surface water bodies and allowed to infiltrate back into the ground unless other techniques are stipulated on a site-specific basis.

5.3.3. Post Development Activities

The following steps shall be completed once well development is complete:

1. The Field Team Leader or designee shall close and lock the well.
2. The Field Team Leader or designee shall properly store and label purge water, if necessary, and record the total volume removed from the well during development.
3. The Field Team Leader or designee shall decontaminate reusable equipment following procedures outlined in Section 5.4 or as specified in the approved work plan.

5.4. Sampling Equipment Decontamination

5.4.1. PFAS-free Water

5.4.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.4.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.4.2. Decontamination Procedures

5.4.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.4.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;

3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. For surface water sampling, the flow-through cell and any non-dedicated equipment (i.e. interface probe) that comes into contact with water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e. those that foam during shaking) will be cleaned as per above in triplicate.

5.4.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.

7. EXHIBITS

Exhibit 1: Well Development Log (attached)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a

WELL DEVELOPMENT LOG

Well ID:

Date ____________ Field Personnel ____________ Weather ____________
Site Name ____________ Contractor ____________ Project No. ____________
Site Location ____________ Evacuation Method ____________ ____________

Well information:

Depth to Bottom (Initial) * ____________ ft. Date(s) Installed ____________ Date(s) Developed ____________
Depth to Bottom (Final)* ____________ ft. Driller ____________ Development Time Start:
Depth to Water (Initial)* ____________ ft. Well Diameter ____________ in. Stop:
Depth to Water (Final)* ____________ ft. Casing Volume ____________ gal. Total:

* Measuring point ____________ Pump setting* (intake) ____________

Well Volumes	Volume of Water Removed (Gallons)	Temperature ^{o}C	pH s.u	Conductivity mS/cm	Turbidity (NTU)	Approximate Flow Rate (gal/min)	Depth to Water (ft.)	Appearance of Water
Start								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Development Water Characteristics:

Total volume of Development water removed: ____________

Physical appearance at start
Color ____________
Odor ____________
Sheen/Free Product ____________

Physical appearance at end
Color ____________
Odor ____________
Sheen/Free Product ____________

NOTES: ____________

Geologist Signature:

Monitoring Well Development Form

Procedure # SOP ENV-06	Title: SOIL BORINGS AND MONITORING WELL INSTALLATION	Revision # 00
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: n/a

1. PURPOSE

This standard operating procedure (SOP) establishes guidelines and procedures for use by field personnel in advancing borings using direct push, hollow stem auger, and rotosonic drilling and for the activities performed during evaluation of the drilled soil (core). The SOP also defines the requirements and procedures for the installation of permanent groundwater monitoring wells that can provide representative groundwater samples. The procedures listed in this SOP can be followed after any borehole method (direct push, sonic, auger, etc.) as specified in the approved Work Plan or QAPP. Proper execution of these activities is necessary to ensure that each boring is adequately evaluated and to assure the quality and integrity of all samples. When installing borings or wells that will be used to sample PFAS compounds or there is the potential to sample PFAS compounds, SOP ENV-01 PFAS Sampling Guidance provides an in-depth discussion of prohibited and approved materials and should be reviewed and used in conjunction with this SOP.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Site Manager	Responsible for ensuring that the work is performed in conformance with this procedure and that the field personnel understand and perform activities in accordance with this SOP.
Field Geologist	Responsible for oversight of drilling activities and for logging soils encountered during advancement of the borehole. The Field Geologist is also responsible for continual inspection and documentation of well construction process including materials to be used, continuous construction activities (insure targeted annular material intervals and well screen locations are achieved), and oversight of the wells surface completion as per the work plan specifications.
Drilling Contractor	The drilling contractor is responsible for ensuring that field personnel are properly trained in drilling techniques and construction of groundwater wells.

3. RELEVANT DEFINITIONS

Term	Definition
Tagging	When the driller uses a weighted tape measure to continually measure the well materials (e.g., filter pack, bentonite, grout) as it is poured to ensure the correct amount of materials are used and to keep the materials from bridging during the construction.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Well Construction Materials	PVC riser and slotted screen, filter pack, sealing and grouting materials, surface pad construction material.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.

Equipment	Brief Description of Function and Purpose
Logging Instruments	Borehole logging and well construction forms, hand lens, USCS classification card, Munsell color chart, digital camera, razor knife, tape measure, and HDPE plastic or cotton sheeting.
GPS Unit	To record coordinates of borehole.
Water Level Indicator	To measure depth to static water level and total depth of well.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products to be used will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Boring Methods

5.2.1. Documentation

The Field Geologist or designee shall record the description of the cores in the Drilling Log Form (**Exhibit 1**) or equivalent electronic boring log per American Society for Testing and Materials (ASTM) standard D 2488 and will also include field screening values for VOCs (if required), drilling time and the footage for each core run, a graphic log, and drill rig specifications. Well construction details will be documented in the Well Construction Form (**Exhibit 2**) or equivalent electronic well construction log. The Field Geologist or designee shall record daily activities including equipment calibration, samples collected (if required per work plan), and any other notable details on the Field Sampling Forms and/or project specific forms.

5.3. Soil Boring Installation

5.3.1. Preparatory Steps for Soil Borings

The following steps shall be completed when preparing for collection of surface soil samples:

1. The Field Geologist shall review the applicable section(s) of the work plan to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Field Geologist shall confirm that the Drilling Contractor is complying with **SOP ENV 01 PFAS Sampling Guidance**, as applicable.
3. The Field Geologist will obtain any necessary excavation permits and, if necessary, contact a local underground utility locating service to perform a utility clearance for all subsurface sample locations.
4. The Field Geologist will navigate to the boring location, make initial observations, and complete the required documentation.
5. The Field Geologist or designee shall record the description of the cores per modified Burmister System or ASTM standards D2487 (USCS)/D2488 in the Drilling Log Form and will also include field screening values for VOCs (if required), drilling time and the footage for each core run, a graphic log, and drill rig specifications.

Well construction details will be documented in the Well Construction Form portion of the electronic log or equivalent paper form. The Field Geologist or designee shall record daily activities including equipment calibration, samples collected (if required per work plan), and any other notable details in the Drilling Log Form and/or project specific forms.

6. The Sample Team shall don clean, powderfree nitrile gloves as per the **SOP ENV 01 PFAS Sampling Guidance.**
7. The Sample Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. The team shall prepare an area for logging and related activities. HDPE plastic sheeting or a clean, washed cotton sheet shall be laid out to set the drill core on. The area should be large enough for the full length of the boring but should also not intrude on the drilling activities.
8. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the boring. All equipment entering the well will be decontaminated prior to advancement and will be free of any petroleum-based materials including fuels, oils, grease, or solvents. With the exception of Hole Products - Thread Armour Thread Joint Compound, no thread lubricants or drilling fluids are permitted without prior approval of the Contractor.
9. The Sample Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.3.2. Soil Boring Operations

Following the preparatory actions (see above), the Field Team and driller shall complete the following steps:

1. As the driller advances the borehole, soil cores will be collected continuously from the ground surface to the bottom of the boring using the selected drilling method (as specified in the work plan/QAPP) operated by an appropriately licensed well driller.
2. Cores will be collected in 2-foot splits spoons (HSA), 5- or 10-foot runs (e.g., sonic, to ensure cores are more representative of the actual formation) or as specified in the approved work plan/QAPP.
3. Water and other drilling fluids should not be used while drilling. If fluids must be introduced into the borehole (e.g., rock coring) their use must be approved by the Site Manager. Water must be from a site approved water source and the amount used on each location will be recorded for well development purposes later.
4. When a core is completed, the drill crew will label the depths on the bottom end of each core section.
5. Each core section will be screened by the field geologist using a PID and recorded on the borehole log (if required per the approved work plan/QAPP).
6. The Field Geologist will perform geologic logging of the core as per modified Burmister System or ASTM standards D2487 (USCS)/D2488.
7. The Field Geologist will also document additional details as described in Section 5.2.1.
8. If samples are required, they will be collected and handled in accordance with **SOP ENV-02, Soil Sampling**, or as otherwise specified in the approved work plan/QAPP.

5.3.3. Bedrock Operations

Bedrock descriptions are dependent on the classification of the rock types present (igneous, sedimentary, or metamorphic). The rock materials retrieved during coring operations will be described on the Bedrock Core Form (Exhibit 3), as applicable, using the following parameters:

1. Color – The overall color of the rock, not a particular mineral;
2. Grain Size – The size of crystals or clasts making up the rock;
3. Texture – This applies only to igneous and some metamorphic rocks, and pertains to whether the rock is crystalline or glassy, equigranular, or porphyritic in nature;
4. Major Minerals – Applies to the identifiable minerals present as necessary as modifiers to the rock type, i.e., mica Schist, feldspathic Granite, quartz-mica Gneiss;
5. Rock Type – Granite, Gneiss, Amphibolite, Argillite, Sandstone, Limestone, Greywacke, etc;
6. Bedding and/or Foliation – Describes lineations within the rock. i.e. massive, poorly foliated, well bedded, cross-bedded, etc. The description in the log will include at least an approximate angle of any foliation or bedding, if present;
7. Continuity – Describes joints and fractures, or the lack of, in the rock, it may also describe cross-cutting veins of materials different from the primary rock type. Fracture, vein and joint angles will be referenced to the foliation. Approximations will be made based on core recovery, weathering, fracture density, etc., regarding the openness of any fracture or joint;
8. Competence – Describes the weathering features of the rock. Weathering features, combined with rock type and continuity, will give the overall hardness of the rock; and
9. Other – Describes secondary minerals, folding features, etc.

Both the overall core length as well as individual pieces of core (greater than 4 inches in length) will be measured. This data is used for the calculation of Rock Quality Designation (RQD) factors and for the interpretation of fracture spacing (per ASTM D6032). Core recovery will be recorded in two manners: as the ratio of core recovered to length of core run; and, as a percentage recovery. (i.e., 3.5 feet of 5.0 feet cored, 70%). The RQD will be calculated by: 1) summing the length of all the pieces greater than or equal to 4 inches in length recovered in the core barrel; and then, 2) by dividing this sum by the cored interval length. The resulting value is expressed as a percent and is recorded on the Bedrock Core Form (Exhibit 3).

Every reasonable attempt will be made to recover the correct orientation of the core samples. Each core will be measured for recovery, and an attempt to identify any missing sections will be made with the driller. Where the core is broken and fragmented, an attempt to reposition the correct orientation of the segments will be made before marking the core. While still in the core barrel, the core sample will be marked with a pair of differently colored (red and black) ceramic marking pencils in a fashion that results in a continuous parallel line down the length of the core. The red marking will be on the right side of the parallel lines when viewing the core from top to bottom. The coloration scheme will allow any piece of core to be correctly oriented in the vertical plane (red on right side). Marked rock cores will be stored in standard core boxes, and missing sections of the core replaced with spacers. Both the core box base and core top will be appropriately labeled with the well identification, core depth, date, and geologic formation origin. Additionally, the core box base will be sufficiently labeled so the top and bottom of the core are clearly evident. Depths for each 2-foot broken interval should be written on the core box base in a relative position that corresponds with the dividers. Spacers will be labeled with the missing interval or sampling information and appropriately positioned within the retrieved core.

5.3.4. Post Drilling Activities

The following steps shall be completed once the boring and any associated soil sample collection is complete:

1. The Sample Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.

2. The Sample Team Leader or designee shall record the sample location GPS coordinates.
3. If a well is to be installed, the Field Team shall follow the procedures described in Section 5.4. If the boring is to be abandoned the following procedures shall be completed:
    (a) The casing will be filled with grout or bentonite grout slurry (as specified in the work plan/QAPP). The grout will extend from the bottom of the borehole (total depth) to ground surface.
    (b) The grout will be a bentonite grout slurry mixed according to the specifications of the manufacturer (typically 14 gallons of water to a 50 pound bag of bentonite powder will produce 2.2 cubic feet of 30% solids grout slurry) or as specified in the work plan/QAPP.
    (c) The grout slurry will be pumped through a tremie pipe to the bottom of the open annulus until undiluted grout is returned to the surface to ensure the seal is complete; and
    (d) Additional slurry or chips will be added to the annulus the following day (to surface) should the grout column settle overnight.
4. The Sample Team will decontaminate reusable sampling equipment as described in Section 5.5 or as otherwise specified in the approved work plan/QAPP.
5. The Sample Team Leader or designee shall complete the CoC and other required documentation and prepare the sample for shipment following procedures outlined in SOP ENV-02, Soil Sampling.

5.4. Well Installation

5.4.1.1. Groundwater monitoring wells should be constructed with materials that will not interfere with sample quality either by contributing contaminants or by sorbing contaminants already present. Further, construction materials must be compatible with (i.e., not degraded by) contaminants present in soil or groundwater (i.e., PFAS). Materials should follow the PFAS guidance provided in **SOP ENV-01, PFAS Sampling Guidance.**

5.4.1.2. Groundwater monitoring wells may serve as preferential pathways for contaminant migration between aquifers or from the surface to the subsurface if they are not constructed properly. Construction procedures and standards must ensure that neither passive nor active introduction of contaminants can occur. Properly installed hydraulic seals and locking well covers (or site security) reduce the potential for introduction of contaminants to monitoring wells. All monitoring wells will be constructed to meet: State requirements; USACE requirements; the United States Environmental Protection Agency (USEPA) RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD); and Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. General procedures of ASTM D5092 are provided below.

5.4.1.3. Well depths and screen placements will depend on the site-specific geologic conditions. These specifications will be provided in the site-specific work plan.

5.4.2. Preparatory Steps for Well Installation

The following general steps shall be completed when preparing for well installation:

1. The Field Geologist shall review the applicable section(s) of the work plan/QAPP and **SOP ENV-01 PFAS Sampling Guidance** to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Field Team shall don clean, powderless nitrile gloves before each sampling event.
3. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the boring. All equipment entering the well will be decontaminated prior to

advancement and will be PFAS-free and free of any petroleum-based materials including fuels, oils, grease, or solvents.

4. The Field Team shall calibrate required equipment and document the calibration on an equipment calibration form.
5. The Field Team shall verify the correct quantity and type of well construction materials are onsite including:

    (a) New threaded flush-jointed riser pipe and slotted screen of an approved material (at a minimum schedule 40 polyvinyl chloride [PVC] or as specified in the work plan/QAPP, 4-inch or 2-inch diameter) in 5- and 10-foot lengths. (Note: no Teflon tape, solvents, glues or lubricants are permitted.) Wells with total depths greater than 100 feet below ground surface will need to be evaluated to determine what schedule of PVC is appropriate based on-site conditions.
    (b) Stainless steel or PVC well centralizers, as necessary (typically every 20-30 feet).
    (c) Filter pack material (quartz sand) larger than the slot size of the screen (0.010-inch or 0.020-inch as determined by the work plan/QAPP). The filter pack shall be certified free of contaminants by the vendor or contractor.
    (d) Pre-packed well screens are recommended if installing wells with direct push.
    (e) If the slot size is not specified in the work plan or known from previous work at the site, 0.010-inch slot will be used to be conservative.
    (f) Well seal materials (bentonite pellets, chips)
    (g) Well grouting materials (bentonite or cement slurry) and tremie pipe
    (h) Well surface pad materials (Portland cement [ASTM Types II or V])
    (i) Steel protective casing with locking cap (stand up or flush mount as specified in the work plan/QAPP).
    (j) All PVC will conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System)

5.4.3. *Single Well Installation Operations (Permanent, Overburden Monitoring Well)*

Following the preparatory actions (see above), the Field Team and driller shall complete the following steps:

1. The drill crew will cap the bottom of a new 10-foot section of PVC screen with a flush, threaded PVC cap. The screen will then be installed cap first with the full length below the water table. If LNAPL is anticipated the screen will be installed with approximately 3 feet of the screen above the static water level and the remaining seven feet below the water table (or as specified in the work plan/QAPP). The well screen will be a 0.010-inch or 0.020-inch slotted depending on the soil formation.
2. The screen will be lowered using threaded flush-jointed riser attached to the top of the screen. The riser will extend from the top of the screen to ground surface or as specified in the work plan.
3. A loose-fitting PVC cap will be used to cover the top of the well riser and will allow equilibration of the groundwater with atmospheric pressure.
4. For wells deeper than 20ft, at least one centralizer will be installed just above the well screen to keep it centered during well construction.
5. Once the screen, riser and centralizer are in place, the drill crew will tremie pour filter pack material using a decontaminated, flush threaded, 1-in. [25-mm] minimum internal diameter tremie pipe. Alternatively, the filter pack may be added directly between the riser pipe and the auger or drive/temporary casing and the top of the filter pack located using a tamper or a weighted line. The borehole should be at least 2 inches greater than the OD of the well casing and a calculated volume of the filter pack annular space and volume of the emplaces sand shall be recorded.
6. The primary filter pack will extend from a minimum of 6-inches below the screen to 20% of the screen length or 2 feet above the above the top of the screen, unless conditions warrant less.

   (a) The filter pack will not cross two water-bearing units.
   (b) The volume of filter pack required to fill the annular space will be calculated and compared to the volume installed. This information will be recorded in the electronic boring log.
   (c) Pre-packed well screens are recommended if installing wells with direct push.

7. A finer grained "choke" sand (100% passing a No. 30 sieve and less than 2% passing the No. 200 sieve) approximately 1-2 feet thick (as conditions warrant) will be installed between the top of the sand pack and the bentonite seal described below.
8. The drill crew will continuously tag the filter pack as it is being installed; any bridging will be broken prior to proceeding. The filter pack will then be surged prior to placing the seal. If the difference of volume of filter pack calculated and filter pack used is significant the Site Manager will be notified.
9. Once the filter pack is complete a bentonite seal will be installed.
10. The bentonite seal will be a minimum thickness of 3 feet placed above the filter pack between the filter pack and the grout slurry.

   (a) If the seal is above the water table, the bentonite will be pre-hydrated and installed in 6-inch lifts; if it is below the water table, sealed bentonite chips will be used. The driller will also continuously tag the bentonite as it is being installed to prevent bridging.
   (b) In wells designed to monitor possible contamination in firm bedrock, the bottom of the bentonite seal should be located at least 3 feet below the top of firm bedrock, as determined by drilling.
   (c) The remaining annulus will be back filled with bentonite grout slurry from the top of the bentonite seal to 3 feet bgs using a tremie pipe.
   (d) Additional chips or slurry will be added the next day if the grout column settles overnight prior to installation of the surface pad. The grout will be allowed to set before wells are developed.

11. The drill crew will complete the well by installing a stick-up or flush mount protective casing into a thick concrete surface pad.

   (a) For above grade completions, the well heads will extend approximately 3-foot above grade and will be fitted with a protective casing with a lockable lid. An approximate 2-foot diameter concrete well pad will be installed around the protective casing. The well pad will be sloped away from the protective casing to shed surface water away from the well head. The well identification will be clearly visible on the inside and outside of the lid of the protective casing. A drain hole will be installed at the base of the protective casing and vent hole will also be located at the top of the protective casing. The annulus of the protective casing will be filled with gravel and a locking well cap installed at the top of the protective casing.
   (b) Well heads in parking lots, roadways, or other areas accessed by vehicular traffic will be completed flush with grade. Flush-mount curb boxes will be fitted over the well head and will be flush to the surrounding grade. The curb box will be set in an approximate 2-foot diameter concrete pad. A locking J-plug will be installed on top of the well.

12. Protective bollards can be installed at each corner of the pad for protection and easier locating of the well if specified in the work plan/QAPP.
13. The top of the well casing and ground surface will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum. The measuring point on all wells will be on the innermost PVC casing.

5.4.4. Single Well Installation Operations (Permanent, Bedrock Monitoring Well)

5.4.4.1. Bedrock monitoring wells will be installed using a combination of hollow stem auger and rock coring, sonic, air rotary, or fluid rotary drilling methods as specified in the work plan/QAPP. Initially, borings will be advanced following the procedures in Sections 5.3.1 and 5.3.2.

5.4.4.2. Once bedrock is encountered, a 6-inch "rock socket" will be installed into the competent rock. If rock cores are to be collected, the bedrock will be cored using NX or HQ core barrels. Information to be recorded during the collection of core samples are indicated on the Core Log provided in **Exhibit 3** or equivalent electronic boring log form.

5.4.4.3. Well installation will follow the procedures outlined in Sections 5.4.2 and 5.4.3.

5.4.5. Nested Well Construction

5.4.5.1. Nested wells are multilevel monitoring wells in which multiple tubes or casings are installed at different depths within the same borehole (**Exhibit 4**). The screens are set at different depths and are separated by seals.

5.4.5.2. The preparatory steps outlined in Section 5.4.2 will be followed along with the following steps if installing nested monitoring wells:

1. In order to measure depth-discrete hydraulic heads and collect depth-discrete groundwater samples, each well screen in the nested well should be no more than 2 or 3 feet in length.
2. The primary filter pack surrounding the lower screened interval should extend a minimum of 6 inches below the bottom of the screen and 20% of the screen length or 2 feet above the top of the screen, whichever is greater.
3. A finer grained "choke" sand (100% passing a No. 30 sieve and less than 2% passing the No. 200 sieve) approximately 1-2 feet thick (as conditions warrant) will be installed between the primary filter pack and the bentonite seal.
4. A bentonite chip seal will be placed above the "choke" sand to a foot below the bottom of the upper screened interval. Sealed bentonite chips will be used for the seal that is below the water table.
5. As described in Section 5.4.3, a filter pack and choke sand will be installed around the screened interval. This process will be repeated if there is more than two screened intervals else the bentonite seal and completions described in Section 5.4.3, Items 10-13 will be followed.

5.4.6. Well Clusters

A well cluster or multiple set is a group of single wells, each installed at different levels in separate boreholes (**Exhibit 4**). If dictated by the project requirements, the screened interval of each well in the cluster will be no more than 2 or 3 feet long so that the head measurements and groundwater samples from each well will be depth discrete and not composited over a larger part of the aquifer. Otherwise the screen interval will be as dictated in the work plan/QAPP. Construction of wells in clusters will be as above in Sections 5.4.2 and 5.4.3.

5.4.7. Post Well Installation Activities

The following steps shall be performed once well installation is complete:

1. The Field Geologist or designee will confirm activities were completed as specified in the approved work plan/QAPP.
2. The Field Geologist or designee shall record the well location with GPS coordinates.
3. The Field Geologist shall complete the Well Construction Form (Exhibit 2) for the well and/or forms specified in the approved work plan.
4. The Field Geologist or designee shall measure and record a final static water level and depth to bottom.
5. The Field Geologist or designee will decontaminate reusable sampling equipment as described in Section 5.5 or as otherwise specified in the approved work plan/QAPP.

5.5. Sampling Equipment Decontamination

5.5.1. PFAS-free Water

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2017). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e. those that foam during shaking) will be cleaned as per above in triplicate.

5.5.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and

allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.5.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ASTM D2487-17, 2017. Standard Practice for Classification of Soils for Engineering Purposed (Unified Soil Classification System), ASTM International.	The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.
ASTM D2488-17, 2017. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM International.	The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties. The descriptions are based on visual-manual procedures conducted in the field.
ASTM D5092/D5092M – 16, 2016 Standard Practice for Design and Installation of Groundwater Monitoring Wells	This practice describes a methodology for designing and installing conventional (screened and filter-packed) groundwater monitoring wells.
ASTM D6032/D6032M – 17; Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core	This test method covers the determination of the rock quality designation (RQD) as a standard parameter in drill core logging of a core sample in addition to the commonly obtained core recovery value
ITRC, 2018. PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
United States Environmental Protection Agency (USEPA), 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD).	EPA Guidance for proper installation of groundwater wells while safeguarding confined and unconfined aquifers integrity.
USEPA, 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.	The Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells is intended to assist personnel involved with the design, construction, and installation of ground-water monitoring wells.
USACE, 1998. Monitoring Well Design, Installation and Documentation at Hazardous, Toxic and Radioactive Waste Sites. Engineer Manual (EM) 1110-1-4000.	This Engineer Manual (EM) provides the minimum elements for consideration in the design, installation, and documentation of monitoring well placement (and other geotechnical activities) at projects known or suspected to contain chemically hazardous, toxic, and/or radioactive waste.

7. EXHIBITS

Exhibit 1:	Drilling Log Form (Attached)
Exhibit 2:	Well Construction Form (Attached)

Exhibit 3:	Coring Log Form (Attached)
Exhibit 4:	Nested and Cluster Monitoring Wells (shown below)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	02/25/2020	Initial Release	n/a

OVERBURDEN BORING REPORT

PARSONS | **CLIENT:** | **BORING NO.:**

PROJECT :
SWMU # (AREA) :
SOP NO.:

START DATE:
FINISH DATE:
CONTRACTOR:
DRILLER:
INSPECTOR:
CHECKED BY:
CHECK DATE:
BORING CONVERTED TO MW? Y N

DRILLING SUMMARY

DRILLING METHOD	HOLE DIA.(ft)	DEPTH INTERVAL (ft)	SAMPLER		HAMMER	
			SIZE	TYPE	TYPE	WT/FALL

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT TYPE	DETECTOR TYPE/ENERGY	RANGE	BACKGROUND			CALIBRATION		WEATHER (TEMP., WIND, ETC.)
			READING	TIME	DATE	TIME	DATE	

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE

DATE			
SOIL AMOUNT : (fraction of drum)			
DRUM #, LOCATION:			

COMMENTS:

SAMPLES TAKEN:

SAMPLES
DUPLICATES
MS/MSD
MRD

PAGE OF

OVERBURDEN BORING REPORT

PARSONS	**CLIENT:**	**BORING NO.:**

COMMENTS:

DRILLER: ______________________

INSPECTOR: ______________________

DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENETRATION RANGE (FEET)	RECOVERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			

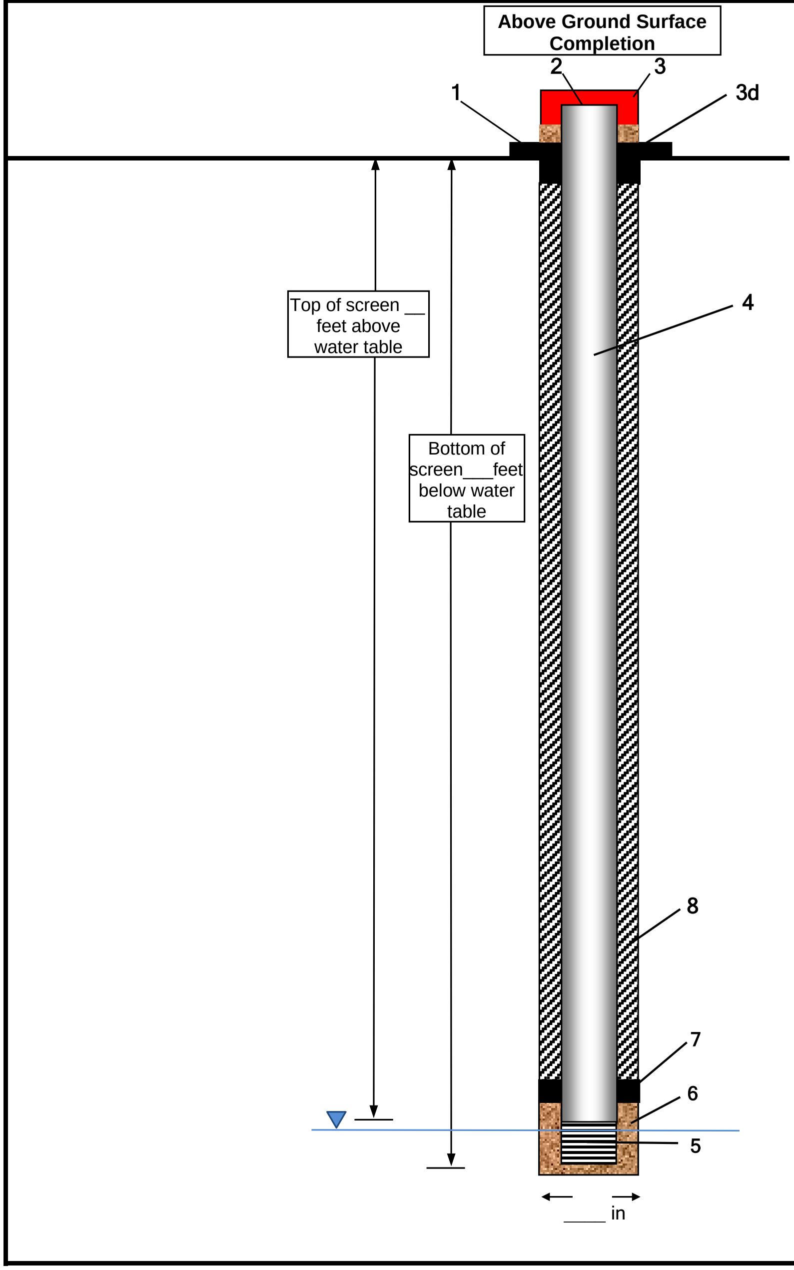
CONTRACTOR PARSONS	WELL NUMBER	FIGURE 1

Project Name

Location Groundwater Monitoring Well

WELL INSTALLATION DATA RECORD

PROJECT : LOCATION :
DRILLING SUBCONTRACTOR : DRILLER:
DRILLING METHOD / EQUIPMENT: HELPERS:
WATER LEVEL: START: END: GEOLOGIST:



DRAWING NOT TO SCALE

1- Ground elevation at well :

2- Measuring point elevation :

3- Surface completion casing :
- a) type / diameter
- b) height above ground
- c) length below ground
- d) type of sealant
- e) protective bollards

4- Well casing :
- a) type / diameter
- b) height above ground
- c) length below ground
- d) type / quantity of sealant
- e) well centralizers

5- Well screen :
- a) type / diameter
- b) slot size
- c) length

6- Well screen filter pack :
- a) type
- b) length

7- Bentonite seal :
- a) method of placement
- b) type
- c) length

8- Grout :
- a) type
- b) grout mix
- c) method of placement
- d) depth (feet bgs)

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS	CLIENT:	WELL #:

PROJECT: ____________________

LOCATION: ____________________

PROJECT NO: ____________________

INSPECTOR: ____________________

CHECKED BY: ____________________

DRILLING CONTRACTOR: ____________________

DRILLER: ____________________

DRILLING COMPLETED: ____________________

BORING DEPTH: ____________________

DRILLING METHOD(S): ____________________

BORING DIAMETER(S): ____________________

ASSOCIATED SWMU/AOC: ____________________

POW DEPTH: ____________________

INSTALLATION STARTED: ____________________

INSTALLATION COMPLETED: ____________________

SURFACE COMPLETION DATE: ____________________

COMPLETION CONTRACTOR/CREW: ____________________

BEDROCK CONFIRMED (Y/N?) ____________________

ESTIMATED GROUND ELEVATION: ____________________

PROTECTIVE SURFACE CASING:

DIAMETER: __________ LENGTH: __________ TOR: __________

RISER:

TOC: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________

SCREEN:

TSC: __________ TYPE: __________ DIAMETER: __________ LENGTH: __________ SLOT SIZE: __________

POINT OF WELL: (SILT SUMP)

YPE: __________ BSC: __________ POW: __________

GROUT:

TG: __________ TYPE: __________ LENGTH: __________

SEAL: TBS: __________ TYPE: __________ LENGTH: __________

SAND PACK: TSP: __________ TYPE: __________ LENGTH: __________

SURFACE COLLAR:

TYPE: __________ RADIUS: __________ THICKNESS CENTER: __________ THICKNESS EDGE: __________

CENTRALIZER DEPTHS

DEPTH 1: __________ DEPTH 2: __________ DEPTH 3: __________ DEPTH 4: __________

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

CORE BORING REPORT

PARSONS	**CLIENT:**	**BORING #:**

PROJECT:

SWMU # (AREA) :

SOP NO.:

DATE CORING STARTED:

DATE CORING COMPLETED:

CONTRACTOR:

DRILLER:

INSPECTOR:

GEOLOGIST:

CHECKED BY:

DATE CHECKED:

TOTAL FOOTAGE CORED:

OVERBURDEN THICKNESS:

GALLONS OF WATER USED

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME

COMMENTS:

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

INVESTIGATION DERIVED WASTE :

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #, LOCATION			

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS | **CLIENT: USACOE** | **WELL #: MW**

PROJECT: ____________
SWMU # (AREA): ____________
SOP NO.: ____________
PROJECT NO: ____________
INSPECTOR: ____________
CHECKED BY: ____________

DRILLING CONTRACTOR: ____________
DRILLER: ____________
DRILLING COMPLETED: ____________
BORING DEPTH: ____________
DRILLING METHOD(S): ____________
BORING DIAMETER(S): ____________
POW DEPTH (ft) : ____________
INSTALLATION STARTED: ____________
INSTALLATION COMPLETED: ____________
SURFACE COMPLETION DATE: ____________
COMPLETION CONTRACTOR/CREW: ____________
BEDROCK CONFIRMED (Y/N?) ____________

PROTECTIVE SURFACE CASING
DIAMETER (ft): ____________ LENGTH (ft): ____________

RISER
TYPE: ____________ TR (ft): ____________
DIAMETER(in): ____________ LENGTH (ft): ____________

SURFACE COLLAR
TYPE: ____________ RADIUS (ft): ____________
THICKNESS OF CENTER (ft): ____________ THICKNESS OF EDGE (in): ____________

SCREEN
TYPE: ____________ TSC (ft): ____________
DIAMETER (in): ____________ SLOT SIZE: ____________ LENGTH (ft): ____________

OUTER CASING
TYPE: ____________ TC (ft): ____________
DIAMETER (in): ____________ POC (ft): ____________ LENGTH (ft): ____________

POINT OF WELL (SILT SUMP)
TYPE: ____________ BSC (ft): ____________ POW(ft): ____________

GROUT
TYPE: ____________ TG (ft): ____________ LENGTH (ft): ____________

SEAL
TYPE: ____________ TBS (ft): ____________ LENGTH (ft): ____________

SAND PACK
FINE SAND TYPE: ____________ TSP (ft): ____________ LENGTH (ft): ____________
COARSE SAND TYPE: ____________ TSP (ft): ____________ LENGTH (ft): ____________

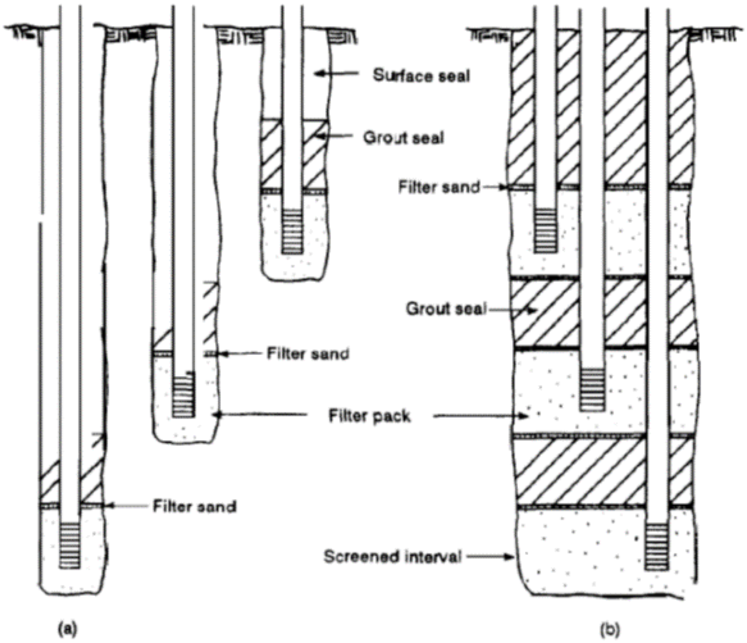
ACRONYMS

TR	Top of Riser	BSC	Bottom of Screen	TG	Top of Grout
TSC	Top of Screen	POW	Point of Well	TBS	Top of Bentonite Seal
BGD	Background	TSP	Top of Sand Pack		

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

EXHIBIT 4 NESTED AND CLUSTER MONITORING WELLS



Wells installed as (a) clusters or, (b) nested. From EPA (1991)

Procedure # MEC-03	Title: MEC AVOIDANCE AND ESCORT	Revision # 00
Effective Date: 02/18/15	**Approved By:** Mike Coon	**Last Reviewed/Revised:** 02/18/15

1. PURPOSE

The purpose of this SOP is to provide the minimum procedures applicable to the performance of munitions and explosives of concern (MEC) escort and MEC avoidance operations at sites where surface and subsurface explosive hazards are present. The SOP also describes the procedures for down-hole magnetometry (i.e., anomaly avoidance used while advancing soil borings or groundwater wells).

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
UXOSO	Determines in which site areas MEC escorts are required and which personnel require escort.
MEC Escort	Conducts MEC escort and anomaly avoidance activities for non-UXO qualified personnel during intrusive activities in potential MEC hazard areas, or during other operations where non-UXO qualified personnel might be exposed to MEC hazards. Must be a qualified UXO Technician II or higher.
Site Geologist	Identifies undisturbed soil during augering/drilling operations.

3. RELEVANT DEFINITIONS

Term	Definition
None	Not applicable.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Metal Detector	Instrument used to detect surface and/or subsurface anomalies indicating potential MEC. Typically instruments used are analog (e.g., Schonstedt magnetic locator, White's metal detector), but may also use digital instruments (e.g., EM61-MK2). Similar instruments attached to cables will be used for down-hole anomaly avoidance (e.g., Schonstedt MG 230/235 Borehole Gradiometer).
GPS Unit	Used to record the location of any MEC or MPPEH found during MEC escort or avoidance

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The UXOSO or designated representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP.

5.2. Confirm Instrument Function

5.2.1. Perform Function Test

Prior to conducting MEC escort or avoidance activities, the MEC Escort (i.e., instrument operator) will complete an instrument function test to confirm the metals detector being used can detect surface and/or subsurface metallic items. The requirements for the function test, including the required measurement performance criteria (MPCs) are described in the work plan.

5.2.2. Document Test Results

Following completion of the function test, the instrument operator will record the results in accordance with the work plan. If the instrument or operator does not pass the function test, corrective actions will be performed as described in the work plan.

5.3. Provide Preparatory Safety Briefing

Prior to any MEC escort or anomaly avoidance activities, the MEC Escort and non-UXO trained personnel performing the planned activity will review the anticipated work location, the ingress/egress routes, and the planned activities. This review will involve a discussion of the overall operation, possible hazards, and potential areas of concern.

5.4. Conduct MEC Escort and Anomaly Avoidance

5.4.1. MEC Escort

When working in areas where non-UXO trained personnel may be exposed to surface explosive hazards (e.g., performing geophysical surveys), the MEC Escort will accompany those personnel, performing metal detector-assisted visual surveys/surface sweeps to check for and avoid possible surface MEC. The swept area(s) shall be at least three feet wide and, if vehicles are involved, as wide as the widest vehicle that will use that route. The MEC Escort will instruct the non-UXO trained personnel to avoid areas where potential hazards are detected. Confirmed MEC items observed will be reported to the UXOSO.

5.4.2. Anomaly Avoidance

Prior to non-UXO trained personnel conducting intrusive activities (e.g., placing survey stakes, burying seed items, collecting soil samples, etc.) in areas with potential subsurface explosive hazards the MEC Escort will conduct MEC avoidance. Prior to conducting the intrusive activity, the MEC Escort will use a metal detector to check the planned intrusive location for surface hazards and subsurface anomalies that might indicate buried MEC. If surface hazards or subsurface anomalies are detected, the MEC Escort will advise the non-UXO trained personnel of the hazards and instruct them to select an offset or alternate location for the intrusive activity. This modified location will be checked by the MEC Escort for surface hazards and subsurface anomalies, and the process will be repeated until an anomaly-free area is located for the intrusive activity. Confirmed MEC items observed will be reported to the UXOSO.

5.5. Conduct Down-Hole Anomaly Avoidance

5.5.1. Initial Anomaly Avoidance

The MEC Escort will conduct down-hole magnetometry for MEC avoidance when augering or drilling (e.g., collecting soil borings, installing groundwater wells, etc.) in areas with potential subsurface explosive hazards. When the proposed augering or drilling location is identified, the MEC Escort will

Procedure # **MEC-03**	**Title:** **MEC AVOIDANCE AND ESCORT**	**Revision #** **00**
Effective Date: 02/18/15	**Approved By:** Mike Coon	**Last Reviewed/Revised:** 02/18/15

conduct anomaly avoidance as described in Section 5.4.2 before intrusive activity is conducted. If the MEC Escort determines the proposed location is free of surface and subsurface magnetic anomalies to a depth of two (2) feet, the auger or drill will be advanced. If the location is not anomaly free, the MEC Escort will advise the auger/drilling team of the hazards and instruct them to select an offset or alternate location for the intrusive activity and repeat the anomaly avoidance process as described in Section 5.4.2.

5.5.2. Down-Hole Anomaly Avoidance

5.5.2.1. During augering/drilling, the MEC Escort will check the hole every two (2) feet using a down-hole magnetometer. This will be achieved by lowering a down-hole magnetometer (Schonstedt MG 230 or equivalent) to the borehole bottom and monitoring the instruments audible signal and panel reading for intensity signatures. This process will be repeated every two (2) feet until borehole depth is reached or undisturbed soil is encountered as identified by the Site Geologist.

5.5.2.2. To avoid potential magnetic interference, the probe rods or corebarrel will be withdrawn from the boring prior to conducting down-hole magnetometry. If the drill rig or other equipment/vehicles are creating interference, the interfering item(s) shall be relocated outside the interference range of the downhole magnetometer during the drill hole inspections.

5.5.2.3. If subsurface magnetic anomalies indicating the potential presence of MEC are encountered and the drill hole cannot be completed, the drill hole will be terminated and backfilled with the removed sediment cuttings. An alternative location will be selected and the process will be repeated starting from Section 5.5.1.

5.5.2.4. If the soils are loose and collapsing into the hole, a polyvinyl pipe (PVC) pipe with a diameter that will allow passage of the downhole probe will be inserted inside the steel casing prior to its removal to maintain an open boring. Once an anomaly-free pilot hole has been advanced to the undisturbed native soil contact as determined by the Site Geologist, the hole will be stopped and the location will be marked with a wooden stake for later advancement. The actual borehole will only be advanced in the same location as the cleared pilot hole. If the cleared boring is not intended as a pilot hole to be returned to later, the boring may continue to its intended target depth without MEC avoidance procedures. If desired, multiple locations may be “pre-cleared” ahead of the actual boring installation (i.e., “pilot holes”).

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
None	Not applicable.

7. EXHIBITS

None.

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
0	02/18/15	Initial Release	n/a

APPENDIX B: WELL LOGS FROM EXISTING MONITORING WELLS

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS

CLIENT: US ACOE

WELL #: MW45-BG-15

PROJECT: Seneca Army Depot

LOCATION: E. Patrol Road

PROJECT NO: 749647.12000

INSPECTOR: E. Ashton (Parsons)

CHECKED BY:

DRILLING CONTRACTOR: NYEG

DRILLER: J. Rauscher

DRILLING COMPLETED: 6-23-20

BORING DEPTH: 16'

DRILLING METHOD(S): Roller bit w/ H2O, splitspoon

BORING DIAMETER(S): 3 7/8"

ASSOCIATED SWMU/AOC: —

POW DEPTH: 16

INSTALLATION STARTED: 6-23-20

INSTALLATION COMPLETED: 6-23-20

SURFACE COMPLETION DATE:

COMPLETION CONTRACTOR/CREW: NYEG

BEDROCK CONFIRMED (Y/N?) y

ESTIMATED GROUND ELEVATION:

PROTECTIVE SURFACE CASING:

DIAMETER: 4.5 LENGTH: 5 TOR: —

RISER:

TOC: See note (1) TYPE: PVC DIAMETER: 2" LENGTH: 6' (1)

SCREEN:

TSC: 6 TYPE: PVC DIAMETER: 2" LENGTH: 10' SLOT SIZE: 10-sl

POINT OF WELL: (SILT SUMP) — NA

TYPE: BSC: POW:

GROUT:

TG: surface ~~2~~ TYPE: type I ~~[illegible]~~ (cement/bent) LENGTH: 2'

SEAL: TBS: 2 TYPE: Bent chips LENGTH: 2'

SAND PACK: TSP: ~~[illegible]~~ 4' TYPE: Morie #0 LENGTH: 12'

SURFACE COLLAR:

TYPE: RADIUS: THICKNESS CENTER: THICKNESS EDGE:

CENTRALIZER DEPTHS — NA

DEPTH 1: DEPTH 2: DEPTH 3: DEPTH 4:

COMMENTS:

(1) Riser is from 0-6' bgs w/ 2.5' riser above ground. Total length is 8.5'.

(2) No significant water lost to formation during drilling

(3.) Protective casing

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

(4.) No choker sand used because of shallow depth of well.

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS	CLIENT: USACOE	BORING NO.: MW45-BG-15

PROJECT : Seneca Army Depot
SWMU # (AREA) : E. Patrol Road
SOP NO.: —

START DATE: 6-23-20
FINISH DATE: 6-23-20
CONTRACTOR: NYEG / Parson
DRILLER: J. Rauscher
INSPECTOR: E. Ashton
CHECKED BY:
CHECK DATE:
BORING CONVERTED TO MW? [✓ Y] N

DRILLING SUMMARY

DRILLING METHOD	HOLE DIA. (~~ft~~ in)	DEPTH INTERVAL (ft)	SAMPLER SIZE	SAMPLER TYPE	HAMMER TYPE	HAMMER WT/FALL
RB	3 7/8	0'-16'	2"x2'	SS	HHR	140lb/30in

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT TYPE	DETECTOR TYPE/ENERGY	RANGE	BACKGROUND READING	BACKGROUND TIME	BACKGROUND DATE	CALIBRATION TIME	CALIBRATION DATE	WEATHER (TEMP., WIND, ETC.)
mini Rae 3000	PID	—	0.0ppm	0900	6-23-20	0730	6-23-20	Sunny - 80's

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE — NA

DATE			
SOIL AMOUNT : (fraction of drum)			
DRUM #, LOCATION:			

COMMENTS:

① RB and split spoon for sampling

② no choke sand used because of shallow depth.

③ no significant water lost to formation during drilling

SAMPLES TAKEN: — NA

SAMPLES
DUPLICATES
MS/MSD
MRD

CONTRACTOR
PARSONS

WELL NUMBER
MW45-BG18

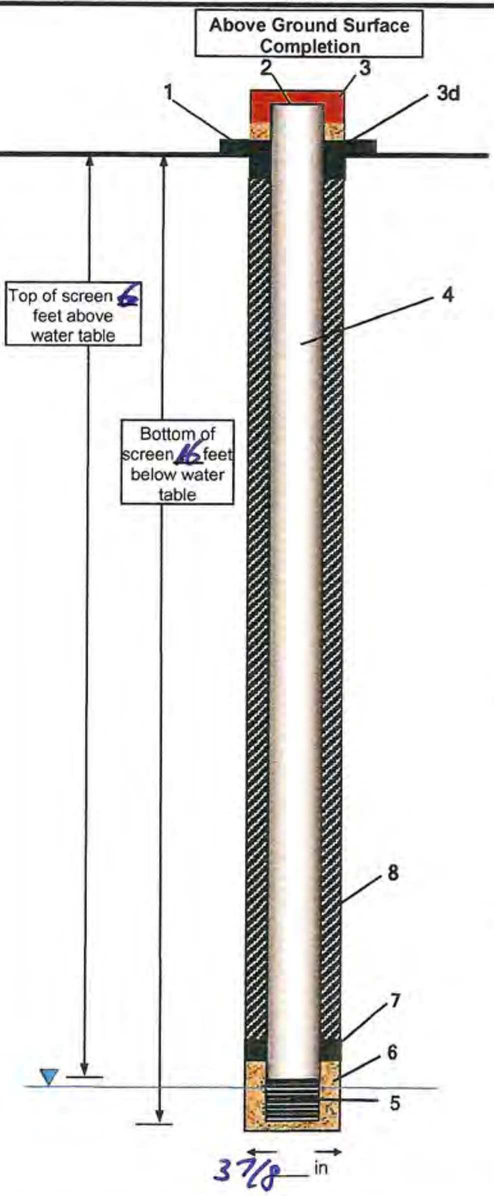
FIGURE
1

~~Project Name~~ Seneca Army Depot
Romulus, NY

Location Groundwater Monitoring Well

WELL INSTALLATION DATA RECORD

PROJECT : Seneca Army Depot, Romulus, NY
DRILLING SUBCONTRACTOR : MEG
DRILLING METHOD / EQUIPMENT: ATV, Roller bit w/water, splitspoon
WATER LEVEL: START: END:
LOCATION : E. Patrol Road
DRILLER: J. Rauscher
HELPERS: M. Trevett
GEOLOGIST: E. Ashton



DRAWING NOT TO SCALE

1- Ground elevation at well :

2- Measuring point elevation :

3- Surface completion casing :
a) type / diameter
b) height above ground
c) length below ground
d) type of sealant
e) protective bollards

4- Well casing :
a) type / diameter PVC / 2"
b) height above ground 2.5'
c) length below ground 6'
d) type / quantity of sealant –
e) well centralizers NA

5- Well screen :
a) type / diameter PVC / 2"
b) slot size 10-in
c) length 10'

6- Well screen filter pack :
a) type Morie #0
b) length 12'

7- Bentonite seal :
a) method of placement pour from surface
b) type chips
c) length 2'

8- Grout :
a) type Type I
b) grout mix cement / bent
c) method of placement pour from surface
d) depth (feet bgs) 2'

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS	CLIENT: USACOE	BORING NO.: MW45-BG1S

COMMENTS: (1.) Drilled to 16' bgs to set well.
(2.) Roller bit-ed w/ water.

DRILLER: J. Rauscha (MAG)
INSPECTOR: E. Ashton (Parsons)
DATE: 6-23-20

DEPTH (FT)	SAMPLING: BLOWS PER 6 INCHES	SAMPLING: PENETRATION RANGE (FEET)	SAMPLING: RECOVERY RANGE (FEET)	SAMPLE: DEPTH INT (FEET)	SAMPLE: NO.	SAMPLE: VOC	SAMPLE: RAD SCRN	SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
NA								* See lithology from log for MW45-BG1D * - Drilled to 16' bgs. - No significant water lost to formation during drilling.	NA	NA

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS

CLIENT: USACOE

WELL #: MW 45-BG10

PROJECT: Seneca Army Depot
SWMU # (AREA): E Patrol Road
SOP NO.: —
PROJECT NO: 749679.12000
INSPECTOR: B Asata C Parsard
CHECKED BY:

DRILLING CONTRACTOR: NYEG
DRILLER: J. Rauscher
DRILLING COMPLETED: 6-23-20
BORING DEPTH: 61'
DRILLING METHOD(S): Air-Hammer
BORING DIAMETER(S): 3 7/8"
POW DEPTH (ft): 61'
INSTALLATION STARTED: 6-24-20
INSTALLATION COMPLETED: 6-24-20
SURFACE COMPLETION DATE:
COMPLETION CONTRACTOR/CREW: NYEG
BEDROCK CONFIRMED (Y/N?) Y

PROTECTIVE SURFACE CASING — NA
DIAMETER (ft):
LENGTH (ft):

RISER
TYPE: PVC
DIAMETER(in): 2
TR (ft): 0 (2)
LENGTH (ft): 48 (2)

SURFACE COLLAR
TYPE:
THICKNESS OF CENTER (ft):
RADIUS (ft):
THICKNESS OF EDGE (in):

SCREEN
TYPE: PVC
DIAMETER (in): 2
SLOT SIZE: 10-in
TSC (ft): 46
LENGTH (ft): 15

OUTER CASING
TYPE: steel drill casing
DIAMETER (in): 4
POC (ft): 18
TC (ft): 0 (1)
LENGTH (ft): 18 (1)

POINT OF WELL (SILT SUMP) — NA
TYPE:
BSC (ft):
POW(ft):

GROUT
TYPE: Cement/bent. TG (ft): 0 LENGTH (ft): 37

SEAL
TYPE: Bent. chips TBS (ft): 37 LENGTH (ft): 5

SAND PACK
FINE SAND TYPE: Morie #00 TSP (ft): 42 LENGTH (ft): 2
COARSE SAND TYPE: Morie #0 TSP (ft): 44 LENGTH (ft): 17

ACRONYMS

TR	Top of Riser	BSC	Bottom of Screen	TG	Top of Grout
TSC	Top of Screen	POW	Point of Well	TBS	Top of Bentonite Seal
BGD	Background	TSP	Top of Sand Pack		

COMMENTS: (1) no water used for drilling; ~~[illegible]~~ no significant water loss during casing install.

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

(1.) Outer casing was set into competent rock at 18' bgs. and acts as a protective casing

(2.) Riser extends 2' above surface

(3)

(4) Centralizer (44'-45')

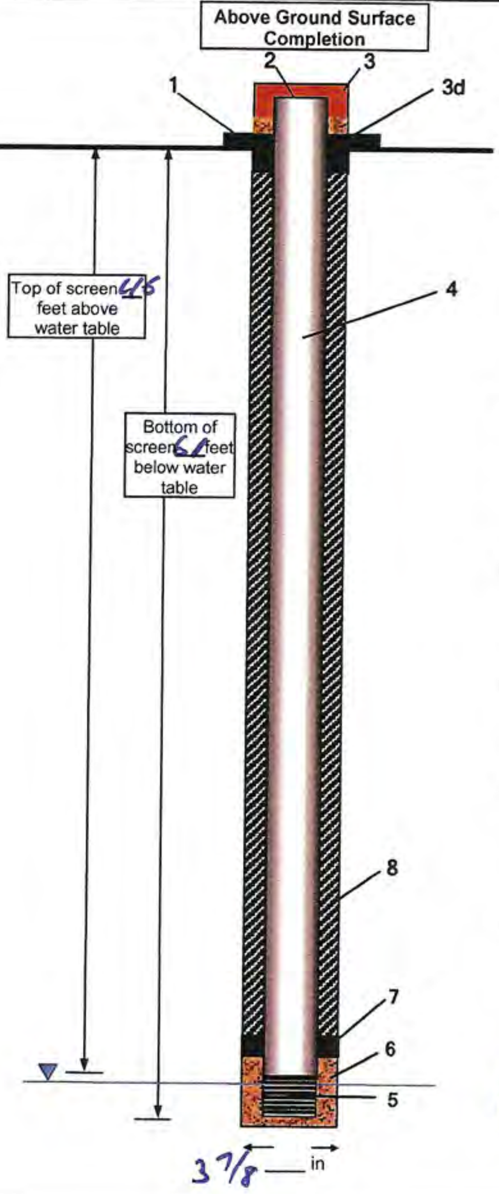
CONTRACTOR	WELL NUMBER	FIGURE
PARSONS	MW45-BG1D	1

Project Name Seneca Army Depot Romulus, NY

Location Groundwater Monitoring Well E. Patrol Road

WELL INSTALLATION DATA RECORD

PROJECT: Seneca Army Depot
LOCATION: E. Patrol Road
DRILLING SUBCONTRACTOR: NMEG
DRILLER: J. Rauscher
DRILLING METHOD / EQUIPMENT: HSA, splitspoon, Roller bit/Tricone w/ H2O, air-hammer
HELPERS: M. Trevett
WATER LEVEL:
START:
END:
GEOLOGIST: E. Asuta



DRAWING NOT TO SCALE

1- Ground elevation at well :

2- Measuring point elevation :

3- Surface completion casing :
   a) type / diameter
   b) height above ground
   c) length below ground
   d) type of sealant
   e) protective bollards

4- Well casing :
   a) type / diameter: PVC Ø 2"
   b) height above ground: ~~46~~ 46'
   c) length below ground: –
   d) type / quantity of sealant: 44-45
   e) well centralizers

5- Well screen :
   a) type / diameter: PVC / 2"
   b) slot size: 10 in
   c) length: 15'

6- Well screen filter pack :
   a) type: Morie #00, Morie #0
   b) length: 2', 17'

7- Bentonite seal :
   a) method of placement: pour from surface
   b) type: chips
   c) length: 5'

8- Grout :
   a) type: Type I
   b) grout mix: cement / bent.
   c) method of placement: Tremie
   d) depth (feet bgs): 0-37'

⑨ outer casing:
- 0-18' bgs
- grouted in place
- steel drill casing (4-in dia)
- Type I grout (cement / bent)

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS	CLIENT: USACOE	BORING NO.: MW45-BG10

COMMENTS: (1) split ~~spoon~~ spoon & HSA to spoon refusal. (2) no significant H2O lost during drilling when RB.

DRILLER: J. Rauscher (NYEG)
INSPECTOR: E. Ashton (Parsons)
DATE: 6-22-20

WS: weathered ~~rock~~ shale
CR = competent rock

DEPTH (FT)	SAMPLING: BLOWS PER 6 INCHES	SAMPLING: PENETRATION RANGE (FEET) PID (ppm)	SAMPLING: RECOVERY RANGE ~~(FEET)~~ (in)	SAMPLE: DEPTH INT (FEET)	SAMPLE: NO.	SAMPLE: VOC	SAMPLE: RAD SCRN	SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
0'	6 12 14 15	0.0	15	NA	NA	NA	NA	(0-2') dry, very stiff, brown, SILT, trace clay, little f-m gravel, low plasticity, no odor or stains. (Till)	(ML)	NA
2'	18 37 28 26	0.0	20					(2-4') SAA, except hard and some f-m gravel (Till)	(ML)	
4'	7 4 10 20	0.0	16	NA				(4-6') dry to moist, stiff, brown, SILT, some clay, little f-m ~~g~~ gravel, trace f sand, low plasticity, no odor or stains. -Till	ML/CL	
6'	43 29 26 20	0.0	22					(6-8') dry to moist, hard, brown, SILT, some clay, little f-m gravel, low ~~tomes~~ plasticity, no odor or stains - Till	ML/CL	
8'	50 16 24 23	0.0	19					(8-10') SAA - Till	ML/CL	
10'	3 5 15	0.0	13					(10-12') moist to wet, very stiff, brown to dark brown, SILT, ~~lit~~ some f-coarse gravel, trace clay, low plasticity, no odor or stains, small % of weathered shale in last 2-in. of spoon. (Till)	ML	
12'	18 17	0.0	10							
	50/5	NA	NA							
14'	- - NA							mixed w/ silt (12-12.10') = wet, hard, brown to gray, WEATHERED SHale ~~SILT w/ weathered~~ w/ silt ~~shale~~, trace clay, no odor or staining. Spoon refusal at 12.10' bgs. HSA to 14' bgs. HSA refusal 13.5' bgs.	WS	
18									CR	

Roller bit to 18' bgs to set 4-in steel drill casing w/ grout.

Page 1 of 1

CORE BORING REPORT

PARSONS

CLIENT: USACOE

BORING #: MW45-BG10

PROJECT: Seneca Army Depot

SWMU # (AREA): E. Patrol Road

SOP NO.: —

DATE CORING STARTED: 6-23-20

DATE CORING COMPLETED: 6-23-20

CONTRACTOR: NYEG / Parsons

DRILLER: J. Rauscher (NYEG)

INSPECTOR: E. Ashton (Parsons)

GEOLOGIST: " "

CHECKED BY:

DATE CHECKED:

TOTAL FOOTAGE CORED: —

OVERBURDEN THICKNESS: —

GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
→	5	0.0 ppm	0900

MiniRae 3000 PID

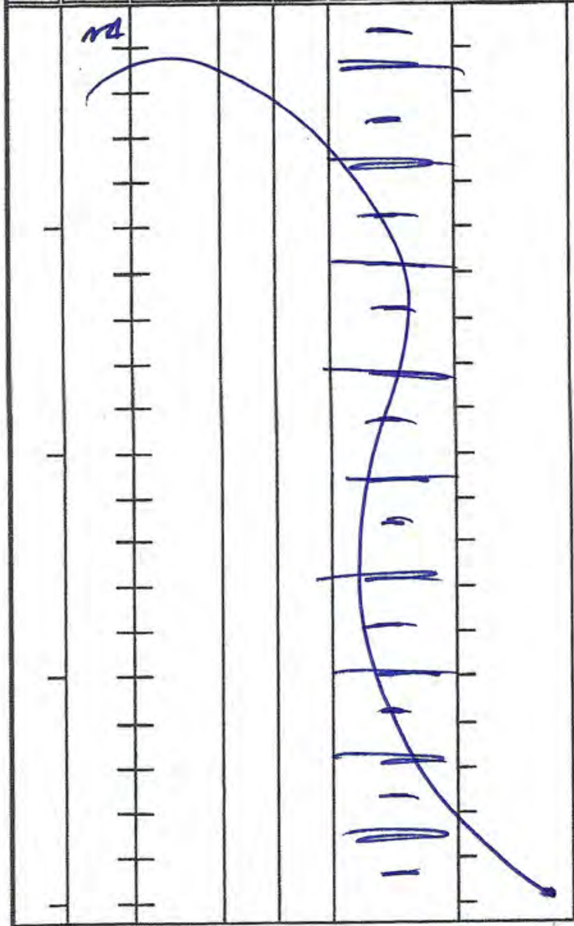
COMMENTS: Air-hammered borehole

CORE EQUIPMENT

BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
AH	—	continuous	3 7/8"	NA

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
18'	NA					
61'						



BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

- start to drill competent rock at ≈ 18' bgs.
  - air-hammered as approved by USACOE.
- no water used
- rock cutting shale from 18 → 41' dry.
- wet cuttings encountered between 51 → 53' bgs. - drilling to 61' bgs.
- Good water bearing zone encountered between 53 → 57' bgs.
- stopped borehole at 61' bgs
- will construct well w/ 15' of screen (46'-61' bgs). ~~[illegible]~~
- Water blowing out of borehole at 61' bgs

INVESTIGATION DERIVED WASTE : - NA

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #, LOCATION			

④ Using 15' of screen to ensure water bearing zones mentioned above are captured.

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS
CLIENT: USACOE
WELL #: MW45-BG2S

PROJECT: Seneca Army Depot
LOCATION: ~~East-West~~ ~~Baseline Road~~
Deer Haven Brewery
PROJECT NO: 749647.12000
INSPECTOR: B. Ashton (Parsons)
CHECKED BY:

DRILLING CONTRACTOR: NYEG
DRILLER: J. Rauscher
DRILLING COMPLETED: 6-18-20
BORING DEPTH: 15'
DRILLING METHOD(S): Roller bit & split spoon & water
BORING DIAMETER(S): 3 7/8"
ASSOCIATED SWMU/AOC: —
POW DEPTH: 15
INSTALLATION STARTED: 6-18-20
INSTALLATION COMPLETED: 6-18-20
SURFACE COMPLETION DATE:
COMPLETION CONTRACTOR/CREW: NYEG
BEDROCK CONFIRMED (Y/N?) Y
ESTIMATED GROUND ELEVATION:

PROTECTIVE SURFACE CASING:
DIAMETER: 4.5 LENGTH: 5 TOR: —

RISER:
TOC: See note (1) TYPE: PVC DIAMETER: 2 LENGTH: 5 (1)

SCREEN:
TSC: 5' TYPE: PVC DIAMETER: 2 LENGTH: 10' SLOT SIZE: 10-in

POINT OF WELL: (SILT SUMP) – NA
YPE: BSC: POW:

GROUT:
TG: surface TYPE: type I (cement / bent.) LENGTH: 2'

SEAL: TBS: 2 TYPE: Bent. chips LENGTH: 1.5'

SAND PACK: TSP: 3.5 TYPE: Morie #0 LENGTH: 11.5'

SURFACE COLLAR:
TYPE: RADIUS: THICKNESS CENTER: THICKNESS EDGE:

CENTRALIZER DEPTHS – NA.
DEPTH 1: DEPTH 2: DEPTH 3: DEPTH 4:

COMMENTS:
(1) Riser is from 0-5' bgs with 2.5' riser above ground. Total length is 7.5'.
(2.) No significant water lost to formation during drilling.

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

(3) Protective casing

(4) No choker sand use because of shallow depth of well.

CONTRACTOR	WELL NUMBER	FIGURE
PARSONS	MW45-BG 2S	1

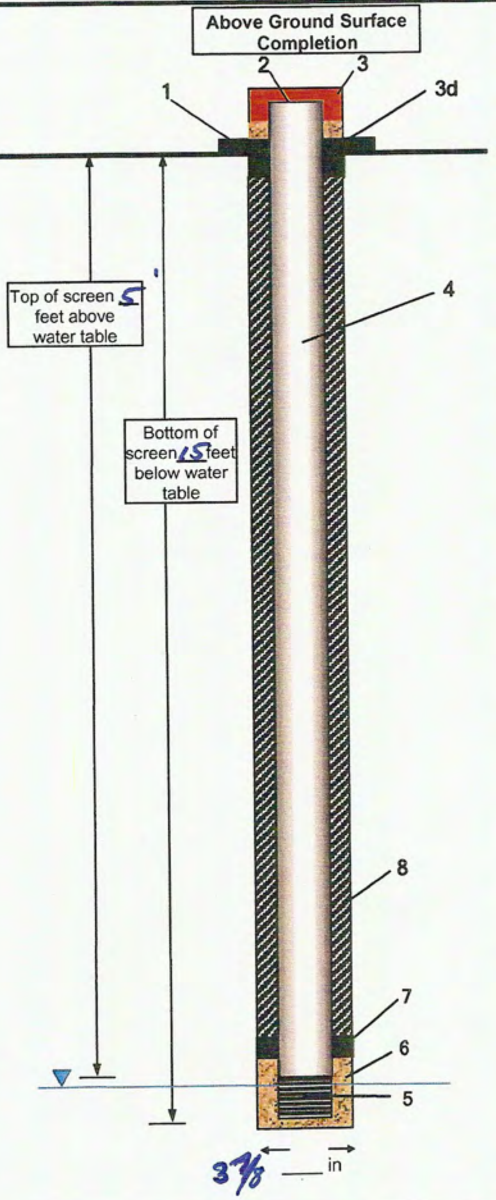
~~*Project Name*~~

Seneca Army Depot
Romulus, NY

Location Groundwater Monitoring Well

WELL INSTALLATION DATA RECORD

PROJECT : Seneca Army Depot, Romulus, N.Y.
DRILLING SUBCONTRACTOR : MEO
DRILLING METHOD / EQUIPMENT: ATV, Roller bit, water, split spoon
WATER LEVEL: START: END:
LOCATION : Deer Haven Pkwy.
DRILLER: J. Rauscher
HELPERS: M. Trevett
GEOLOGIST: E. Ashton



DRAWING NOT TO SCALE

1- Ground elevation at well :

2- Measuring point elevation :

3- Surface completion casing :
a) type / diameter
b) height above ground
c) length below ground
d) type of sealant
e) protective bollards

4- Well casing :
a) type / diameter PVC/2"
b) height above ground 2.5'
c) length below ground 5'
d) type / quantity of sealant —
e) well centralizers NA

5- Well screen :
a) type / diameter PVC/2"
b) slot size 10-in
c) length 10'

6- Well screen filter pack :
a) type Morie #0
b) length ~~DS~~ 11.5'

7- Bentonite seal :
a) method of placement pour from surface
b) type chips
c) length 1.5'

8- Grout :
a) type Type I
b) grout mix cement/bent
c) method of placement pour from surface
d) depth (feet bgs) 2'

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS

CLIENT: USACOE

BORING NO.: MW45-BG25

PROJECT: Seneca Army Depot

SWMU # (AREA): Deer Haven Pkwy.

SOP NO.:

START DATE: 6-17-20

FINISH DATE: 6-18-20

CONTRACTOR: NYBG & Parsons

DRILLER: J. Ranscha

INSPECTOR: E. Ashton

CHECKED BY:

CHECK DATE:

BORING CONVERTED TO MW? [✓ Y] N

DRILLING SUMMARY

DRILLING	HOLE	DEPTH	SAMPLER		HAMMER	
METHOD	DIA. ~~(ft)~~ in	INTERVAL (ft)	SIZE	TYPE	TYPE	WT/FALL
RB	3 7/8	0-15	2'x2"	SS	HHR	140lb/30-in

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT	DETECTOR	RANGE	BACKGROUND			CALIBRATION		WEATHER
TYPE	TYPE/ENERGY		READING	TIME	DATE	TIME	DATE	(TEMP., WIND, ETC.)
mini Rae 3000	PID	—	0.0ppm	0800	6-18-20	0730	6-18-20	Sunny - 70's

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE - NA

DATE			
SOIL AMOUNT : (fraction of drum)			
DRUM #, LOCATION:			

COMMENTS:

(1.) RB and split spoon for sampling

(2.) No choker sand use because of shallow depth.

SAMPLES TAKEN: - NA

SAMPLES

DUPLICATES

MS/MSD

MRD

(3.) No significant water lost to formation during drilling

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS

CLIENT: USACOE

BORING NO.: MW45-BG-2S

COMMENTS:
WS = Weathered shale
CR = Competent Rock

DRILLER: J. Ramsch (NYEG)
INSPECTOR: E Ashton (Parsons)
DATE: 6-17-20.

DEPTH (FT)	SAMPLING: BLOWS PER 6 INCHES	SAMPLING: ~~PENETRATION RANGE (FEET)~~ PID (ppm)	SAMPLING: RECOVERY RANGE ~~(FEET)~~ (in)	SAMPLE: DEPTH INT (FEET)	SAMPLE: NO.	SAMPLE: VOC	SAMPLE: RAD SCRN	SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
0'	3	~~[illegible]~~		NA	NA	NA	NA	~~0-2'~~ (0-2') dry, stiff, brown, SILT, ē roots	ML/CC	
	5	0.0	14					some clay, trace f. gravel, low		
	5							plasticity, no odor or stains - Till		
	4									
2'	50/4	0.0	.4					(2-2.4') = ~~Dry, gray~~ ~~hard~~ dry, hard,	WS	
	–							gray, WEATHERED SHALE		
	–							spoon refusal at 2.4' bgs.		
	–	NA	NA					Roller bit to 3' bgs.	CR	
4'	NA							competent rock at 3' bgs		
								- Roller bit to 15' bgs in competent rock		
								- No significant water lost to formation during drilling.		
15'										

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS

CLIENT: USACOE

WELL #: MW 45-BG20

PROJECT: Seneca Army Depot

SWMU # (AREA): Deer Haven Airway

SOP NO.: —

PROJECT NO: 749674.1200

INSPECTOR: E. Ashton (Parsons)

CHECKED BY:

DRILLING CONTRACTOR: NYEG

DRILLER: J. Ranscher

DRILLING COMPLETED: 6-19-20

BORING DEPTH: 48'

DRILLING METHOD(S): HQ

BORING DIAMETER(S): 3 5/8" OD; 2½" ID

POW DEPTH (ft) : 48

INSTALLATION STARTED: 6-19-20

INSTALLATION COMPLETED: 6-19-20

SURFACE COMPLETION DATE:

COMPLETION CONTRACTOR/CREW: NYEG

BEDROCK CONFIRMED (Y/N?) Y

PROTECTIVE SURFACE CASING — NA

DIAMETER (ft):

LENGTH (ft):

RISER

TYPE: PVC

DIAMETER(in): 2

TR (ft): 0 (2)

LENGTH (ft): 40 (4)

SURFACE COLLAR

TYPE:

THICKNESS OF CENTER (ft):

RADIUS (ft):

THICKNESS OF EDGE (in):

SCREEN

TYPE: PVC

DIAMETER (in): 2

SLOT SIZE: 10-ID

TSC (ft): 38

LENGTH (ft): 10

OUTER CASING

TYPE: Steel drill casing

DIAMETER (in): 4

POC (ft): 8

TC (ft): 0 (1)

LENGTH (ft): 8 (3)

POINT OF WELL (SILT SUMP) — NA

TYPE:

BSC (ft):

POW(ft):

GROUT

TYPE: Cement/Bent

TG (ft): 0

LENGTH (ft): 29

SEAL

TYPE: Bent. chips

TBS (ft): 29

LENGTH (ft): 5

SAND PACK

FINE SAND TYPE: Morie #00

TSP (ft): 34

LENGTH (ft): 2

COARSE SAND TYPE: Morie #0

TSP (ft): 36

LENGTH (ft): 12

ACRONYMS

TR	Top of Riser	BSC	Bottom of Screen	TG	Top of Grout
TSC	Top of Screen	POW	Point of Well	TBS	Top of Bentonite Seal
BGD	Background	TSP	Top of Sand Pack		

COMMENTS: (1) Lost approximately 50 gals of water to formation during coring and ~15 gals during casing install. Total: 65 gals lost

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

(1) Outer casing was set into competent rock at 8' bgs and acts as a protective casing.

(2) Riser extends 2' above surface

(3.)

(4) Centralizer (37-38')

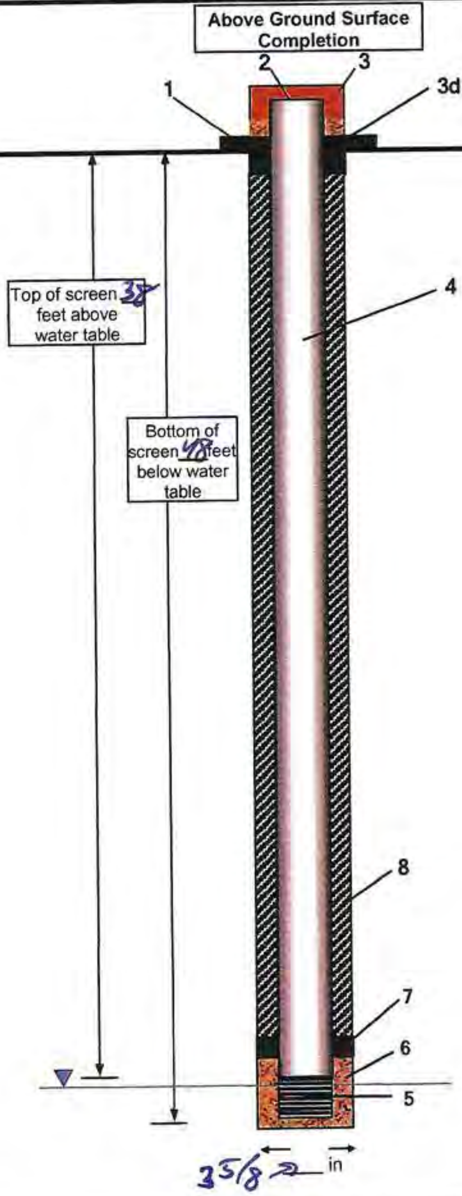
CONTRACTOR	WELL NUMBER	FIGURE
PARSONS	MW45-BG20	1

~~*Project Name*~~ Seneca Army Depot Romulus, NY

Location **Groundwater Monitoring Well**

WELL INSTALLATION DATA RECORD

PROJECT : Seneca Army Depot, Romulus, NY
DRILLING SUBCONTRACTOR : NYEG
DRILLING METHOD / EQUIPMENT: ATV, roller bit, H2O
WATER LEVEL: START: END:
LOCATION : Deer Haven Prkwy
DRILLER: J. Rauscher
HELPERS: M. Trevett
GEOLOGIST: E. Ashton



DRAWING NOT TO SCALE

1- Ground elevation at well :
2- Measuring point elevation :
3- Surface completion casing :
- a) type / diameter
- b) height above ground
- c) length below ground
- d) type of sealant
- e) protective bollards

4- Well casing :
- a) type / diameter PVC / 2"
- b) height above ground 2'
- c) length below ground 38'
- d) type / quantity of sealant —
- e) well centralizers 37-38'

5- Well screen :
- a) type / diameter PVC / 2"
- b) slot size 10-in
- c) length 10'

6- Well screen filter pack :
- a) type Morie #00, Morie #0
- b) length ~~345~~ 2', 12'

7- Bentonite seal :
- a) method of placement Free ~~pour~~ pour from surface
- b) type chips
- c) length 5'

8- Grout :
- a) type Type I
- b) grout mix cement / bent.
- c) method of placement Tremie
- d) depth (feet bgs) 0-29'

⑨ outer casing:
- 0-8' bgs
- grouted in place
- steel drill casing (4-in dia)
- Type I grout (Cement / Bent.)

PAGE 1 OF 1

OVERBURDEN BORING REPORT

PARSONS	CLIENT: USACE	BORING NO.: MW45-BG20
COMMENTS:		DRILLER: J. Rauscher (NYEG) INSPECTOR: E. Ashton (Parsons) DATE: 6-17-20

DEPTH (FT)	SAMPLING: BLOWS PER 6 INCHES	SAMPLING: PENETRATION RANGE (FEET)	SAMPLING: RECOVERY RANGE (FEET)	SAMPLE: DEPTH INT (FEET)	SAMPLE: NO.	SAMPLE: VOC	SAMPLE: RAD SCRN	SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
0	NA	NA	NA	NA	NA	NA	NA	- see log MW45-BG25 for lithology. - Competent Rock encountered at ≈3' bgs. Roller bitting to ~~10~~ 8' bgs to set 4-in drill casing w/ grout - lost approx. 15 gals to formation during drilling.	~~NA~~ NA	NA
8										

Run #1
8-13' bgs

~~Page 18~~
Page 1 of 8

CORE BORING REPORT

PARSONS	CLIENT: USACOE	BORING #: MW45-BG-20

PROJECT: Seneca Army Depot
SWMU # (AREA): Deer Haven Pickup
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: MEG / Parsons
DRILLER: J. Rauscher (MEG)
INSPECTOR: E. Ashton (Parsons)
GEOLOGIST: " "
CHECKED BY:
DATE CHECKED:
TOTAL FOOTAGE CORED: 45
OVERBURDEN THICKNESS: 3
GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
	5'	0.0	0900

miniRae 3000 PID

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5	3 5/8"	2 1/2"

COMMENTS:
HF = Horizontal Fracture
VF = Vertical Fracture
AF = Angle Fracture

8

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)
	8 13	5	0.0 ppm	~~96~~ 0		See inform. to right	Run #1 (8-13) = run consists of various cores less than 4'-in length. main fracture mech is HFs & VFs with a few AFs (10' to 20'). micro HFs & VFs various locations w/ calcite present. various locations of fractures have a clayey silt present. End Run #1 ① shale dark gray ② no iron staining or fossils. ③ Depth in ft-in.

13

INVESTIGATION DERIVED WASTE : —NA

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #,			
LOCATION			

Page 2 of 8

Run #2
13'-18' 5ft

CORE BORING REPORT

PARSONS

CLIENT: USACE

BORING #: MW45-BG 2D

PROJECT: Seneca Army Depot
SWMU # (AREA) : Deer Haven Pkwy
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: NYEG / Parsons
DRILLER: J. Rauscher (NYEG)
INSPECTOR: E. Ashton (Parsons)
GEOLOGIST: " "
CHECKED BY:
DATE CHECKED:
TOTAL FOOTAGE CORED: 45'
OVERBURDEN THICKNESS: 3'
GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
see page 1	→	→	→

COMMENTS: See page 1

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5'	3 5/8"	2 1/2"

13

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
	13	5	0.0 ppm	0		See on form to right
	18					

8

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

start Run #2

(13'-18') = Run same as Run #1, except NO AFs and much less % of clay silt. Sediment present is more of a silt.
- core block at last foot retrieved

end of Run #3

① shale is dark gray
② no fossils or iron staining
③ Depth in ft-in.

INVESTIGATION DERIVED WASTE : — NA

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #, LOCATION			

Appendix G

5/20/2005

Run #3
18'-23' 5ft

Page 3 of 8

CORE BORING REPORT

PARSONS

CLIENT: USACOE

BORING #: MW45-BG-20

PROJECT: Seneca Army Depot
SWMU # (AREA): Near Hanger Rd & Parkway
SOP NO.: —

DATE CORING STARTED: 6-18-2
DATE CORING COMPLETED: 6-19-2
CONTRACTOR: MEGI Parsons
DRILLER: Jr Rauscha (MEGI)
INSPECTOR: E Ashton (Parsons)
GEOLOGIST: "
CHECKED BY:
DATE CHECKED:
TOTAL FOOTAGE CORED: 45
OVERBURDEN THICKNESS: 3
GALLONS OF WATER USED —

6

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
See Page 1			

COMMENTS: See Page 1

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5	3 5/8"	2½"

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)
18	18	5	0.0 ppm	10		See inform to the right	Begin Run #3 (18'-23') Run consists of various cores less than 4" in length; with the exception of one core (6") towards bottom (22-23'), main fracture mech is HFs; VFs, micro VFs; HFs also present in cores w/ Calcite. minor silt in ~~fracture~~ fractures End of Run #3 ① Shale dark gray ② no fossils or iron staining ③ Depth in ft-bw.
23	23						

INVESTIGATION DERIVED WASTE : — NA.

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #,			
LOCATION			

Run #4
23'-28' 5ft

Page 4 of 8

CORE BORING REPORT

PARSONS

CLIENT: USACOE

BORING #: MW45-BG2A

PROJECT: Seneca Army Depot
SWMU # (AREA): Deer Haven Pickup
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: MEG / Parsons
DRILLER: J. Rauscher (MEG)
INSPECTOR: E. Ashton (Parsons)
GEOLOGIST: "
CHECKED BY:
DATE CHECKED:
TOTAL FOOTAGE CORED: 45
OVERBURDEN THICKNESS: 3
GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
See page 1	→	→	→

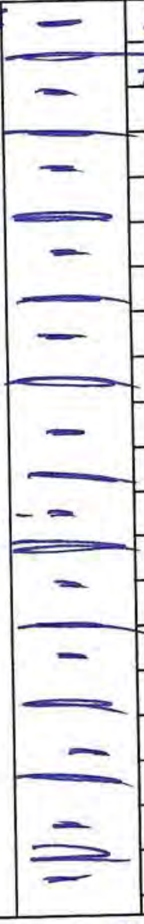
COMMENTS:

See page 1

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5'	3 5/8"	2 1/2"

23

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
	23	5	NC Run	31%		See info form to right
	28					

28

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

Begin Run #4

(23'-28') = Run consists various cores less than 4" in length with the exception of three cores (4"; 6"; 5"). major fracture mech is VFs: HFs. minor fracture present will calcite micro VFs: HFs present. Small percentage of silt w/clay present in fractures; side of (clos. core AF (65') at bottom of run.

End of Run #4

(1) Shale dark gray.

(2) no fossils or iron staining.

(3) Depth in ft-in

(4) Core block at last 8" retrieval

INVESTIGATION DERIVED WASTE : NA

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #,			
LOCATION			

9
6
4

RUN #5
28-33' bgs

Page 5 of 8

CORE BORING REPORT

PARSONS

CLIENT: USACE

BORING #: MW45-BG-20

PROJECT: Seneca Army Depot

SWMU # (AREA): Deer Haven Pickup

SOP NO.: —

DATE CORING STARTED: 6-18-20

DATE CORING COMPLETED: 6-19-20

CONTRACTOR: NYEG / Parsons

DRILLER: J. Rauscher (NYEG)

INSPECTOR: E. Ashton (Parsons)

GEOLOGIST: " "

CHECKED BY:

DATE CHECKED:

TOTAL FOOTAGE CORED: 45

OVERBURDEN THICKNESS: 3

GALLONS OF WATER USED —

COMMENTS: See page 1

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
See page 1	→		

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5	3 5/8"	2 1/2"

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
28	28	5	0.0 ppm	63.33		See inform. to right
33	33					

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

Begin Run #5

28-28.8 = shale broken up into various cores, VFs; HFs, one AF (50'), micro HFs; VFs w/ calcite. Cores less than 4" in length.

28.8 - 28.8.1 = HF = 90'

28.8.1 - 29.6 = shale, micro VFs; HFs w/ calcite.

29.6 - 30 = Section of run SAA (28 - 28.8') Bounded by AF (upper - 120') and lower HF (90').

30 - 30.11 = shale, SAA ~~2~~8.8.1 - 29.6

~~30.11 - 31.6 =~~

30.11 - 30.11.1 = HF = 90'

30.11.1 - 31.6 = shale, SAA 28.8.1 - 29.6

31.6 - 31.61 = HF = 90'

31.6.1 - 31.10 = shale, SAA 28.8.1 - 29.6

31.10 - 31.10.1 = AF = 95'

31.10.1 - 32.3 = shale, SAA 28.8.1 - 29.6

INVESTIGATION DERIVED WASTE : — NA

32.3 - 32.3.1 = HF = 90'

DATE

32.3.1 - 32.7 = shale, SAA 28.8.1 - 29.6

SOIL AMOUNT (fraction of drum)

32.7 - 37.7.1 = HF = 90'

DRUM #,

End of Run #5 → 37.7.1 - 33 = shale, SAA 28.8.1 - 29.6

LOCATION

5/20/2005

Appendix G

① shale dark gray

② No fossils or iron staining

③ ~~cut in f~~ Depth in ft - w

④ Pumped borehole dry to see if water comes in borehole. Did at 33' before ~~[illegible]~~ borehole DTW = 10.2' and came up to = 14.98' after pumping dry.

Run #6
33-38 bgs

page 6 of 8

CORE BORING REPORT

PARSONS

CLIENT: USACOE

BORING #: MW 45 -BG-20

PROJECT: Seneca Army Depot
SWMU # (AREA) : Deer Haven Pkwy
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: NYEG / Parsons
DRILLER: J. Rauscher (NYEG) 4
INSPECTOR: E. Ashton (Parsons) 4.5
GEOLOGIST: " " 9
CHECKED BY: 11
DATE CHECKED:
TOTAL FOOTAGE CORED: 45 5
OVERBURDEN THICKNESS: 3
GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
see page 1			

COMMENTS:
See page 1

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5	3 5/8"	2½"

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
33	33	5	0.0 ppm	55.83		See info to right
38	38					

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

Begin Run #6

33-35.6 = section ~~of ru~~ of run that consists of cores less than 4" in length, except one (4") and shale broken up via HFs & VFs, one AF (115°). micro VFs & HFs w/ calcite. silty clay sed. in between and on cores

35.6-35.6.1 = HF = (90°)

35.6.1 - 35.11 = shale, micro VFs & HFs w/ calcite and silty clay sed

35.11 - 35.11.1 = HF = (90°)
35.11.1 - 36.10 = shale. SAA (35.6.1-35.11)
36.10 - 36.10.1 = HF = (90°)
36.10.1 - 37.8 = Shale SAA (35.6.1-35.11)
37.8 - 37.8.1 = HF = (60°)
37.8.1 - 37.9 = shale, SAA (35.6.1-35.11)
37.9 - 38 = section with broken up shale cores less than 4" in length via HFs & VFs. micro VFs & HFs w/ calcite & silty clay sediment present

INVESTIGATION DERIVED WASTE : -NA

DATE			
SOIL AMOUNT (fraction of drum)		End of Run #6	
DRUM #, LOCATION			

Appendix G

(1) shale dark gray
(2) no fossils or iron staining
(3) Depth in ft-in.

5/20/2005

Run #7
38-43' bgs

page ~~Page~~ 7 of 8

CORE BORING REPORT

PARSONS	CLIENT: USACOE	BORING #: MW45-BG20

PROJECT: Seneca Army Depot
SWMU # (AREA): Deer Haven Prkwy
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: MYBG (Parsons)
DRILLER: J. Rauscha (MYBG)
INSPECTOR: E. Ashton (Parsons)
GEOLOGIST: " "
CHECKED BY:
DATE CHECKED:
TOTAL FOOTAGE CORED: 45
OVERBURDEN THICKNESS: 3
GALLONS OF WATER USED —

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
See page 1	—	—	—

COMMENTS: See page 1

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
HQ	HQ	5	3 5/8"	2 1/2"

8
8
16
8
4

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
38	38 43	5	no ppm	13.33		See information to the right
43						

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

start Run #7

38-38.9 = Shale, micro VFs; HFs w/ calcite. upper boundary is a AF = 95'. Sed - ~~clay~~ siltyclay. present

38.9-38.9.1 = AF = 115'

38.9.1-39.7 = shale, SAA 38-38.9

39.7-39.7.1 = HF = 90'

39.7.1-40.6' = shale, SAA (38-38.9) except split in half via VF.

40.6-40.61 = HF = 90'

40.61-41.11 = shale, SAA 38-38.9

~~38.9-38.9.1 = HF = 90'~~

~~38.9.1-~~

41.11-41.11.1 = HF = 90'

41.11.1-42.1 = shale, SAA 38-38.9'

42.1-42.1.1 = HF = 90'

42.1.1-42.8 = shale, SAA 38-38.9

42.8-42.8.1 = HF = 90'

42.8.1-43' = shale, SAA 38-38.9.

End of Run # 7

INVESTIGATION DERIVED WASTE: - NA

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #, LOCATION			

Appendix G

5/20/2005

① Shale dark gray
② no fossils or iron ~~staining~~ Staining
③ Depth in ft-in.

Run # 8
43'-48' 5ft

Page 8 of 8

CORE BORING REPORT

PARSONS

CLIENT: USACOE

BORING #: MW45-BG20

PROJECT: Seneca Army Depot
SWMU # (AREA): Deer Haven Priory
SOP NO.: —

DATE CORING STARTED: 6-18-20
DATE CORING COMPLETED: 6-19-20
CONTRACTOR: NYEG / Parsons
DRILLER: J. Rauscher (Cameo) 6.5
INSPECTOR: E Ashton (Parsons)
GEOLOGIST: " " 6
CHECKED BY: 4.5
DATE CHECKED:
TOTAL FOOTAGE CORED: 45' 12
OVERBURDEN THICKNESS: 3 4
GALLONS OF WATER USED —

COMMENTS: See page 1

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME
See page 1 →			

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.
Hx	Hx	5'	3 5/8"	2 1/2"

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)
43'	43	5	0.0 ppm	55		See inform to the right
48'	48					

BEDROCK/ CORE DESCRIPTIONS AND REMARKS
(color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

start Run # 8
43'-43.4 = shale, w/ micro VFs: HFs w/ calcite. silty clay sed. present
43.4-43.4.1 = HF = 90' mica
43.4.1-44 = shale, w/ VFs: HFs w/ calcite: silty clay sed.
44-44.01 = AF = 10'
44.01-44.7 = shale w/ micro VFs: HFs w/ calcite: silty clay, core split via VF.
44.7-44.7.1 = HF = 90'
44.7.1 - 45.5 = shale, SAA 43-43.4
45.5-45.5.1 = HF = 90'
45.5.1-45.9 = shale, SAA 43-43.4
45.9-45.9.1 = HF = 90'
45.9.1-45.11 = shale, SAA 43-43.4
45.11-45.11.1 = HF = 90'
45.11.1-46.4 = shale, SAA 43-43.4
46.4-46.4.1 = HF = 90'
46.4.1-47.4 = Shale, SAA 43-43.4
47.4-47.4.1 = HF = 90
47.4.1-47.8 = shale, SAA 44.01-44.7
47.8-47.8.1 = HF = 90
47.8.1-48 = shale, SAA 43-43.4
④ End of Run # 8

INVESTIGATION DERIVED WASTE: — NA

DATE	
SOIL AMOUNT (fraction of drum)	
DRUM #,	
LOCATION	

5/20/2005

Appendix G

(1) shale dark gray
(2) no fossils or iron staining
(3) [illegible] w/ fractures
(4) % of silty clay decreased w/ depth.

PAGE 1 OF 2

OVERBURDEN BORING REPORT

PARSONS	**CLIENT:**	**BORING NO.:** SEAD 25-24

PROJECT : Seneca Army Depot
SWMU # (AREA) : SEAD 25
SOP NO.:

START DATE: 5/17/19
FINISH DATE: 5/17/19
CONTRACTOR: Parratt-Wolff
DRILLER: Mark Eaves
INSPECTOR: MGC
CHECKED BY:
CHECK DATE:
BORING CONVERTED TO MW? [✓ Y] N

DRILLING SUMMARY

DRILLING METHOD	HOLE DIA.(ft)	DEPTH INTERVAL (ft)	SAMPLER SIZE	SAMPLER TYPE	HAMMER TYPE	HAMMER WT/FALL
HSA ~~Augers~~	~~8~~ 5"	2' CS	2"	SS	HMR	140
Air Rotary	~~8"~~ 5"					

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT TYPE	DETECTOR TYPE/ENERGY	RANGE	BACKGROUND READING	BACKGROUND TIME	BACKGROUND DATE	CALIBRATION TIME	CALIBRATION DATE	WEATHER (TEMP., WIND, ETC.)
PID	Mini Rae 3000	ppm	0.0ppm	1015	5/17/19		5/17/19	60s, cloudy, winds @ 4mph

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE

DATE	5/17/19		
SOIL AMOUNT : (fraction of drum)	–		
DRUM #, LOCATION:	–		

COMMENTS: Used Diatech drill rig w/ 5" augers to 8.5', then air rotary to 10' bgs.

SAMPLES TAKEN:
SAMPLES –
DUPLICATES –
MS/MSD –
MRD –

PAGE 1 OF 1

OVERBURDEN BORING REPORT

MW25-24

PARSONS

CLIENT:

BORING NO.: SEAD25-~~26~~

COMMENTS: Augered to 8.5' bgs, then refusal at weathered shale bedrock. Air rotary to 10', install 5' screen (5-10' bgs), sand, + bentonite.

DRILLER: Mark

INSPECTOR: MGC

DATE: 5/17/19

DEPTH (FT)	SAMPLING: BLOWS PER 6 INCHES	SAMPLING: PENETRATION RANGE (FEET)	SAMPLING: RECOVERY RANGE (FEET)	SAMPLE: DEPTH INT (FEET)	SAMPLE: NO.	SAMPLE: VOC	RAD SCRN	SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
2'	3-5 14-15	2'	1			0.0		moist, dk brown, SILT, little F Gravel, some organics in top ~2". Rock in bottom ~4". No odor	ML	
4'	10-8 8-12	2'	0.75			0.0		Top ~3": Wet, brown-gray F-C GRAVEL, some silt. Bottom ~6": Wet, brown-gray SILT, little F Gravel, trace Clay. No odor	GM ML	
6'	7-9 10-9	2'	0.85			0.0		Top 6": moist, brown-gray, SILT, little F-C Gravel. No odor. Bottom 4": moist, F SAND, some silt, little F-C Gravel	ML SM	
8'	29- 50/4"	1.3'	0.5			0.0		Top 2": wet, brown, SILT and F sand, little F Gravel. Bottom 4": weathered shale.	ML	

Drilled to 10' bgs w/ auger + air rotary

~~Well~~ Construction:

Total depth: 10'

Screen: 5-10' (PVC)

Filter sand: 3-10' (Bellmore, Natural Sand, B-2 bags)

Bentonite: 1-3' (Enviroplug, medium - 1 bag)

Finished w/ road box, flush mount cover, and 2' diameter concrete pad

APPENDIX C: UFP-QAPP

BACKGROUND STUDY – UFP-QAPP
FINAL

Former Seneca Army Depot, Romulus, New York

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS, ENGINEERING
AND SUPPORT CENTER,
HUNTSVILLE
5021 Bradford Drive East
Huntsville, Alabama 35805

U.S. ARMY CORPS OF ENGINEERS,
NEW YORK DISTRICT
26 Federal Plaza
New York, New York 10278

CONTRACT NO. W912DY22D0131
TASK ORDER NO. W912DY22F0374

March 2024

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Definition
%	percent
ANSI	American National Standards Institute
AOC	Area of concern
APP	Accident Prevention Plan
ASQ	American Society for Quality
BRAC	Base Realignment and Closure
B.A.	Bachelor of Arts
B.S.	Bachelor of Science
CA	Corrective Action
CCV	Continuing calibration verification
CEHNC	USACE Huntsville District
CENAN	USACE New York District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	Chain of Custody
COPC	Chemical of Potential Concern
COR	Contracting Officer's Representative
CPG	Certified Professional Geologist
CSM	Conceptual Site Model
CSP	Certified Safety Professional
DFW	Definable Feature of Work
DL	Detection Limit
DoD	Department of Defense
DQO	Data Quality Objective
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ELLE	Eurofins Lancaster Laboratories Environment Testing, LLC
EPA	Environmental Protection Agency
FW	freshwater
ICAL	Initial calibration
ICS	Interference Check Standard
ICV	Initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
IS	Internal Standard
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation
µg/L	Micrograms per liter
µg/kg	Micrograms per kilogram
MCL	Maximum contaminant level
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams per kilogram
MPC	Measurement Performance Criteria
M.S.	Master of Science
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MPC	Measurement Performance Criterion
n/a	not applicable
NA	Not available
ND	Non-detect
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OD	Open Detonation
OED	Ordnance and Explosives Design Center
PAL	Project Action Limit
Parsons	Parsons Government Services, Inc.
PFAS	Per- and Polyfluoroalkyl Substances
PG	Professional Geologist
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Manual
RPD	Relative Percent Difference
RSL	Regional Screening Levels
RSD	Relative Standard Deviation
SEDA	Seneca Army Depot Activity
SOPs	Standard Operating Procedures
SSHP	Site Safety and Health Plan
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TBD	To Be Determined
THQ	Target Hazard Quotient

Acronym	Definition
TO	Task Order
TR	Target Risk
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
U.S.	United States
USACE	U.S. Army Corps of Engineers

Acronym	Definition
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

Executive Summary

ES.1 Introduction

This Background Study Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) addresses investigation activities within the former Seneca Army Depot Activity (SEDA or the Depot) related to a base-wide background study. Specific details of the field investigation are provided in the Seneca Background Study Workplan Final, Revision 2, March 2024, herein referred to as the Background Study Workplan. The purpose of composing this QAPP for the background study is to provide information on the project personnel and organization, the Conceptual Site Model (CSM), the laboratory and project action limits, the sampling plan, lab standard operating procedures (SOPs), and data validation procedures. The study includes the collection of surface and subsurface soil, groundwater, surface water, and sediment samples for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), perchlorate, metals, explosives, phosphorus, orthophosphate and per- and polyfluoroalkyl substances (PFAS). Details regarding field sampling plans including soil sampling, surface water and sediment collection and monitoring well installation are discussed in the Seneca Background Study Workplan, March 2024.

ES.1.1 BACKGROUND STUDY

Background concentrations within the Depot will be investigated through the collection of selected environmental parameters in soil, groundwater, surface water and sediment. Dynamic media (groundwater, surface water and sediment) will be collected during different seasons to address temporal variability. The selected parameters are chemicals related to former uses at areas of concern (AOCs) within SEDA. The goal is to develop a database of recent background concentrations in an anthropogenic setting. The study is purposefully designed to avoid sampling areas of known or suspected contaminant releases, or areas downgradient of those releases. This study will also include investigation into background concentrations of PFAS.

ES.2 Project Objectives and Technical Approach

The project objectives are discussed in the Background Study Workplan. The investigation will include analysis of VOCs, SVOCs, perchlorate, metals (including mercury, CrIII and CrVI), explosives, total and dissolved phosphorus, orthophosphate, and PFAS in groundwater, surface water, soil and sediment within upgradient locations throughout SEDA. The Conceptual Site Model (CSM) is described on **Worksheet #10. Section 2** of the Background Study Workplan includes a more detailed summary of the CSM.

Project-specific data quality objectives (DQOs) were developed based on this CSM and these are described on **Worksheet #11** of this UFP-QAPP. These DQOs include a design for obtaining data to support future sampling at AOCs withing SEDA. The project approach is described in detail in the Background Study Work Plan and on **Worksheet #17**, and specific analyses are noted on **Worksheet #18**.

The general scope of the activities related to the sampling is as follows:

- Assess the presence of naturally occurring and anthropogenic substances (chemicals of potential concern [COPCs]) in soil, shallow overburden and deeper bedrock groundwater, surface water, and sediment in areas of the former SEDA that are not directly impacted by former site activities but have similar on-site conditions.
- The background study will include sampling of soil, groundwater, surface water and sediment for PFAS.
- Collect dynamic media (groundwater, surface water and sediment) during different seasons to address temporal variability.

- Evaluate and present the data distribution and basic statistics for each medium.

While these components are the focus of the project, the field operations involve multiple elements, or “definable features of work” (DFWs) that will be required to achieve the project goals. These DFWs are listed on **Worksheet #14** and they are explained further in **Worksheet #17**, with references to relevant standard operating procedures (SOPs) (**Worksheet #21** and **Appendix A** and **B**), measurement performance criteria (MPCs) (**Worksheet #12**), and other sections of this UFP-QAPP, as necessary.

ES.3 Document Organization

This UFP-QAPP was prepared under Task Order W912DY22F0374 of Contract W912DY22D0131, in accordance with UFP-QAPP, Optimized UFP-QAPP Worksheets (IDQTF, 2012), Environmental Protection Agency (EPA) Quality Assurance (QA)/G-5 (EPA, 2002), and EM 200-1-15 to ensure environmental data collected are scientifically sound, of known and documented quality, and suitable for their intended purposes. This UFP-QAPP focuses on the site-specific details for the groundwater, surface water, soil and sediment sampling related to the development of a background dataset. This UFP-QAPP is intended to be reviewed and used in tandem with the Background Study Workplan.

This UFP-QAPP uses the “optimized” worksheets format published by the Intergovernmental Data Quality Task Force in March 2012 (IDQTF, 2012). Supporting plans and other information are included in the references section of this UFP-QAPP.

Crosswalk from UFP-QAPP Manual to Worksheets

This UFP-QAPP presents the plan for collecting data to support the collection of background samples within SEDA. The UFP-QAPP uses "optimized" worksheets published by the Intergovernmental Data Quality Task Force (IDQTF) in March 2012. The optimized worksheets address all requirements of ANSI/ASQ E4-2004 and CIO 2106-G-05. The following table provides a "crosswalk" between the worksheets and the respective elements of CIO 2106-G-05. In addition, each revised worksheet includes a reference to the appropriate CIO 2106-G-05 element.

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
1&2	Title and Approval Page	2.2.1	Title, Version, and Approval / Sign-Off
3&5	Distribution List and Project Organization	2.2.3 2.2.4	Distribution List Project Organization and Schedule
4, 7 & 8	Personnel Qualifications and Sign-Off Sheet	2.2.1 2.2.7	Title, Version, and Approval / Sign-Off Special Training Requirements and Certification
6	Communication Pathways and Procedures	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements for Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1 2.3.2	Sample Collection Procedure, Experimental Design, and Sampling Tasks Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Quality Control	2.3.5	Quality Control Requirements
21	Field Standard Operating Procedures	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical Standard Operating Procedures	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
31, 32 & 33	Assessments and Corrective Action	2.4 2.5.5	Assessments and Data Review Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Usability Assessment	2.5.2 2.5.3 2.5.4	Quantitative and Qualitative Evaluations of Usability Potential Limitations on Data Interpretation Reconciliation with Project Requirements

Worksheets #1 & 2: Title and Approval Page

(EPA UFP-QAPP Guidance Manual, Section 2.1; Environmental Protection Agency (EPA) Guidance 2106-G-05 Section 2.2.1)

1.1 PROJECT IDENTIFYING INFORMATION

Site Name / Project Name:	Seneca Army Depot Activity / Background Study
Site Location / No.:	Romulus, NY, EPA Site ID# NY0213820830, NY Site ID# 8-50-006
Contract / TO No.:	W912DY22D0131/ Task Order W912DY22F0374

1.2 CONCURRING SIGNATURES

The below signatures indicate the representatives of the subject organizations have reviewed this UFP-QAPP and concur with its implementation as written.

Lead Organization / Contracting Officer Representative

HEATON.CHARLES.HUDDLESTON.JR.1144858758 Digitally signed by HEATON.CHARLES.HUDDLESTON.JR.1144858758 Date: 2024.03.06 13:09:17 -06'00'

Charles H. Heaton P.E., USACE-Huntsville Point of Contract/ Contracting Officer's Representative (COR) Project Manager — Date

Lead Organization / Project Manager

Digitally signed by GALLO.CHRISTOPHER.T.1604778820 Date: 2024.03.06 11:37:24 -05'00'

Christopher Gallo, USACE New York District (CENAN) — Date

Prime Contractor Project Manager

03/05/24

Tim Reese, EA Project Manager — Date

Subcontractor Task Lead

Beth Badik 03/05/24

Beth Badik, Parsons Task Lead — Date

Federal Regulatory Agency

Treinen, Karyn Digitally signed by Treinen, Karyn Date: 2024.03.08 09:36:46 -05'00'

Karyn Treinen, United States Environmental Protection Agency (USEPA) Regional Project Manager — Date

Lynn E Arabia Digitally signed by LYNN ARABIA Date: 2024.03.08 09:28:37 -05'00'

Lynn Arabia, CHMM, USEPA Quality Assurance Manager — Date

State Regulatory Agency

Melissa Sweet, New York State Department of Environmental Conservation (NYSDEC) Project Manager — Date

Subcontractor Quality Assurance

Lauren N. Ranker 01/22/24

Lauren Ranker, Parsons Corporate Quality Manager Date

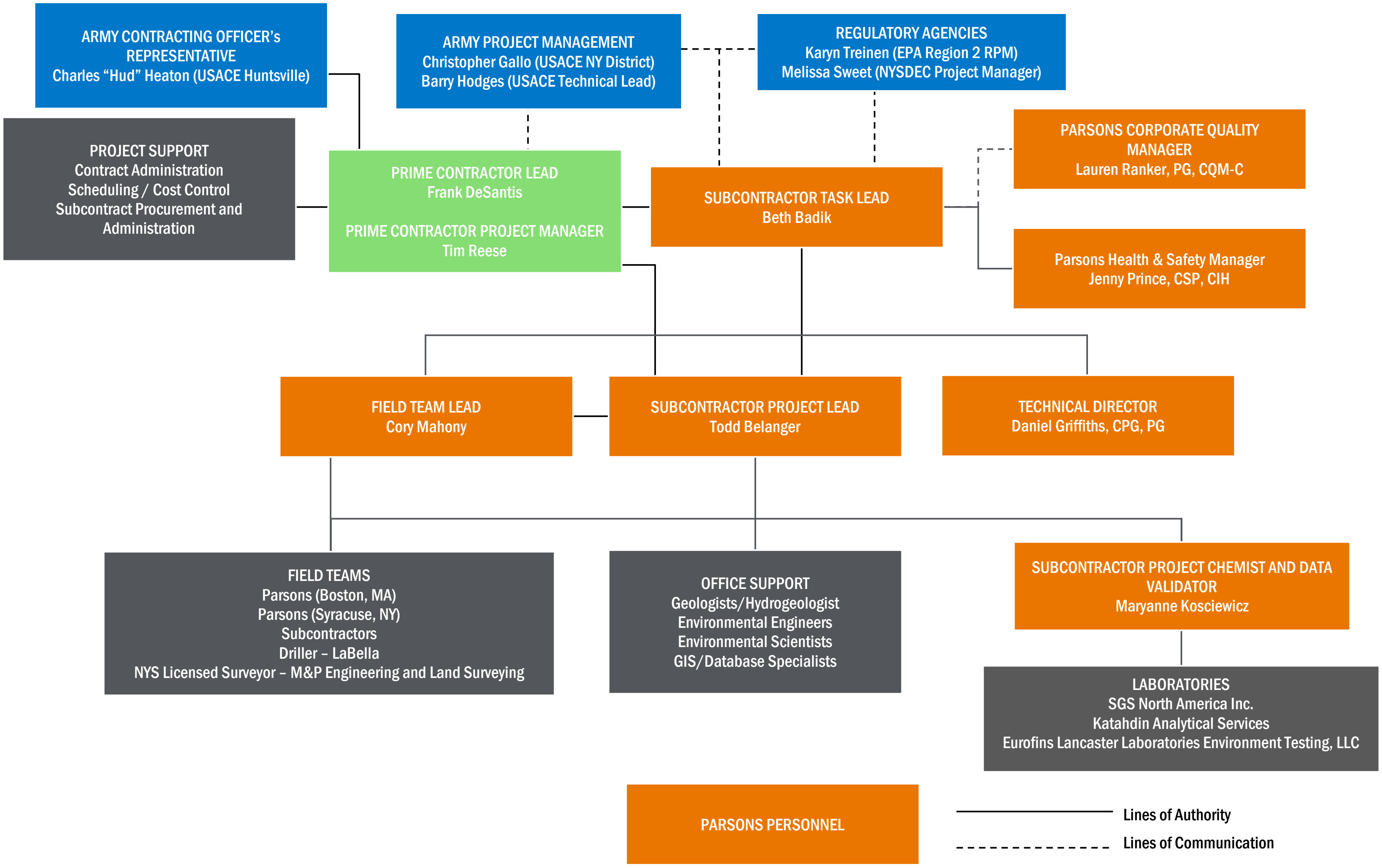
1.3 QAPP IDENTIFYING INFORMATION

Guidance Used:	Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets (IDQTF, 2012); EPA QA/G-5 (EPA, 2002); and EM 200-1-15
Regulatory Program:	Base Realignment and Closure (BRAC), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Approval Entity:	US Army Engineering and Support Center, Huntsville
Data Users:	U.S. Army, USEPA, NYSDEC
QAPP Type:	Optimized UFP-QAPP
Scoping Sessions	See **Worksheet #9**
Previous UFP-QAPPs:	None

Worksheets #3 & 5: Project Organization and QAPP Distribution

(EPA UFP-QAPP Guidance Manual, Section 2.4.1; EPA Guidance QA/G-5, Sections 2.1.3 and 2.2.4)

Figure 3.1 – Project Organization and QAPP Distribution



Worksheets #4, 7, & 8: Personnel Qualifications and Sign-Off Sheet

(EPA UFP-QAPP Guidance Manual, Section 2.4.3, EPA Guidance QA/G-5, Section 2.1.8)

4.1 KEY PROJECT PERSONNEL

Project Title/Role	Name/ Organization	Contact Information (telephone/e-mail)	Experience	Specialized Training/ Certifications	Signature/Date (1)
USACE Contracting Officer's Representative (COR)	Charles Heaton USACE, Huntsville - Ordnance and Explosives Design Center (CEHNC-OED)	256-895-1657 Charles.H.Heaton@usace.army.mil	n/a	n/a	*Signature on Worksheets #1 & 2*
USACE Project Manager (PM)	Christopher Gallo, CENAN, BRAC BEC	917-575-1819 Christopher.T.Gallo@usace.army.mil	n/a	n/a	*Signature on Worksheets #1 & 2*
USACE Technical Lead	Barry Hodges, CEHNC	256-895-1894 Barry.A.Hodges@usace.army.mil	n/a	n/a	
Federal Regulator	Karyn Treinen USEPA Region 2	212-637-4436 Treinen.Karyn@epa.gov	n/a	n/a	*Signature on Worksheets #1 & 2*
Federal Regulator	Lynn Arabia USEPA Region 2	732-321-4384 Arabia.Lynn@epa.gov	n/a	*Signature on Worksheets #1 & 2*	
State Regulator	Melissa Sweet NYSDEC	518-402-9614 Melissa.Sweet@dec.ny.gov	n/a	n/a	*Signature on Worksheets #1 & 2*
Prime Contractor Lead	Frank DeSantis	315-395-7689 fdesantis@eaest.com	Over 19 years of experience performing and managing preliminary site assessments, site characterizations, RI/FS, and remedial design/remedial actions	Bachelor of Science (B.S.), Environmental and Forest Biology	n/a
Prime Contractor PM	Tim Reese, PE EA	410-329-5185 Treese@eaest.com	Over 31 years of experience as PM conducting environmental investigations	Bachelor of Science (B.S.), Civil Engineering	*Signature on Worksheets #1 & 2*
Subcontractor Task Lead	Beth Badik Parsons	617-449-1565 Beth.Badik@parsons.com	Over 15 years of experience as PM conducting HTRW investigations	BS, Chemical Engineering, 2001	n/a

Subcontractor Project Lead	Todd Belanger Parsons	202-591-6826 Todd.Belanger@parsons.com	Over 14 years of experience leading environmental investigation and field events.	M.S., Structural Geology	n/a
Technical Director	Daniel Griffiths, CPG, PG Parsons	303-764-1940 Daniel.R.Griffiths@parsons.com	Parsons PFAS Director. Over 25 years of experience in groundwater restoration.	M.S., Geology	n/a
Field Team Lead	Cory Mahony Parsons	386-264-5929 Cory.Mahony@parsons.com	Over 20.5 years of experience leading environmental investigation and field events.	B.S., Geology	n/a
Subcontractor Project Chemist and Data Validator	Maryanne Kosciewicz	315-552-9703 Maryanne.Kosciewicz@parsons.com	QA officer and project chemist with more than 26 years' experience with various hydrogeologic and remedial investigations. Member of American Chemical Society	B.S. Mathematics B.S. Chemistry	n/a
Parsons Health and Safety Manager	Jenny Prince, MS, MS, CIH, CSP	803.443.5311 Jenny.Prince@parsons.com	Over 14 years as safety, health, and environmental manager	M.S. Occupational Health and Industrial Hygiene M.S. Occupational Safety Management	n/a
Parsons Corporate Quality Manager	Lauren Ranker, PG, CQM-C	720.693.6989 Lauren.Ranker@parsons.com	16 years environmental remediation experience	B.S. Geology P.G., Wyoming CQM-C Certification	*Signature on Worksheets #1 & 2*

(1) Signatures indicate personnel have read this UFP-QAPP and agree to implement the procedures as written.

4.2 OTHER PROJECT PERSONNEL

Project Title/Role	Name/ Organization	Contact Information (telephone/e-mail)	Experience	Specialized Training/ Certifications [(1)]	Receives Copy of QAPP
Analytical Laboratory Project Manager	Ariel Hartney SGS Orlando	407-702-5754 Ariel.Hartney@sgs.com	16 years of laboratory experience	B.S. Wildlife Ecology and Conservation	Yes
Analytical Laboratory QA Officer	Svetlana Izosimova SGS Orlando	407-425-6700 Svetlana.Izosimova@sgs.com	32 years of laboratory experience	PhD. Colloidal Chemistry	Yes
Analytical Laboratory Project Manager	Heather Manz Katahdin Analytical Services	207-874-2400 ext. 17 hmanzjobrin@katahdinlab.com	15 years of analytical laboratory and chemistry-related experience with Katahdin	B.S. Ocean Studies, 1999	Yes
Analytical Laboratory QA Officer	Leslie Dimond Katahdin Analytical Services	207-874-2400 ext. 20 ldimond@katahdinlab.com	25 years of analytical laboratory and chemistry-related experience with Katahdin	B.A., Chemistry	Yes
Analytical Laboratory Project Manager	Vanessa Badman ELLE	717-556-9762 Vanessa.Badman@et.eurofinsus.com	19 years of analytical laboratory and chemistry-related experience	B.S., Biology	Yes
Analytical Laboratory QA Director	Kenneth Boley ELLE	717-556-9413 Kenneth.Boley@et.eurofinsus.com	20 years of analytical laboratory and chemistry-related experience	B.S., Chemistry	Yes

Worksheet #6: Communication Pathways and Procedures

(EPA UFP-QAPP Guidance Manual, Section 2.4.2, EPA Guidance 2106-G-05 Section 2.2.4)

Communicator Driver	Initiator (Role)(1)(2)	Recipient(s) (Role)(1)	Procedure
General communication between Lead Organization and other process development team (PDT) members	Lead Organization PM or designee	Appropriate PDT member(s)	Communicates directly as needed (verbally and/or in writing).
Regulatory interface	Lead Organization PM	Regulator	Provides project update via e-mail at least every other week during field activities.
Regulatory oversight	Regulator	Lead Organization PM	Communicates directly as needed (verbally and/or in writing).
Project management, Task Order administration and logistics, QAPP changes prior to field/laboratory work	Prime Contractor PM	Lead Organization PM and/or lead technical and site management personnel	Communicates directly as needed (verbally and/or in writing).
Weekly project conference calls	Prime Contractor PM	Lead Organization PM, appropriate PDT member(s)	Communicates project status verbally via weekly conference call.
Field progress reports	Field Team Lead, Parsons Field Team Member, Parsons	Subcontractor Project Lead and lead technical and site personnel. Serves as Parsons Field Team Lead.	Documents progress in daily report and submits to Subcontractor Project Lead for onward distribution to PDT. Daily reports will be submitted to USAESCH PM within 24 hrs of work completion that day whenever possible.
Stop work due to safety issues	Field Team Member, Parsons	Subcontractor Project Lead	Verbally notify Subcontractor Project Lead as soon as possible after work stoppage.
	Subcontractor Project Lead	Prime Contractor PM Prime Contractor Lead	Notify Prime Contractor PM verbally or via e-mail as soon as possible after work stoppage.
	Prime Contractor PM	Lead Organization and Design Center PMs	Notify USAESCH PMs verbally or via e-mail as soon as possible after work stoppage.
QAPP changes in the field	Subcontractor Project Lead	Prime Contractor PM Prime Contractor Lead	Follows change and review and approval process; Communicates directly as needed (verbally and/or in writing) and submits draft Field Change Request form for discussion; does not implement change until approval is granted; consults with other personnel as needed.
	Prime Contractor PM	Lead Organization and Design Center PMs State and Federal Regulators	Submits Field Change Request form to USAESCH for approval; does not implement change until approval is granted. State and Federal regulators notified of significant changes to the QAPP via email or phone during the field event. Will not implement until approval granted.
Field corrective actions	Field Team Member, Parsons Subcontractor Project Lead	Prime Contractor PM Prime Contractor Lead Lead Organization and Design Center PMs	The need for field corrective actions will be determined by the Prime Contractor PM, and/or contractor technical personnel. The Subcontractor technical personnel will notify the Prime Contractor PM of any needed field corrective actions and the Prime Contractor PM will respond within 24 hrs.

Communicator Driver	Initiator (Role)(1)(2)	Recipient(s) (Role)(1)	Procedure
	Prime Contractor PM	State and Federal Regulators	Field corrective actions will be included in the site-specific report.
Reporting laboratory Quality Control (QC) variances or sample receipt variances	Analytical or QA Laboratory Project Manager	Subcontractor Project Chemist	Applicable Laboratory Project Manager will notify Subcontractor Project Chemist verbally and in writing. All sample receipt variances will be communicated within 24 hours of sample receipt.
	Subcontractor Project Chemist	Subcontractor Project Lead	Subcontractor Project Chemist will notify Subcontractor Project Lead immediately for significant variances.
	Subcontractor Project Lead	Prime Contractor PM Prime Contractor Lead	Subcontractor Project Lead will notify Prime Contractor PM immediately for significant variances.
Analytical corrective actions and data validation corrective actions	Subcontractor Project Chemist	Subcontractor Project Lead	The need for Corrective Actions for analytical and data validation issues will be determined by the Subcontractor Project Chemist and laboratory when error occurs during the analysis or noticed during data review or validation stage. Corrective action report will be included in the associated data package.
	Subcontractor Project Lead	Prime Contractor PM Prime Contractor Lead	The Subcontractor Project Lead will notify the Prime Contractor PM of any non-conformance lab issues if errors cause rejected data or re-analysis cannot be performed due to holding time.
	Prime Contractor PM	Lead Organization and Design Center PMs	The Prime Contractor PM will notify USAESCH of any non-conformance lab issues if errors cause rejected data or re-analysis cannot be performed due to holding time.
	Prime Contractor PM	State and Federal Regulators	Any non-conformance lab issues will be documented in the site-specific report.
Reporting data validation issues	Subcontractor Project Chemist Subcontractor Data Validator	Analytical or QA Laboratory Project Manager	All completeness and data issues will be addressed with the laboratory directly, verbally and in writing immediately in case the team is still in the field and samples can be recollected. The validated data package will be due within approximately 14 calendar days of receipt. Subcontractor Data validator will validate laboratory data package with analytical results.

(1) Names and contact information for personnel provided on **Worksheets #4, 7,** & **8**.

(2) The initiator may designate another qualified individual to communicate with the recipient(s); however, the initiator shown is responsible for the communication being made.

Worksheet #9: Project Planning Session Summary

(EPA UFP-QAPP Guidance Manual, Section 2.5.1 and Figures 9-12, EPA Guidance 2106-G-05 Section 2.2.5)

Technical Project Planning (TPP) meetings have not been held to discuss the background investigation at Seneca. However, weekly telephone conferences are held between project management to discuss the relevant action items and project planning related to upcoming activities to be performed at Seneca. The primary focus of the conference calls is to discuss upcoming field activities, project deliverables, and document reviews. A list of the weekly conference call participants is included in the table below.

Name	Organization	Title / Role	E-mail / Phone
Charles Heaton	CEHNC	USACE COR / PM	Charles.H.Heaton@usace.army.mil 256-895-1657
Chris Gallo	CENAN	Project Manager	Christopher.T.Gallo@usace.army.mil 917-575-1819
Barry Hodges	CEHNC	Technical Lead	Barry.A.Hodges@usace.army.mil 256-895-1894
Alexandria Chesnut	CEHNC	Chemist	Alexandria.R.Lambert@usace.army.mil 256-316-7005
Tim Reese	EA	Prime Contractor Project Manager	Treese@eaest.com 410-329-5185
Frank DeSantis	EA	Prime Contractor Project Lead	Fdesantis@eaest.com 315-395-7689
Beth Badik	Parsons	Subcontractor Task Lead	Beth.Badik@parsons.com 617-429-9624
Todd Belanger	Parsons	Subcontractor Project Lead	Todd.Belanger@parsons.com 202-591-6826

Worksheet #10: Conceptual Site Model

(EPA UFP-QAPP Guidance Manual, Section 2.5.2, EPA Guidance 2106-G-05 Section 2.2.5)

10.1 OVERVIEW

The primary objectives of the investigation activities are as follows:

- Assess the presence of naturally occurring and anthropogenic substances (chemicals of potential concern [COPCs]) in soil, shallow overburden and deeper bedrock groundwater, surface water, and sediment in areas of the former SEDA that are not directly impacted by former site activities but have similar on-site conditions.
    - The background study will include sampling of soil, groundwater, surface water and sediment for PFAS, VOCs, SVOCs, metals (including mercury, CrIII and CrVI), perchlorate, explosives, total and dissolved phosphorus, and orthophosphate.
    - The field activities and methods herein are appropriately modified to prevent cross-contamination and to avoid the introduction of external PFAS contaminant sources. The sampling program will adhere to the guidance provided by NYSDEC (2021) with the exception of the PFAS analytical method (Draft Method 1633) which is required by the Department of Defense (DoD). Appendix A includes a summary of prohibited and acceptable items for PFAS sampling and PFAS standard operating procedures.
- Collect dynamic media (groundwater, surface water and sediment) during different seasons to address temporal variability.
- Present the data distribution and basic statistics for each medium.

Section 2 of the Background Study Work Plan for the SEDA includes a description of the site history, geology, and hydrogeology at the former Seneca Army Depot.

10.2 CONCEPTUAL SITE MODEL

The CSM is a description of a site and its environment that can be used to depict the nature of potential contamination, its location, and the possible interactions of human and environmental receptors with that contamination. The CSM summarizes which potential receptor exposure pathways are (or may be) complete and which are (and are likely to remain) incomplete. An exposure pathway is considered incomplete unless *all four* of the following elements are present (USEPA, 1989):

- A source of contamination;
- An environmental transport and/or exposure medium;
- A point of exposure at which the contaminant can interact with the receptor; and
- A receptor and a likely route of exposure at the point of exposure.

Table 10.1 – Overview of Preliminary Conceptual Site Model, Background Study, Seneca Army Depot Activity

Site Details	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: SEDA Background **Release mechanisms**: Aerial deposition and upgradient sources; decades of former use. **Current and Future Land Use**: Limited. Background areas selected to be away from active use and point sources.	VOCs, SVOCs, explosives, metals, perchlorate, total and dissolved phosphorus, orthophosphate, PFAS.	Low levels of contamination sources potentially present in site media as a result of aerial deposition, upgradient off-site sources and decades of use as an active DoD facility rather than point source releases. Concentrations expected to represent basewide anthropogenic background.	Soil Groundwater Surface Water Sediment	Current and future on-site worker, future on-site residential, recreational users, wildlife.	Exposure to soil, groundwater (ingestion), surface water, sediment

Worksheet #11: Data Quality Objectives

(EPA UFP-QAPP Guidance Manual, Section 2.6.1; EPA Guidance QA/G-5, Section 2.1.7)

DQOs are qualitative and quantitative statements that specify the quality and level of data required to support the decision-making processes for a project. Guidance for DQO development is contained in *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4), February 2006, EPA/240/B-06/001.

Specific DQOs for the site are outlined in **Table 11.1**. These DQOs follow the USEPA's seven-step, iterative process for DQO development. In addition to these DQOs all data collected during this project are required to attain the MPCs described on **Worksheet #12** to be considered adequate to support environmental decisions, unless sufficient alternative justification is provided to and accepted by the project team. Before final environmental decisions are made, data will be verified and validated as described in **Worksheets #34** through **#37**.

Table 11.1 – Data Quality Objectives and Technical Approach Summary for Emerging Contaminant Sampling at SEDA

Site	State the Problem	Identify the Goal of the Study	Identify Information Inputs	Define the Boundaries of the Study	Develop the Analytic Approach	Specify Performance or Acceptance Criteria (see Worksheet #17)	Develop the Detailed Plan for Obtaining Data (see Worksheet #17)
SEDA Background	• A variety of COPCs have been identified at Seneca, and there is currently no recent background dataset for the full suite of COPCs. A solid background data set could be used to support the evaluation of on-base concentrations and identification of what COPCs may be anthropogenic in nature and be cause for further remedial action.	• Develop a database of recent background concentrations in an anthropogenic setting. • Assess the presence of naturally occurring and anthropogenic substances in soil, shallow overburden and deeper bedrock groundwater, surface water, and sediment in areas of the former SEDA that are not directly impacted by former site activities but have similar on-site conditions. • Present the data distribution and basic statistics for each medium.	• Analytical results from surface and subsurface soil, groundwater, surface water, and sediment data (VOCs, SVOCs, metals, explosives, perchlorate, total and dissolved phosphorus, orthophosphate, and PFAS)	• The investigation will be in the surface and subsurface soil, groundwater, surface water, and sediment in areas not expected to be impacted by former SEDA activities. • Generally, sample collection will be along the eastern boundary of the former SEDA away from potential point sources.	• Collect and analyze soil, groundwater, surface water, and sediment samples and review concentrations of detected chemicals compared to Project Action Limits (PALs) (Worksheet #15) and regional background values (e.g., historical data such as soil surveys and groundwater quality reports).	• State and Federal criteria will be used for reference (See Worksheet 15)	• Collect samples from surface and subsurface soil, groundwater, surface water, and sediment away from point source, as described in the Work Plan for the SEDA Backgrounds Study.

Worksheet #12: Measurement Performance Criteria

(EPA UFP-QAPP Guidance Manual, Section 2.6.2; EPA Guidance QA/G-5, Section 2.1.7)

The tables below summarize the MPCs that have been established for the groundwater, surface water, soil and sediment sampling tasks to be conducted under this task order (TO). The quality of the sampling procedures and laboratory results will be evaluated for compliance with DQOs through a review in accordance with the procedures described in **Worksheet #37**. Data validation is conducted in accordance with the QAPP, DoD General Data Validation Guidelines (EDQW 2019), and the USEPA Region 2 SOPs for organic and inorganic data review. A data usability summary report (DUSR) will be provided to the NYSDEC upon request. Sample collection procedures and analytical methods/SOPs are summarized on **Worksheet #21** and **Worksheet #23**, respectively.

12.1 MEASUREMENT PERFORMANCE CRITERIA FOR VOCs

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	VOC / 8260D
Concentration Level	Low

Data Quality Indicators	Quality Control (QC) Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	Relative Percent Difference (RPD) ≤ 30% for water matrix and ≤50% for soil matrix when target analytes are detected in both samples with concentrations are ≥ sample specific Limit of Quantitation (LOQ). If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD Quality Systems Manual (QSM) Version 5.4 Appendix C Table C-23 limits for solid matrix and Table C-24 limits for water matrix (See WS #28 Table 28.1b and 28.1c).
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-23 limits for solid matrix and Table C-24 limits for water matrix (See WS #28 Table 28.1b and 28.1c).
Analytical Precision/Bias (matrix interference)	Matrix Spike Duplicate	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	No target analyte concentrations ≥ 1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks/Trip Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.2 MEASUREMENT PERFORMANCE CRITERIA FOR SVOCs

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	SVOC / 8270E
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when target analytes are detected in both samples with concentrations are ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD QSM Version 5.4 Appendix C Table C-25 limits for solid matrix and Table C-26 limits for water matrix. (See WS #28 Table 28.2b and 28.2c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-25 limits for solid matrix and Table C-26 limits for water matrix. (See WS #28 Table 28.2b and 28.2c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	No target analyte concentrations ≥ 1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.3 MEASUREMENT PERFORMANCE CRITERIA FOR METALS

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	TAL Metals / 6020B(1)
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for solid matrix when the target metals are detected in both samples ≥ sample-specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD QSM Version 5.4 Appendix C Table C-6 limits for water matrix and C-5 for solid matrix (See WS #28 Table 28.4b and 28.4c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-6 limits for water matrix and C-5 for solid matrix (See WS #28 Table 28.4b and 28.4c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

(1) Trivalent chromium is calculated by the SGS Laboratory Information Management System (LIMS) using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

12.4 MEASUREMENT PERFORMANCE CRITERIA FOR MERCURY

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	Mercury / 7470A / 7471B
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when mercury is detected in both samples ≥ sample-specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD QSM Version 5.4 Appendix C Table C-11 limits for solid matrix and Table C-12 limits for water matrix (See WS #28)
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-11 limits for solid matrix and Table C-12 limits for water matrix (See WS #28)
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.
Overall accuracy/bias (contamination)	Equipment Blanks	No mercury concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.5 MEASUREMENT PERFORMANCE CRITERIA FOR EXPLOSIVES

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	Explosives / 8330B
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when target analytes are detected in both samples with concentrations ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD QSM Version 5.4 Appendix C Table C-36 limits for water matrix and Table C-37 limits for soil matrix (See WS #28 Table 28.8b and 28.8c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-36 limits for water matrix and Table C-37 limits for soil matrix (See WS #28 Table 28.8b and 28.8c)
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	No target analyte concentrations ≥ 1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.6 MEASUREMENT PERFORMANCE CRITERIA FOR PERCHLORATE

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil, and Sediment
Analytical Group or Method:	Perchlorate / 6850
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when target analytes are detected in both samples with concentrations ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 15%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	Within DoD QSM Version 5.4 Appendix C Table C-7 limits for soil matrix and Table C-8 limits for water matrix (See WS #28)
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Within DoD QSM Version 5.4 Appendix C Table C-7 limits for soil matrix and Table C-8 limits for water matrix (See WS #28)
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 15%
Overall accuracy/bias (contamination)	Method Blank	No target analyte concentrations ≥ 1/2 LOQ or >1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.7 MEASUREMENT PERFORMANCE CRITERIA FOR ORTHOPHOSPHATE AS P

Laboratory:	Katahdin
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	Orthophosphate as P / SM 4500P-E
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤30% for water matrix and ≤50% for soil matrix when target analytes are detected in both samples with concentrations ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Duplicates	RPD ≤ 20%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	80-120%
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	75-125%
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blanks	No analytes detected >1/2LOQ or >1/10 sample concentration or >1/10 regulatory limit, whichever is greater
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.8 MEASUREMENT PERFORMANCE CRITERIA FOR TOTAL PHOSPHORUS

Laboratory:	Katahdin
Matrix:	Soil and Sediment
Analytical Group or Method:	Total Phosphorus / EPA 365.4
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤50% for solid matrix when target analytes are detected in both samples with concentrations ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Duplicates	RPD ≤ 20%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	90-110%
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	85-115%
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blanks	No target analyte concentrations ≥ LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.9 MEASUREMENT PERFORMANCE CRITERIA FOR TOTAL AND DISSOLVED PHOSPHORUS

Laboratory: Katahdin
Matrix: Groundwater and Surface Water
Analytical Group or Method: Dissolved and Total Phosphorus / EPA 365.2
Concentration Level Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% when detected in both samples with concentrations are ≥ sample specific LOQ.
Analytical Precision (laboratory)	Laboratory Duplicates	RPD ≤ 20%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	80-120%.
Analytical Accuracy/Bias (matrix interference)	Matrix Spike	75-125%
Overall accuracy/bias (contamination)	Method Blanks	No target analyte concentrations ≥ LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

12.10 MEASUREMENT PERFORMANCE CRITERIA FOR HEXAVALENT CHROMIUM

Laboratory:	SGS Orlando
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	Hexavalent Chromium/ 7196A(1)
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when the target metals are detected in both samples ≥ sample-specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 20%, LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples	In-house limits of 85-115% for waters and 80-120% for solids.
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	In-house limits of 85-115% for waters and 75-125% for solids.
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 20%
Overall accuracy/bias (contamination)	Method Blank	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater
Overall accuracy/bias (contamination)	Equipment Blanks	No target analyte concentrations ≥ 1/2 LOQ
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

(2) Trivalent chromium is calculated by the SGS Laboratory Information Management System (LIMS) using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

12.11 MEASUREMENT PERFORMANCE CRITERIA FOR PFAS

Laboratory:	ELLE
Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group or Method:	PFAS/ Draft Method 1633
Concentration Level	Low

Data Quality Indicators	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	RPD ≤ 30% for water matrix and ≤50% for soil matrix when PFAS analytes are detected in both samples ≥ sample-specific LOQ.
Analytical Precision (laboratory)	Laboratory Control Sample Duplicates	RPD ≤ 30%. LCSD is only required when a MS/MSD pair is not performed.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Sample (LCS) or Ongoing Precision and Recovery Standard (OPR) and Low-Level Laboratory Control Sample (LLLCS) or Low-Level Ongoing Precision and Recovery Standard (LLOPR)	Table B-24 QSM 5.4 default limits of 40-150% must be used until in-house limits are generated. In-house control limits have not been developed for waters (WS #28, Table 28.12b) therefore 40-150% will be used. In-house limits for some soil analytes were developed, see WS #28, Table 12c for actual control limits used.
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes	Table B-24 QSM 5.4 default limits of 40-150% (same as Laboratory Control Sample [LCS]) until in-house limits are generated.
Analytical Accuracy/Bias (matrix interference)	Matrix Spike Duplicates	RPD ≤ 30%
Overall accuracy/bias (contamination)	Instrument Blank	Concentration of each analyte must be ≤ ½ LOQ.
Overall accuracy/bias (contamination)	Method Blank	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.
Overall accuracy/bias (contamination)	Equipment Blanks	No analytes detected >½ LOQ or >1/10th the amount measured in any associated sample or 1/10th the regulatory limit, whichever is greater.
Sensitivity	Instrument sensitivity check	All analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values. Signal-to noise ratio must be ≥ 3:1.
Sensitivity	Bile Salt Standards	The retention time of the bile salt(s) peak must fall outside of the retention time window of PFOS by at least one minute.
Completeness	>90% sample collection, >90% laboratory analysis	Data Completeness Check

Worksheet #13: Secondary Data Criteria and Limitations

(EPA UFP-QAPP Guidance Manual, Section 2.7)

This table lists the secondary data used to support decision making during this investigation.

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Background metals concentrations in soil	Seneca County, NY Soil Survey (1972) USDA Natural Resources Conservation Service, Web Soil Survey	U.S. Department of Agriculture (USDA)	Data will be used to compare against background metals concentrations to establish a baseline for regional comparison.	Regional variation
Regional metals concentrations in groundwater	Mozola (1956). The groundwater resources of Seneca Co., NY USGS (2012). Groundwater quality in central New York, 2012. Open Report 2014-1226.	U.S. Geological Survey (USGS)	Data will be used to compare against background metals concentrations to establish a baseline for regional comparison.	Age of data Regional Variation

Worksheets #14 & 16: Project Tasks and Schedule

(EPA UFP-QAPP Guidance Manual, Section 2.8.2, EPA Guidance QA/G-5, Section 2.1.4)

The activities to be conducted at Seneca Army Depot Activity to achieve the project DQOs (**Worksheet #11**) comprise one primary component: to obtain analytical data to develop a background database of potential COPCs in soil, groundwater, surface water, and sediment at the former SEDA. Multiple elements, or “DFWs,” are required to achieve the project goals. Table 14.1 provides a summary of these definable features of work (DFWs) and the associated component tasks. A detailed discussion of the primary project component at each site and the related DFWs is included on **Worksheet #17**, and the specific field procedures to be used for the activities described in this summary are included in the various SOPs appended to this UFP-QAPP. The task schedule for sampling preformed under this UFP-QAPP is provided in Section 3.9 of the Background Study Workplan.

Table 14.1 – Project Tasks

Definable Feature of Work (Activity)	Associated Tasks	Related SOPs
Mobilization	Preparation (review plans, make travel arrangements, etc.) Mobilize equipment and vehicles to the site Set up site communications Conduct site-specific training and briefing for required field personnel	--
Site Preparation	Set up and calibrate sampling equipment Prepare sample bottles and labels	• Parsons SOPs (Worksheet #21)
Drilling, Well Installation, and Abandonment	Drilling Well Installation Well Abandonment, if applicable	• Parsons SOPs (Worksheet #21)
Well Development	Well Development	• Parsons SOPs (Worksheet #21)
Sampling and Analysis	Collect and analyze samples Conduct QC evaluation of analytical data for validation Document data validation and sample results	• Parsons SOPs (Worksheet #21) • Analytical SOPs (Worksheet #23)
Demobilization	Upon completion of field activities all personnel, equipment and materials will be removed from the site	--
Reports	Background Study: The results of the sampling will be reported in an analytical results letter report	--

Worksheet #15: Project Action Limits and Laboratory-Specific Detection / Quantitation Limits

(EPA UFP-QAPP Guidance Manual, Section 2.8.1)

This worksheet provides the parameters to be analyzed and their associated limits of quantitation (LOQ), limits of detection (LOD), and detection limits (DL). The Project Action Limits (PALs), as referenced in the DQOs on **Worksheet #11**, are also included. The PALs for this project use applicable New York State (NYS) criteria where available, or lower EPA maximum contaminant level (MCL), if applicable. If a promulgated NYS value was not available, an EPA source was used as an alternative. References for the criteria used are available in the table footnotes below. In the absence of sediment specific screening levels for human health, soil screening levels are used. This is a conservative approach, as the exposure frequency for sediment is usually expected to be less than for soil (i.e., a receptor is not expected to be exposed to sediment every day as they are for soil).

In some cases, the LOQ is greater than the screening value due to limitations in the analytical method. This is common in some analyses due to sample preparation and analytical limitations. This could lead to a situation where the analyte is present at a concentration greater than the screening value, but is reported as "not detected or estimated," leading to a potential underestimate of risk. In such a case, detections between the LOQ and LOD are J qualified and addressed as detects, the data will be considered usable for determining nature and extent and all detects will be used for planning purposes. The selected laboratory is using the appropriate analytical method and no approved alternative method has been identified that would achieve lower LOD/LOQs. If the sensitivity requirements are not met for a particular analyte, the PDT will evaluate whether the data can still be used for project decisions. The LOD/LOQs are considered sufficient for determining data usability at this site. Any analytes that are not detected in any well at the site will be considered to not be present at the site and site-related decisions will be based on this information.

Table 15.1 – Project Action Limits and SGS Orlando Reference Limits for VOCs in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 8260D)

			Achievable Laboratory Limits[3]		
Analyte	**Project Action Limit (µg/L) [1]**	**PAL Reference[2]**	**LOQ (µg/L)**	**LOD (µg/L)**	**DL (µg/L)**
1,1,1,2-Tetrachloroethane	5/0.57	NYS/EPA Tap	1.0	0.50	0.28
1,1,1-Trichloroethane	5/800	NYS/EPA Tap	1.0	0.50	0.25
1,1,2,2-Tetrachloroethane	5/0.076	NYS/EPA Tap	1.0	0.50	0.30
1,1,2-Trichloroethane	1 0.041	NYS/LOQ EPA Tap	1.0	0.50	0.47
1,1-Dichloroethane	5/2.8	NYS/EPA Tap	1.0	0.50	0.34
1,1-Dichloroethene	5/28	NYS/EPA Tap	1.0	0.50	0.32
1,1-Dichloropropene	NA	NYS/EPA Tap	1.0	0.50	0.34
1,2,3-Trichlorobenzene	5/0.70	NYS/EPA Tap	2.0	1.0	0.50
1,2,3-Trichloropropane	2 0.04/0.00075	LOQ NYS/EPA Tap	2.0	1.0	0.63
1,2,4-Trichlorobenzene	25/0.40	NYS/EPA Tap	2.0	1.0	0.50
1,2,4-Trimethylbenzene	5/5.6	NYS/EPA Tap	1.0	0.50	0.32
1,2-Dibromo-3-Chloropropane	5 0.04/0.00033	LOQ NYS/EPA Tap	5.0	2.0	1.0
1,2-Dibromoethane	2	LOQ	2.0	1.0	0.28

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
	NA/0.0075	NYS/EPA Tap			
1,2-Dichlorobenzene	3/30	NYS/EPA Tap	1.0	0.50	0.32
1,2-Dichloroethane	1 0.6/0.17	LOQ NYS/EPA Tap	1.0	0.50	0.31
1,2-Dichloropropane	1 0.82	NYS/LOQ EPA Tap	1.0	0.50	0.43
1,3,5-Trimethylbenzene	5/6	NYS/EPA Tap	1.0	0.50	0.27
1,3-Dichlorobenzene	3/NA	NYS/EPA Tap	1.0	0.50	0.22
1,3-Dichloropropane	5/37	NYS/EPA Tap	1.0	0.50	0.31
1,4-Dichlorobenzene	3/0.48	NYS/EPA Tap	1.0	0.50	0.26
2,2-Dichloropropane	5/0.82	NYS/EPA Tap	1.0	0.50	0.24
2-Butanone (MEK)	NA/560	NYS/EPA Tap	5.0	3.5	2.0
2-Chlorotoluene	5/24	NYS/EPA Tap	1.0	0.50	0.22
2-Hexanone	10 NA/3.8	LOQ NYS/EPA Tap	10.0	5.0	2.0
4-Chlorotoluene	5/25	NYS/EPA Tap	1.0	0.50	0.31
4-Methyl-2-pentanone (MIBK)	NA/630	NYS/EPA Tap	5.0	2.0	1.0
Acetone	NA/1800	NYS/EPA Tap	25.0	20.0	10.0
Benzene	1 0.46	NYS/LOQ EPA Tap	1.0	0.50	0.31
Bromobenzene	5/6.2	NYS/EPA Tap	1.0	0.50	0.37
Bromochloromethane	5/8.3	NYS/EPA Tap	1.0	0.50	0.45
Bromodichloromethane	1 NA/0.13	LOQ NYS/EPA Tap	1.0	0.50	0.24
Bromoform	NA/3.3	NYS/EPA Tap	1.0	0.50	0.41
Bromomethane	5 0.75	NYS/LOQ EPA Tap	5.0	4.0	2.0
cis-1,2-Dichloroethene	5/3.6	NYS/EPA Tap	1.0	0.50	0.28
cis-1,3-Dichloropropene (sum of cis- and trans- isomers)	1 0.4/0.47	LOQ NYS/EPA Tap	1.0	0.50	0.29
Carbon disulfide	60 81	NYS EPA Tap	2.0	1.0	0.53
Carbon tetrachloride	5/0.46	NYS/EPA Tap	1.0	0.50	0.36
Chlorobenzene	5/7.8	NYS/EPA Tap	1.0	0.50	0.20
Chloroethane	5/830	NYS/EPA Tap	2.0	1.0	0.67
Chloroform	7/0.22	NYS/EPA Tap	1.0	0.50	0.30
Chloromethane	NA/19	NYS/EPA Tap	2.0	1.0	0.50
Dibromochloromethane	1 NA/0.87	LOQ NYS/EPA Tap	1.0	0.50	0.28
Dibromomethane	5/0.83	NYS/EPA Tap	2.0	0.50	0.37

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Dichlorodifluoromethane	5/20	NYS/EPA Tap	2.0	1.0	0.50
Ethylbenzene	5/1.5	NYS/EPA Tap	1.0	0.50	0.36
Hexachlorobutadiene	2 0.5/0.14	LOQ NYS/EPA Tap	2.0	1.0	0.30
Isopropylbenzene	5/45	NYS/EPA Tap	1.0	0.50	0.22
m-, p-Xylenes	5/19	NYS/EPA Tap	2.0	1.0	0.47
Methylene Chloride	5 11	NYS/LOQ EPA Tap	5.0	4.0	2.0
Methyl tert-Butyl Ether (MTBE)	NA/14	NYS/EPA Tap	1.0	0.50	0.23
Naphthalene	5 NA/0.12	LOQ NYS/EPA Tap	5.0	2.0	1.0
n-Butylbenzene	5/100	NYS/EPA Tap	1.0	0.50	0.23
o-Xylene	5/19	NYS/EPA Tap	1.0	0.50	0.26
p-Isopropyltoluene	5/NA	NYS/EPA Tap	1.0	0.50	0.21
n-Propylbenzene	5/66	NYS/EPA Tap	1.0	0.50	0.29
sec-Butylbenzene	5/200	NYS/EPA Tap	1.0	0.50	0.24
Styrene	5/120	NYS/EPA Tap	1.0	0.50	0.22
trans-1,2-Dichloroethene	5/6.8	NYS/EPA Tap	1.0	0.50	0.22
trans-1,3-Dichloropropene	NA	NYS/EPA Tap	1.0	0.50	0.21
tert-Butylbenzene	5/69	NYS/EPA Tap	1.0	0.50	0.31
Tetrachloroethene	5/4.1	NYS/EPA Tap	1.0	0.50	0.22
Toluene	5/110	NYS/EPA Tap	1.0	0.50	0.30
Trichloroethene	5/0.28	NYS/EPA Tap	1.0	0.50	0.35
Trichlorofluoromethane	5/520	NYS/EPA Tap	2.0	1.0	0.50
Vinyl Acetate	NA/41	NYS/EPA Tap	10	5.0	2.0
Vinyl chloride	2/0.019	NYS/EPA Tap	1.0	0.50	0.41
Total Xylenes	NA/19	NYS/EPA Tap	3.0	1.5	0.73

(1) PAL was determined by selecting the lower of either NYS Class GA (6 CRR-NY 703.5) or EPA Regional Screening Levels (RSL) Tap Water (Target Risk [TR]=1E-06, Target Hazard Quotient [THQ]=0.1), November 2023. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening value is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and NYS GA Standard.

NA = Not available; µg/L = Micrograms per liter

Table 15.2 – Project Action Limits and SGS Orlando Reference Limits for VOCs in Surface Water (Ecological) (Method SW-846 8260D)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,1,1,2-Tetrachloroethane	85	EPA 2018, Freshwater (FW) Chronic	1.0	0.50	0.28
1,1,1-Trichloroethane	76	EPA 2018, FW Chronic	1.0	0.50	0.25
1,1,2,2-Tetrachloroethane	200	EPA 2018, FW Chronic	1.0	0.50	0.30
1,1,2-Trichloroethane	730	EPA 2018, FW Chronic	1.0	0.50	0.47
1,1-Dichloroethane	410	EPA 2018, FW Chronic	1.0	0.50	0.34
1,1-Dichloroethene	130	EPA 2018, FW Chronic	1.0	0.50	0.32
1,1-Dichloropropene	NA	NA	1.0	0.50	0.34
1,2,3-Trichlorobenzene	5	NYS(4)	2.0	1.0	0.50
1,2,3-Trichloropropane	2 / 0.04	LOQ / NYS(4)	2.0	1.0	0.63
1,2,4-Trichlorobenzene	5	NYS(4)	2.0	1.0	0.50
1,2,4-Trimethylbenzene	15	EPA 2018, FW Chronic	1.0	0.50	0.32
1,2-Dibromo-3-Chloropropane	NA	NA	5.0	2.0	1.0
1,2-Dibromoethane	NA	NA	2.0	1.0	0.28
1,2-Dichlorobenzene	5	NYS(4)	1.0	0.50	0.32
1,2-Dichloroethane	2,000	EPA 2018, FW Chronic	1.0	0.50	0.31
1,2-Dichloropropane	520	EPA 2018, FW Chronic	1.0	0.50	0.43
1,3,5-Trimethylbenzene	26	EPA 2018, FW Chronic	1.0	0.50	0.27
1,3-Dichlorobenzene	5	NYS(4)	1.0	0.50	0.22
1,3-Dichloropropane	NA	NA	1.0	0.50	0.31
1,4-Dichlorobenzene	5	NYS(4)	1.0	0.50	0.26
2,2-Dichloropropane	NA	NA	1.0	0.50	0.24
2-Butanone (MEK)	22,000	EPA 2018, FW Chronic	5.0	3.5	2.0
2-Chlorotoluene	5	NYS	1.0	0.50	0.22
2-Hexanone	99	EPA 2018, FW Chronic	10.0	5.0	2.0
4-Chlorotoluene	5	NYS(4)	1.0	0.50	0.31
4-Methyl-2-pentanone (MIBK)	170	EPA 2018, FW Chronic	5.0	2.0	1.0
Acetone	1,700	EPA 2018, FW Chronic	25.0	20.0	10.0
Benzene	10	NYS, Human (Fish Consumption) [H(FC)]	1.0	0.50	0.31
Bromobenzene	NA	NA	1.0	0.50	0.37
Bromochloromethane	5	NYS(4)	1.0	0.50	0.45
Bromodichloromethane	340	EPA 2018, FW Chronic	1.0	0.50	0.24
Bromoform	230	EPA 2018, FW Chronic	1.0	0.50	0.41
Bromomethane	16	EPA 2018, FW Chronic	5.0	4.0	2.0
cis-1,2-Dichloroethene	620	EPA 2018, FW Chronic	1.0	0.50	0.28
cis-1,3-Dichloropropene	1.7	EPA 2018, FW Chronic(5)	1.0	0.50	0.29

			Achievable Laboratory Limits(3)		
Analyte	**Project Action Limit (µg/L) (1)**	**PAL Reference(2)**	**LOQ (µg/L)**	**LOD (µg/L)**	**DL (µg/L)**
Carbon disulfide	15	EPA 2018, FW Chronic	2.0	1.0	0.53
Carbon tetrachloride	77	EPA 2018, FW Chronic	1.0	0.50	0.36
Chlorobenzene	5	NYS(4)	1.0	0.50	0.20
Chloroethane	NA	NA	2.0	1.0	0.67
Chloroform	140	EPA 2018, FW Chronic	1.0	0.50	0.30
Chloromethane	NA	NA	2.0	1.0	0.50
Dibromochloromethane	320	EPA 2018, FW Chronic	1.0	0.50	0.28
Dibromomethane	5	NYS(4)	2.0	0.50	0.37
Dichlorodifluoromethane	5	NYS(4)	2.0	1.0	0.50
Ethylbenzene	61	EPA 2018, FW Chronic	1.0	0.50	0.36
Hexachlorobutadiene	2/0.01	LOQ/NYS	2.0	1.0	0.30
Isopropylbenzene	4.8	EPA 2018, FW Chronic	1.0	0.50	0.22
m-, p-Xylenes	5	NYS(4)	2.0	1.0	0.47
Methylene Chloride	200	NYS(4)	5.0	4.0	2.0
MTBE	730	EPA 2018, FW Chronic	1.0	0.50	0.23
Naphthalene	21	EPA 2018, FW Chronic)	5.0	2.0	1.0
n-Butylbenzene	5	NYS(4)	1.0	0.50	0.23
o-Xylene	5	NYS(4)	1.0	0.50	0.26
p-Isopropyltoluene	16	EPA 2018, FW Chronic	1.0	0.50	0.21
n-Propylbenzene	5	NYS(4)	1.0	0.50	0.29
sec-Butylbenzene	5	NYS(4)	1.0	0.50	0.24
Styrene	32	EPA 2018, FW Chronic	1.0	0.50	0.22
trans-1,2-Dichloroethene	558	EPA 2018, FW Chronic	1.0	0.50	0.22
trans-1,3-Dichloropropene	1.7	EPA 2018, FW Chronic(5)	1.0	0.50	0.21
tert-Butylbenzene	5	NYS(4)	1.0	0.50	0.31
Tetrachloroethene	53	EPA 2018, FW Chronic	1.0	0.50	0.22
Toluene	62	EPA 2018, FW Chronic	1.0	0.50	0.30
Trichloroethene	40	NYS, H(FC)	1.0	0.50	0.35
Trichlorofluoromethane	NA	NA	2.0	1.0	0.50
Vinyl Acetate	16	EPA 2018, FW Chronic	10	5.0	2.0
Vinyl chloride	930	EPA 2018, FW Chronic	1.0	0.50	0.41
Total Xylenes	27	EPA 2018, FW Chronic	3.0	1.5	0.73

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 703.5 Class C, Aquatic (Chronic) and Human (Fish Consumption) water quality standards (NYS WQS) and, if not available, the EPA Region 4 Surface Water Screening Values [Freshwater Screening Values; Chronic] (EPA Region 4 SV). Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
   b. https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the “best achievable detection limit” or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the NYS WQS and the EPA Region 4 SV, then the PAL is set to the higher value between NYS WQS and the EPA Region 4 SV.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the NYS WQS and the EPA Region4 SV.

(4) NYS A(C) WQS, NYS H(FC) WQS, and EPA values not available. NYS H(WS) WQS value used for comparison only.

(5) Value applicable to 1,3-Dichloropropene (cis and trans) combined.

NA = Not available; µg/L = Micrograms per liter

Table 15.3 – Project Action Limits and SGS Orlando Reference Limits for VOCs in Soil and Sediment (Method SW-846 8260D)

Analyte	Project Action Limit (µg/kg)(1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
1,1,1,2-Tetrachloroethane	NA/2,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,1,1-Trichloroethane	680/810,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,1,2,2-Tetrachloroethane	NA/600	NYS/EPA Res Soil	5.0	2.0	1.0
1,1,2-Trichloroethane	NA/150	EPA Res Soil	5.0	2.0	1.0
1,1-Dichloroethane	270/3,600	NYS/EPA Res Soil	5.0	2.0	1.8
1,1-Dichloroethene	330/23,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,1-Dichloropropene	NA	NA	5.0	2.0	1.0
1,2,3-Trichlorobenzene	NA/6,300	NYS/EPA Res Soil	5.0	3.5	1.4
1,2,3-Trichloropropane	NA/5.1	NYS/EPA Res Soil	5.0	3.5	1.3
1,2,4-Trichlorobenzene	NA/5,800	NYS/EPA Res Soil	5.0	3.5	1.0
1,2,4-Trimethylbenzene	3,600/30,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,2-Dibromo-3-Chloropropane	NA/5.3	NYS/EPA Res Soil	5.0	3.5	1.9
1,2-Dibromoethane	NA/36	NYS/EPA Res Soil	5.0	2.0	1.0
1,2-Dichlorobenzene	1,100/180,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,2-Dichloroethane	20/460	NYS/EPA Res Soil	5.0	2.0	1.0
1,2-Dichloropropane	NA/1,600	NYS/EPA Res Soil	5.0	2.0	1.0
1,3,5-Trimethylbenzene	8,400/27,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,3-Dichlorobenzene	2,400/NA	NYS/EPA Res Soil	5.0	2.0	1.0
1,3-Dichloropropane	NA/160,000	NYS/EPA Res Soil	5.0	2.0	1.0
1,4-Dichlorobenzene	1,800/2,600	NYS/EPA Res Soil	5.0	2.0	1.2
2,2-Dichloropropane	NA	NA	5.0	2.0	1.0
2-Butanone (MEK)	NA/2,700,000	NYS/EPA Res Soil	25.0	15.0	7.3
2-Chlorotoluene (o-)	NA/160,000	NYS/EPA Res Soil	5.0	2.0	1.0
2-Hexanone	NA/20,000	NYS/EPA Res Soil	25.0	15.0	7.5
4-Chlorotoluene (p-)	NA/160,000	NYS/EPA Res Soil	5.0	2.0	1.0
4-Methyl-2-pentanone (MIBK)	NA/3,300,000	NYS/EPA Res Soil	25.0	15.0	7.5
Acetone	200 50/7,000,000	LOQ NYS/EPA Res Soil	200	150	100
Benzene	60/1,200	NYS/EPA Res Soil	5.0	2.0	1.2
Bromobenzene	NA/29,000	NYS/EPA Res Soil	5.0	2.0	1.0
Bromochloromethane	NA/15,000	NYS/EPA Res Soil	5.0	2.0	1.5
Bromodichloromethane	NA/290	NYS/EPA Res Soil	5.0	2.0	1.0
Bromoform	NA/19,000	NYS/EPA Res Soil	5.0	2.0	1.0
Bromomethane	680	EPA Res Soil	5.0	3.5	2.0
cis-1,2-Dichloroethene	250(4)/16,000	NYS/EPA Res Soil	5.0	2.0	1.4
cis-1,3-Dichloropropene	NA	NA	5.0	2.0	1.0

Analyte	Project Action Limit (µg/kg)(1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
Carbon disulfide	77,000	EPA Res Soil	5.0	2.0	1.0
Carbon tetrachloride	760/650	NYS/EPA Res Soil	5.0	2.0	1.0
Chlorobenzene	1,100/28,000	NYS/EPA Res Soil	5.0	2.0	1.0
Ethyl Chloride (Chloroethane)	540,000	EPA Res Soil	5.0	3.5	2.0
Chloroform	370/320	NYS/EPA Res Soil	5.0	2.0	1.3
Chloromethane	11,000	EPA Res Soil	5.0	3.5	2.0
Dibromochloromethane	8,300	EPA Res Soil	5.0	2.0	1.0
Dibromomethane (Methylene Bromide)	2,400	EPA Res Soil	5.0	2.0	1.0
Dichlorodifluoromethane	8.7	EPA Res Soil	5.0	3.5	2.0
Ethylbenzene	1,000/5,800	NYS/EPA Res Soil	5.0	2.0	1.0
Hexachlorobutadiene	1,200	EPA Res Soil	5.0	2.0	1.3
Isopropylbenzene (cumene)	190,000	EPA Res Soil	5.0	2.0	1.0
m-, p-Xylenes	260/55,000	NYS(4)/EPA Res Soil	10.0	4.0	1.1
Methylene Chloride	50/35,000	NYS/EPA Res Soil	20.0	15.0	11.0
MTBE	930/47,000	NYS/EPA Res Soil	5.0	2.0	1.0
Naphthalene	12,000/2,000	NYS/EPA Res Soil	5.0	3.5	2.0
n-Butylbenzene	12,000/ 390,000	NYS/ EPA Res Soil	5.0	2.0	1.0
o-Xylene	260/64,000	NYS(4)/EPA Res Soil	5.0	2.0	1.0
p-Isopropyltoluene	NA	NA	5.0	2.0	1.0
n-Propylbenzene	3,900/380,000	NYS/EPA Res Soil	5.0	2.0	1.0
sec-Butylbenzene	11,000/ 780,000	NYS/ EPA Res Soil	5.0	2.0	1.0
Styrene	600,000	EPA Res Soil	5.0	2.0	1.0
trans-1,2-Dichloroethene	190/7,000	NYS/EPA Res Soil	5.0	2.0	1.0
trans-1,3-Dichloropropene	NA	NA	5.0	2.0	1.0
tert-Butylbenzene	5,900/780,000	NYS/EPA Res Soil	5.0	2.0	1.0
Tetrachloroethene	1,300/8,100	NYS/EPA Res Soil	5.0	2.0	1.3
Toluene	700/490,000	NYS/EPA Res Soil	20.0	15.0	10.0
Trichloroethene	470/410	NYS/EPA Res Soil	5.0	2.0	1.0
Trichlorofluoromethane	2,300,000	EPA Res Soil	5.0	3.5	2.0
Vinyl Acetate	91	EPA Res Soil	25.0	20.0	16.0
Vinyl chloride	20/59	NYS/EPA Res Soil	5.0	2.0	1.0
Total Xylenes	260/58,000	NYS(4)/EPA Res Soil	15.0	6.0	2.1

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives (NYS Unrestricted Use SCO) or 2) EPA RSL Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil (EPA RSL Resident Soil). Values in grey font are for reference.

  a. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29
  b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening value is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Resident Soil and NYS Unrestricted Use SCO, then the PAL is set to the higher value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(4) NYS value for individual isomers and total xylenes not found. NYS value for Xylene (mixed) provided for comparison.

NA = Not available; µg/kg = micrograms per kilogram

Table 15.4 – Project Action Limits and SGS Orlando Reference Limits for SVOCs in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 8270E)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference (2)	Achievable Laboratory Limits (3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,2,4-Trichlorobenzene	5 0.4	NYS/LOQ EPA Tap	5.0	2.0	1.1
1,2-Dichlorobenzene	3/30	NYS/EPA Tap	5.0	2.0	0.50
1,2-Diphenylhydrazine (Azobenzene)	5 ND/0.078	LOQ NYS/EPA Tap	5.0	2.0	0.76
1,3-Dichlorobenzene	5 3	LOQ NYS	5.0	2.0	0.50
1,4-Dichlorobenzene	5 3/0.48	LOQ NYS/EPA Tap	5.0	2.0	0.50
1-Methylnaphthalene	5 1.1	LOQ EPA Tap	5.0	1.0	0.53
2,4,5-Trichlorophenol	120	EPA Tap	5.0	2.0	0.74
2,4,6-Trichlorophenol	5 1.2	LOQ EPA Tap	5.0	2.0	0.75
2,4-Dichlorophenol	5 1/4.6	LOQ NYS/EPA Tap	5.0	1.0	0.84
2,4-Dimethylphenol	1/36	NYS/EPA Tap	5.0	2.0	0.74
2,4-Dinitrophenol	25 1/3.9	LOQ NYS/EPA Tap	25.0	20.0	5.0
2,4-Dinitrotoluene	5 0.24	NYS/LOQ EPA Tap	5.0	1.0	0.81
2,6-Dinitrotoluene	5 0.049	NYS/LOQ EPA Tap	5.0	1.0	0.71
2-Chloronaphthalene	75	EPA Tap	5.0	2.0	0.50
2-Chlorophenol	9.1	EPA Tap	5.0	1.0	0.63
2-Methylnaphthalene	5 3.6	LOQ EPA Tap	5.0	1.0	0.60
2-Methylphenol (o-Cresol)	93	EPA Tap	5.0	1.0	0.56

Analyte	Project Action Limit (µg/L) (1)	PAL Reference (2)	Achievable Laboratory Limits (3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
2-Nitroaniline	5 19	NYS/LOQ EPA Tap	5.0	3.5	1.8
2-Nitrophenol	NA	NA	5.0	2.0	0.85
3,3'-Dichlorobenzidine	5 0.13	NYS/LOQ EPA Tap	5.0	2.0	0.64
3 & 4-Methylphenol (m/p-Cresol)	93	EPA Tap	5.0	2.0	0.98
3-Nitroaniline	5	NYS/LOQ	5.0	2.0	0.88
4,6-Dinitro-2-Methylphenol	10 0.15	LOQ EPA Tap	10.0	4.0	2.0
4-Bromophenyl-phenyl ether	NA	NA	5.0	1.0	0.85
4-Chloro-3-Methylphenol (Cresol, p-chloro-m-)	140	EPA Tap	5.0	1.0	0.59
4-Chloroaniline	5 0.37	NYS/LOQ EPA Tap	5.0	1.0	0.63
4-Chlorophenyl-phenyl ether	NA	NA	5.0	1.0	0.54
4-Nitroaniline	5 3.8	NYS/LOQ EPA Tap	5.0	2.0	1.2
4-Nitrophenol	NA	NA	25.0	10.0	5.0
Acenaphthene	53	EPA Tap	5.0	1.0	0.63
Acenaphthylene	NA	NA	5.0	1.0	0.64
Anthracene	180	EPA Tap	5.0	1.0	0.80
Benzidine	25 5/0.00011	LOQ NYS/EPA Tap	25	10.0	5.0
Benzo(a)anthracene	5 0.03	LOQ EPA Tap	5.0	1.0	0.76
Benzo(a)pyrene	5 ND/0.025	LOQ NYS/EPA Tap	5.0	1.0	0.78
Benzo(b)fluoranthene	5 0.25	LOQ EPA Tap	5.0	1.0	0.78
Benzo(g,h,i)perylene	NA	NA	5.0	1.0	0.82
Benzo(k)fluoranthene	5 2.5	LOQ EPA Tap	5.0	1.0	0.86
Benzoic acid	7,500	EPA Tap	50.0	25.0	10.0
Benzyl alcohol	200	EPA Tap	5.0	1.0	0.61
Bis(2-Chloroethoxy) methane	5 5.9	NYS/LOQ EPA Tap	5.0	2.0	0.81
Bis(2-Chloroethyl)ether	5 1/0.014	LOQ NYS/EPA Tap	5.0	1.0	0.73

Analyte	Project Action Limit (µg/L) (1)	PAL Reference (2)	Achievable Laboratory Limits (3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Bis(2-ethylhexyl)phthalate	5 5.6	NYS/LOQ EPA Tap	5.0	2.0	1.0
Butyl benzyl phthalate	16	EPA Tap	5.0	2.0	1.0
Carbazole	NA	NA	5.0	1.0	0.60
Chrysene	25	EPA Tap	5.0	1.0	0.85
Dibenzo(a,h)anthracene	5 0.025	LOQ EPA Tap	5.0	1.0	0.80
Dibenzofuran	5 0.79	LOQ EPA Tap	5.0	1.0	0.60
Diethylphthalate	1,500	EPA Tap	5.0	2.0	1.0
Dimethyl phthalate	NA	NA	5.0	2.0	1.0
Di-n-butyl phthalate	50/90	NYS/EPA Tap	5.0	2.0	1.0
Di-n-octyl phthalate	20	EPA Tap	5.0	2.0	1.0
Fluoranthene	80	EPA Tap	5.0	1.0	0.55
Fluorene	29	EPA Tap	5.0	1.0	0.70
Hexachlorobenzene	5 0.04/0.0098	LOQ NYS/EPA Tap	5.0	1.0	0.69
Hexachlorobutadiene	5 0.5/0.14	LOQ NYS/EPA Tap	5.0	1.0	0.50
Hexachlorocyclopentadiene	5 0.041	NYS/LOQ EPA Tap	5.0	3.5	1.8
Hexachloroethane	5 0.33	NYS/LOQ EPA Tap	5.0	2.0	1.6
Indeno(1,2,3-cd)pyrene	5 0.25	LOQ EPA Tap	5.0	1.0	0.71
Isophorone	78	EPA Tap	5.0	1.0	0.78
Naphthalene	5 0.12	LOQ EPA Tap	5.0	1.0	0.50
Nitrobenzene	5 0.4/0.14	LOQ NYS/EPA Tap	5.0	2.0	0.93
n-Nitrosodimethylamine	5 0.00011	LOQ EPA Tap	5.0	2.0	0.50
n-Nitroso-di-n-propylamine	5 0.011	LOQ EPA Tap	5.0	2.0	0.67
n-Nitrosodiphenylamine	12	EPA Tap	5.0	2.0	0.81
Pentachlorophenol	25 1/0.041	LOQ	25.0	10.0	5.0

Analyte	Project Action Limit (µg/L) (1)	PAL Reference (2)	Achievable Laboratory Limits (3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
		NYS/EPA Tap			
Phenanthrene	NA	NA	5.0	1.0	0.86
Phenol	580/1	EPA Tap/NYS	5.0	2.0	0.50
Pyrene	12	EPA Tap	5.0	1.0	0.68

(1) PAL was determined by selecting the lower of NYS Class GA (6 CRR-NY 703.5) or the EPA RSL Tap Water (TR=1E-06, THQ=0.1), November 2023. NYS Class GA or EPA RSL shown for reference if LOQ selected as PAL. Values in grey font are for reference.

  a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
  b. https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants
  c. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and the NYS GA Standard.

NA = Not available; µg/L = Micrograms per liter

Table 15.5 – Project Action Limits and SGS Orlando Reference Limits for SVOCs in Surface Water (Ecological) (Method SW-846 8270E)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ) (µg/L)	LOD (µg/L)	DL (µg/L)
1,2,4-Trichlorobenzene	5	NYS/LOQ	5.0		1.1
1,2-Dichlorobenzene	5	NYS(4)/LOQ	5.0	2.0	0.50
1,2-Diphenylhydrazine	5 ND	LOQ NYS(5)	5.0	2.0	0.76
1,3-Dichlorobenzene	5	NYS/LOQ	5.0	2.0	0.50
1,4-Dichlorobenzene	5	NYS(6)/LOQ)	5.0	2.0	0.50
1-Methylnaphthalene	6.1	EPA 2018, FW Chronic	5.0	1.0	0.53
2,4,5-Trichlorophenol	5 1.9	LOQ EPA 2018, FW Chronic	5.0	2.0	0.74
2,4,6-Trichlorophenol	5 4.9	LOQ EPA 2018, FW Chronic	5.0	2.0	0.75
2,4-Dichlorophenol	5 1	LOQ NYS	5.0	1.0	0.84
2,4-Dimethylphenol	1,000	NYS	5.0	2.0	0.74
2,4-Dinitrophenol	25 5	LOQ NYS	25.0	20.0	5.0
2,4-Dinitrotoluene	440	EPA 2018, FW Chronic	5.0	1.0	0.81
2,6-Dinitrotoluene	81	EPA 2018, FW Chronic	5.0	1.0	0.71
2-Chloronaphthalene	10	NYS(6)	5.0	2.0	0.50
2-Chlorophenol	18	EPA 2018, FW Chronic	5.0	1.0	0.63
2-Methylnaphthalene	5 4.7	LOQ EPA 2018, FW Chronic	5.0	1.0	0.60
2-Methylphenol	67	EPA 2018, FW Chronic	5.0	1.0	0.56
2-Nitroaniline	17	EPA 2018, FW Chronic	5.0	3.5	1.8
2-Nintrophenol	73	EPA 2018, FW Chronic	5.0	2.0	0.85
3,3'-Dichlorobenzidine	5 4.5	LOQ EPA 2018, FW Chronic	5.0	2.0	0.64
3+4-Methylphenol	62/53	EPA 2018, FW Chronic (7)	5.0	2.0	0.98
3-Nitroaniline	5	NYS(5)/LOQ	5.0	2.0	0.88
4,6-Dinitro-2-Methylphenol	NA	NA	10.0	4.0	2.0
4-Bromophenyl-phenylether	5 1.5	LOQ EPA 2018, FW Chronic	5.0	1.0	0.85
4-Chloro-3-Methylphenol	5 1	LOQ EPA 2018, FW Chronic	5.0	1.0	0.59
4-Chloroaniline	5 0.8	LOQ EPA 2018, FW Chronic	5.0	1.0	0.63
4-Chlorophenyl-phenylether	NA	NA	5.0	1.0	0.54

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ) (µg/L)	LOD (µg/L)	DL (µg/L)
4-Nitroaniline	5	NYS(5)/LOQ	5.0	2.0	1.2
4-Nitrophenol	58	EPA 2018, FW Chronic	25.0	10.0	5.0
Acenaphthene	15	EPA 2018, FW Chronic	5.0	1.0	0.63
Acenaphthylene	13	EPA 2018, FW Chronic	5.0	1.0	0.64
Anthracene	5 0.02	LOQ EPA 2018, FW Chronic	5.0	1.0	0.80
Benzidine	25 0.1	LOQ NYS	25.0	10.0	5.0
Benzo(a)anthracene	5 0.03	LOQ NYS	5.0	1.0	0.76
Benzo(a)pyrene	5 0.06	LOQ EPA 2018, FW Chronic	5.0	1.0	0.78
Benzo(b)fluoranthene	5 0.68	LOQ EPA 2018, FW Chronic, Narcotic Mode	5.0	1.0	0.78
Benzo(g,h,i)perylene	5 0.012	LOQ EPA 2018, FW Chronic	5.0	1.0	0.82
Benzo(k)fluoranthene	5 0.06	LOQ EPA 2018, FW Chronic	5.0	1.0	0.86
Benzoic acid	50 42	LOQ EPA 2018, FW Chronic	50.0	25.0	10.0
Benzyl alcohol	8.6	EPA 2018, FW Chronic	5.0	1.0	0.61
Bis(-2-Chloroethoxy)methane	NA	NA	5.0	2.0	0.81
Bis(2-Chloroethyl)ether	NA	NA	5.0	1.0	0.73
Bis(2-ethylhexyl)phthalate	5 0.6	LOQ NYS	5.0	2.0	1.0
Butyl benzyl phthalate	18	EPA 2018, FW Chronic, Narcotic Mode	5.0	2.0	1.0
Carbazole	5 4	LOQ EPA 2018, FW Chronic	5.0	1.0	0.60
Chrysene	5 2	LOQ EPA 2018, FW Chronic, Narcotic Mode	5.0	1.0	0.85
Dibenzo(a,h)anthracene	5 0.012	LOQ EPA 2018, FW Chronic	5.0	1.0	0.80
Dibenzofuran	5 4	LOQ EPA 2018, FW Chronic	5.0	1.0	0.60
Diethylphthalate	220	EPA 2018, FW Chronic	5.0	2.0	1.0
Dimethyl phthalate	1,100	EPA 2018, FW Chronic	5.0	2.0	1.0
Di-n-butyl phthalate	19	EPA 2018, FW Chronic	5.0	2.0	1.0
Di-n-octyl phthalate	215	EPA 2018, FW Chronic	5.0	2.0	1.0

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ) (µg/L)	LOD (µg/L)	DL (µg/L)
Fluoranthene	5 0.8	LOQ EPA 2018, FW Chronic	5.0	1.0	0.55
Fluorene	5 0.54	LOQ NYS	5.0	1.0	0.70
Hexachlorobenzene	5 0.00003	LOQ NYS	5.0	1.0	0.69
Hexachlorobutadiene	5 0.01	LOQ NYS	5.0	1.0	0.50
Hexachlorocyclopentadiene	5 0.45	LOQ NYS	5.0	3.5	1.8
Hexachloroethane	5 0.6	LOQ NYS	5.0	2.0	1.6
Indeno(1,2,3-cd)pyrene	5 0.012	LOQ EPA 2018, FW Chronic	5.0	1.0	0.71
Isophorone	920	EPA 2018, FW Chronic	5.0	1.0	0.78
Naphthalene	13	NYS	5.0	1.0	0.50
Nitrobenzene	230	EPA 2018, FW Chronic	5.0	2.0	0.93
n-Nitrosodimethylamine	NA	NA	5.0	2.0	0.50
n-Nitroso-di-n-propylamine	NA	NA	5.0	2.0	0.67
n-Nitrosodiphenylamine	NA	NA	5.0	2.0	0.81
Pentachlorophenol	25 15	LOQ EPA 2018, FW Chronic	25.0	10.0	5.0
Phenanthrene	5	NYS/LOQ	5.0	1.0	0.86
Phenol	5	NYS/LOQ	5.0	2.0	0.50
Pyrene	5 4.6	LOQ NYS	5.0	1.0	0.68

(1) PAL was determined by selecting the lower of the NYS 6 CRR-NY 703.5 Class C, Aquatic (Chronic) and Human (Fish Consumption) water quality standards (NYS WQS) and, if not available, the EPA Region 4 Surface Water Screening Values [Freshwater Screening Values; Chronic] (EPA Region 4 SV). Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
   b. https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the NYS WQS and the EPA Region 4 SV, then the PAL is set to the higher value between NYS WQS and the EPA Region 4 SV.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the NYS WQS and the EPA Region 4 SV.

(4) Applies to the sum of 1,2-, 1,3- and 1,4-dichlorobenzene.

(5) NYS A(C) and EPA values not available. NYS H(WS) value used for comparison only. For 1,2-Diphenylhydrazine, applies to the sum of 1,1- and 1,2-diphenylhydrazine, CAS Nos. 530-50-7 and 122-66-7, respectively.

(6) NYS A(C) and EPA values not available. NYS E(WS) Class A, A-S, AA, AA-S value used for comparison only.

(7) Individual values for 3-Methylphenol (Cresol, m-) and 4-Methylphenol (Cresol, p-) provided for comparison.

NA = Not available; µg/L = Micrograms per liter

Table 15.6 – Project Action Limits and SGS Orlando Reference Limits for SVOCs in Soil and Sediment (Method SW-846 8270E)

Analyte	Project Action Limit (µg/kg) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
1,2,4-Trichlorobenzene	5,800	EPA Res Soil	170	33	20
1,2-Dichlorobenzene	1,100/180,000	NYS/EPA Res Soil	170	67	17
1,2-Diphenylhydrazine (Azobenzene)	NA/5,600	NYS/EPA Res Soil	170	33	17
1,3-Dichlorobenzene	2,400/NA	NYS/EPA Res Soil	170	67	18
1,4-Dichlorobenzene	1,800/2,600	NYS/EPA Res Soil	170	67	22
1-Methylnaphthalene	NA/18,000	EPA Res Soil	170	33	17
2,4,5-Trichlorophenol	NA/630,000	NYS/EPA Res Soil	170	33	27
2,4,6-Trichlorophenol	NA/6,300	NYS/EPA Res Soil	170	33	19
2,4-Dichlorophenol	NA/19,000	NYS/EPA Res Soil	170	33	19
2,4-Dimethylphenol	NA/130,000	NYS/EPA Res Soil	170	67	44
2,4-Dinitrophenol	NA/13,000	NYS/EPA Res Soil	830	500	170
2,4-Dinitrotoluene	NA/1,700	NYS/EPA Res Soil	170	33	17
2,6-Dinitrotoluene	NA/360	NYS/EPA Res Soil	170	33	21
2-Chloronaphthalene	NA/480,000	NYS/EPA Res Soil	170	33	17
2-Chlorophenol	NA/39,000	NYS/EPA Res Soil	170	33	20
2-Methylnaphthalene	NA/24,000	NYS/EPA Res Soil	170	33	17
2-Methylphenol (o-Cresol)	330/320,000	NYS/EPA Res Soil	170	33	20
2-Nitroaniline	NA/63,000	NYS/EPA Res Soil	170	67	39
2-Nintrophenol	NA	NA	170	33	18
3,3'-Dichlorobenzidine	NA/1,200	NYS/EPA Res Soil	170	67	40
3&4-Methylphenol (m/p-Cresol)	330/320,000	NYS/EPA Res Soil	170	67	27
3-Nitroaniline	NA	NA	170	67	19
4,6-Dinitro-2-Methylphenol (Dinitro-o-cresol)	NA/510	NYS/EPA Res Soil	330	130	67
4-Bromophenyl-phenylether	NA	NA	170	33	17
4-Chloro-3-Methylphenol (Cresol, p-chloro-m-)	NA/630,000	NYS/EPA Res Soil	170	33	19
4-Chloroaniline (p-)	NA/2,700	NYS/EPA Res Soil	170	67	42
4-Chlorophenyl-phenylether	NA	NA	170	33	17
4-Nitroaniline	NA/25,000	NYS/EPA Res Soil	170	67	48
4-Nitrophenol	NA	NA	830	330	170
Acenaphthene	20,000/360,000	NYS/EPA Res Soil	170	33	18
Acenaphthylene	100,000/NA	NYS/EPA Res Soil	170	33	17
Anthracene	100,000/1,800,000	NYS/EPA Res Soil	170	33	19
Benzidine	1700 NA/0.53	LOQ NYS/EPA Res Soil	1700	830	330
Benzo(a)anthracene	1,000/1,100	NYS/EPA Res Soil	170	33	17

Analyte	Project Action Limit (µg/kg) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
Benzo(a)pyrene	1,000/110	NYS/EPA Res Soil	170	33	20
Benzo(b)fluoranthene	1,000/1,100	NYS/EPA Res Soil	170	33	18
Benzo(g,h,i)perylene	100,000/NA	NYS/EPA Res Soil	170	33	17
Benzo(k)fluoranthene	800/11,000	NYS/EPA Res Soil	170	33	22
Benzoic acid	NA/25,000,000	NYS/EPA Res Soil	830	330	170
Benzyl alcohol	NA/630,000	NYS/EPA Res Soil	170	33	17
Bis(2-Chloroethoxy)methane	NA/19,000	NYS/EPA Res Soil	170	33	17
Bis(2-Chloroethyl)ether	NA/230	NYS/EPA Res Soil	170	33	19
Bis(2-ethylhexyl)phthalate	NA/39,000	NYS/EPA Res Soil	330	120	33
Butyl benzyl phthalate	NA/290,000	NYS/EPA Res Soil	170	67	33
Carbazole	NA	NA	170	33	23
Chrysene	1,000/110,000	NYS/EPA Res Soil	170	33	17
Dibenzo(a,h)anthracene	330/110	NYS/EPA Res Soil	170	33	21
Dibenzofuran	7,000/7,800	NYS/EPA Res Soil	170	33	17
Diethyl phthalate	NA/5,100,000	NYS/EPA Res Soil	330	120	33
Dimethyl phthalate	NA	NA	170	67	33
Di-n-butyl phthalate	NA/630,000	NYS/EPA Res Soil	330	120	67
Di-n-octyl phthalate	NA/63,000	NYS/EPA Res Soil	170	37	33
Fluoranthene	100,000/240,000	NYS/EPA Res Soil	170	33	17
Fluorene	30,000/240,000	NYS/EPA Res Soil	170	33	18
Hexachlorobenzene	330/78	NYS/EPA Res Soil	170	33	17
Hexachlorobutadiene	NA/1,200	NYS/EPA Res Soil	170	67	17
Hexachlorocyclopentadiene	NA/180	NYS/EPA Res Soil	170	67	33
Hexachloroethane	NA/1,800	NA/EPA Res Soil	170	67	20
Indeno(1,2,3-cd)pyrene	500/1,100	NYS/EPA Res Soil	170	33	20
Isophorone	NA/570,000	NYS/EPA Res Soil	170	33	17
Naphthalene	12,000/2,000	NYS/EPA Res Soil	170	33	17
Nitrobenzene	NA/5,100	NYS/EPA Res Soil	170	33	17
n-Nitrosodimethylamine	170 NA/2.0	LOQ NYS/EPA RES SOIL	170	33	17
n-Nitroso-di-n-propylamine	170 NA/78	LOQ NYS/EPA RES SOIL	170	67	28
n-Nitrosodiphenylamine	NA/110,000	NYS/EPA Res Soil	170	67	18
Pentachlorophenol	800/1,000	NYS/EPA Res Soil	830	330	170
Phenanthrene	100,000/NA	NYS/EPA Res Soil	170	33	17
Phenol	330/1,900,000	NYS/EPA Res Soil	170	33	17
Pyrene	100,000/180,000	NYS/EPA Res Soil	170	33	19

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives (NYS Unrestricted Use SCO) or EPA Regional Screening Level (RSL) Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil (EPA RSL Resident Soil). Values in grey font are for reference.

a. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29

b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the “best achievable detection limit” or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Resident Soil and NYS Unrestricted Use SCO, then the PAL is set to the higher value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

NA = Not available; µg/kg = micrograms per kilogram

Table 15.7 – Project Action Limits SGS Orlando Reference Limits for TAL Metals (Excluding Mercury) in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 and 6020B)

			Achievable Laboratory Limits(3)		
Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Aluminum	NA/2,000	NYS/EPA Tap	200	50	22
Antimony	3/0.78	NYS/EPA Tap	2.0	0.8	0.20
Arsenic	25/0.052	NYS/EPA Tap	2.0	0.80	0.212
Barium	1,000/380	NYS/EPA Tap	2.0	0.80	0.20
Beryllium	NA/2.5	NYS/EPA Tap	2.0	0.80	0.20
Cadmium	5/1.8	NYS/EPA Tap	2.0	0.80	0.20
Calcium	NA	NA	200	100	36
Chromium(4)	50/2,200	NYS/EPA Tap	2.0	0.80	0.20
Cobalt	50 NA/0.6	LOQ NYS/EPA Tap	2.0	0.8	0.20
Copper	200/80	NYS/EPA Tap	10	4.0	1.0
Iron(5)	300/1,400	NYS/EPA Tap	200	50	23.2
Lead	25/15	NYS/EPA Tap	2.0	0.80	0.20
Magnesium	NA	NA	200	100	50
Manganese	300/43	NYS/EPA Tap	2.0	0.80	0.20
Nickel	100/39	NYS/EPA Tap	4.0	1.6	0.40
Potassium	NA	NA	200	150	75
Selenium	10/10	NYS/EPA Tap	2.0	0.80	0.22
Silver	50/9.4	NYS/EPA Tap	2.0	0.80	0.20
Sodium(6)	20,000/NA	NYS/EPA Tap	200	100	50
Thallium	2 NA/0.02	LOQ NYS/EPA Tap	2.0	0.80	0.20
Vanadium	NA/8.6	NYS/EPA Tap	2.0	0.80	0.24
Zinc	NA/600	NYS/EPA Tap	10	5.0	1.68

(1) PAL was determined by selecting the lower of either the NYS Class GA (6 CRR-NY 703.5) or the EPA RSL Tap Water (TR=1E-06, THQ=0.1), November 2023. Values in grey font are for reference (e.g., the EPA RSL Tap Water is shown where lower than the NYS Class GA or LOQ.)
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and NYS GA Standard.

(4) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

(5) The screening level (NYS GA standard) for iron is not a risk-based criteria. As such, the EPA RSL for Tap Water was used as the determining screening criteria for iron.

(6) For reference only. There is no drinking water standard for sodium, state and federal agencies recommend sodium levels in water not exceed 20 milligrams per liter (mg/L) for people on very low sodium diets and 270 mg/L for people on moderately restricted sodium diets (NYSDOH).

NA=Not available; µg/L = Micrograms per liter

Table 15.8 – Project Action Limits SGS Orlando Reference Limits for TAL Metals in Surface Water (Ecological), Excluding Mercury (Method SW-846 6020B)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3)		
			LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Aluminum	200 100	LOQ NYS	200	50	22
Antimony	190	EPA 2018, FW Chronic	2.0	0.80	0.20
Arsenic	150	NYS	2.0	0.80	0.212
Barium	220	EPA 2018, FW Chronic	2.0	0.80	0.20
Beryllium	1,100	NYS(4)	2.0	0.80	0.20
Cadmium	3.6	NYS(4)	2.0	0.80	0.20
Calcium	NA	NA	200	100	36
Chromium(5)	131	NYS(4)	2.0	0.80	0.20
Cobalt	5	NYS	2.0	0.80	0.20
Copper	16.3	NYS(4)	10	4.0	1.0
Iron	1,000	EPA 2018, FW Chronic	200	50	23.2
Lead	8	NYS(4)	2.0	0.80	0.20
Magnesium	82,000	EPA 2018, FW Chronic	200	100	50
Manganese	93	EPA 2018, FW Chronic	2.0	0.80	0.20
Nickel	93.9	NYS(4)	4.0	1.6	0.40
Potassium	53,000	EPA 2018, FW Chronic	200	150	75
Selenium	4.6	NYS	2.0	0.80	0.22
Silver	2 0.1	LOQ NYS	2.0	0.80	0.20
Sodium	680,000	EPA 2018, FW Chronic	200	100	50
Thallium	8	NYS	2.0	0.80	0.20
Vanadium	14	NYS	2.0	0.80	0.24
Zinc	150	NYS(5)	10	5.0	1.68

(1) PAL was determined by selecting the NYS 6 CRR-NY 703.5 Class C, Aquatic (Chronic) water quality standards (NYS WQS) and, if not available, the EPA Region 4 Surface Water Screening Values [Freshwater Screening Values; Chronic] (EPA Region 4 SV). Values in grey font are for reference.
  a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
  b. https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the NYS WQS and the EPA Region 4 SV, then the PAL is set to the higher value between NYS WQS and the EPA Region 4 SV.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between NYS WQS and the EPA Region 4 SV.

(4) Water hardness based on lowest water hardness value (201 mg/L as $CaCO_3$) calculated from samples collected during the 1991 Reeder Creek survey.

(5) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

NA=Not available; µg/L = Micrograms per liter

Table 15.9 – Project Action Limits SGS Orlando Reference Limits for TAL Metals in Soil and Sediment, Excluding Mercury (Method SW-846 6020B)

Analyte	Project Action Limit (mg/kg) (1)	PAL Reference[2]	Achievable Laboratory Limits[3] LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Aluminum	NA/7,700	NYS/EPA Res Soil	25.0	12.5	6.25
Antimony	NA/3.1	NYS/EPA Res Soil	0.250	0.100	0.025
Arsenic	13/0.68	NYS/EPA Res Soil	0.250	0.100	0.025
Barium	350/1,500	NYS/EPA Res Soil	0.250	0.100	0.025
Beryllium	7.2/16	NYS/EPA Res Soil	0.250	0.100	0.027
Cadmium	2.5/0.71	NYS/EPA Res Soil	0.250	0.100	0.025
Calcium	NA	NA	25.0	12.5	6.250
Chromium)[4]	30/12,000	NYS[5]/EPA Res Soil	0.250	0.100	0.025
Cobalt	2.3	EPA Res Soil	0.250	0.100	0.025
Copper	50/310	NYS/EPA Res Soil	1.25	0.500	0.125
Iron	NA/5,500	NYS/EPA Res Soil	25.0	12.5	0.625
Lead	63/400	NYS/EPA Res Soil	0.250	0.100	0.025
Magnesium	NA	NA	25.0	12.5	6.250
Manganese	1,600/180	NYS/EPA Res Soil	0.250	0.100	0.025
Nickel	30/150	NYS/EPA Res Soil	0.500	0.200	0.050
Potassium	NA	NA	25.0	12.5	6.250
Selenium	3.9/39	NYS/EPA Res Soil	0.250	0.100	0.045
Silver	2/39	NYS/EPA Res Soil	0.250	0.100	0.025
Sodium	NA	NA	25.0	12.5	6.250
Thallium	0.25 NA/0.078	LOQ NA/EPA Res Soil	0.250	0.100	0.025
Vanadium	NA/39	NYS/EPA Res Soil	0.250	0.100	0.025
Zinc	109/2,300	NYS/EPA Res Soil	1.250	1.00	0.363

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives (NYS Unrestricted Use SCO) or EPA RSL Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil (EPA RSL Resident Soil. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Resident Soil and NYS Unrestricted Use SCO, then the PAL is set to the higher value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(4) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

(5) Value for trivalent chromium is presented.

NA=Not available; mg/kg = milligrams per kilogram

Table 15.10 – Project Action Limits and SGS Orlando Reference Limits for Mercury in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 7470A)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ (µg/L)	LOD (µg/L)	LOQ (µg/L)
Mercury	0.7/0.063	NYS/EPA Tap	0.50	0.10	0.03

(1) PAL is the lower of the NYS Class GA (6 CRR-NY 703.5) or EPA RSL Tapwater (TR = 1E-06, HQ = 0.1) (November 2023). Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Gray highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and NYS GA Standard.

µg/L = Micrograms per liter

Table 15.11 – Project Action Limits and SGS Orlando Reference Limits for Mercury in Surface Water (Ecological) (Method SW-846 7470A)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ (µg/L)	LOD (µg/L)	LOQ (µg/L)
Mercury	0.50 0.0007	LOQ NYS	0.50	0.10	0.03

(1) PAL is from the NYS 6 CRR-NY 703.5 Class C, Human (Fish Consumption) water quality standard (NYS WQS). Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ.

(3) Gray highlighted cells indicate that the laboratory limit value is greater than or equal to the NYS WQS.

µg/L = Micrograms per liter

Table 15.12 – Project Action Limits and SGS Orlando Reference Limits for Mercury in Soil and Sediment (Method SW-846 7471B)

Analyte	Project Action Limit (mg/kg) (1)	PAL Reference	Achievable Laboratory Limits LOQ (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Mercury	0.18/1.1	NYS/EPA Res Soil	0.042	0.017	0.0042

(1) PAL is the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives or EPA RSL Summary Table (TR=1E-06, HQ=1) November 2023 Resident Soil. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

mg/kg = milligrams per kilogram

Table 15.13 – Project Action Limits SGS Orlando Reference Limits for Explosives in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 8330B)

			Achievable Laboratory Limits(3)		
Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,3,5-Trinitrobenzene	5/59	NYS/EPA Tap	0.200	0.100	0.099
1,3-Dinitrobenzene	0.20 5	EPA Tap/LOQ NYS	0.200	0.100	0.080
2,4,6-Trinitrotoluene	5/0.98	NYS/EPA Tap	0.200	0.100	0.080
2,4-Dinitrotoluene	5/0.24	NYS/EPA Tap	0.200	0.100	0.080
2,6-Dinitrotoluene	5/0.049	NYS/EPA Tap	0.200	0.100	0.080
2-Amino-4,6-dinitrotoluene	0.25 NA/0.19	LOQ NYS/EPA Tap	0.200	0.100	0.080
2-Nitrotoluene (o-)	5/0.31	NYS/EPA Tap	0.200	0.100	0.080
3,5-Dinitroaniline	NA/0.77	NYS/EPA Tap	0.200	0.100	0.080
3-Nitrotoluene (m-)	5/0.17	NYS/EPA Tap	0.200	0.100	0.080
4-Amino-2,6-dinitrotoluene	0.2 NA/0.19	LOQ NYS/EPA Tap	0.200	0.100	0.080
4-Nitrotoluene (p-)	5/4.3	NYS/EPA Tap	0.200	0.100	0.080
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NA/100	NYS/EPA Tap	0.200	0.10	0.08
Nitrobenzene	0.4/0.14	NYS/EPA Tap	0.200	0.100	0.097
Nitroglycerin	2 NA/0.2	LOQ NYS/EPA Tap	2.0	1.0	0.500
Pentaerythritol tetranitrate (PETN)	NA/17	NYS/EPA Tap	2.0	1.0	0.500
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	NA/0.97	NYS/EPA Tap	0.200	0.100	0.080
Tetryl	NA/3.9	NYS/EPA Tap	0.200	0.100	0.080

(1) PAL was determined by selecting lower of either the NYS Class GA (6 CRR-NY 703.5) or the EPA RSL Tap Water (TR=1E-06, THQ=0.1), November 2023. The EPA RSL Tap Water is shown for reference if lower than the NYS Class GA. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the "best achievable detection limit" or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and NYS GA Standard.

NA = Not available; µg/L = Micrograms per liter

Table 15.14 – Project Action Limits SGS Orlando Reference Limits for Explosives in Surface Water (Ecological) (Method SW-846 8330B)

			Achievable Laboratory Limits		
Analyte	Project Action Limit (µg/L) (1)	PAL Reference	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
1,3,5-Trinitrobenzene	11	EPA 2018, FW Chronic	0.200	0.100	0.099
1,3-Dinitrobenzene	22	EPA 2018, FW Chronic	0.200	0.100	0.080
2,4,6-Trinitrotoluene	13	EPA 2018, FW Chronic	0.200	0.100	0.080
2,4-Dinitrotoluene	44	EPA 2018, FW Chronic	0.200	0.100	0.080
2,6-Dinitrotoluene	81	EPA 2018, FW Chronic	0.200	0.100	0.080
2-Amino-4,6-dinitrotoluene	18	EPA 2018, FW Chronic	0.200	0.100	0.080
2-Nitrotoluene (o-)	71	EPA 2018, FW Chronic	0.200	0.100	0.080
3,5-Dinitroaniline	70	EPA 2018, FW Chronic	0.200	0.100	0.080
3-Nitrotoluene (m-)	42	EPA 2018, FW Chronic	0.200	0.100	0.080
4-Amino-2,6-dinitrotoluene	11	EPA 2018, FW Chronic	0.200	0.100	0.080
4-Nitrotoluene (p-)	46	EPA 2018, FW Chronic	0.200	0.100	0.080
HMX	220	EPA 2018, FW Chronic	0.200	0.100	0.080
Nitrobenzene	230	EPA 2018, FW Chronic	0.200	0.100	0.097
Nitroglycerin	18	EPA 2018, FW Chronic	2.0	1.0	0.500
Pentaerythritol tetranitrate (PETN)	NA	NA	2.0	1.0	0.500
RDX	79	EPA 2018, FW Chronic	0.200	0.100	0.080
Tetryl	NA	NA	0.200	0.100	0.080

(1) PAL was determined by selecting the NYS 6 CRR-NY 703.5 Class C, Aquatic (Chronic) water quality standards and, if not available, the EPA Region 4 Surface Water Screening Values [Freshwater Screening Values; Chronic]. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
   b. https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf

NA = Not available; µg/L = Micrograms per liter

Table 15.15 – Project Action Limits SGS Orlando Reference Limits for Explosives in Soil and Sediment (Method SW-846 8330B)

Analyte	Project Action Limit (mg/kg) (1)	PAL Reference(2)	Achievable Laboratory Limits(3) LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
1,3,5-Trinitrobenzene	220	EPA RES SOIL	0.10	0.075	0.050
1,3-Dinitrobenzene	0.63	EPA RES SOIL	0.10	0.075	0.050
2,4,6-Trinitrotoluene	3.6	EPA RES SOIL	0.10	0.075	0.050
2,4-Dinitrotoluene	1.7	EPA RES SOIL	0.10	0.075	0.050
2,6-Dinitrotoluene	0.36	EPA RES SOIL	0.10	0.075	0.050
2-Amino-4,6-dinitrotoluene	0.77	EPA RES SOIL	0.10	0.075	0.050
2-Nitrotoluene (o-)	3.2	EPA RES SOIL	0.10	0.075	0.050
3,5-Dinitroaniline	2.5	EPA RES SOIL	0.10	0.075	0.050
3-Nitrotoluene (m-)	0.63	EPA RES SOIL	0.10	0.075	0.050
4-Amino-2,6-dinitrotoluene	0.77	EPA RES SOIL	0.10	0.075	0.051
4-Nitrotoluene (p-)	25	EPA RES SOIL	0.10	0.075	0.050
HMX	390	EPA RES SOIL	0.10	0.075	0.051
Nitrobenzene	5.1	EPA RES SOIL	0.10	0.075	0.050
Nitroglycerin	1 0.63	LOQ EPA RES SOIL	1.00	0.500	0.250
Pentaerythritol tetranitrate (PETN)	57	EPA RES SOIL	1.00	0.500	0.250
RDX	8.3	EPA RES SOIL	0.10	0.075	0.050
Tetryl	16	EPA RES SOIL	0.10	0.075	0.050

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives (NYS Unrestricted Use SCO) or EPA RSL Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil (EPA RSL Resident Soil). Values in grey font are for reference.
   a. https://semspub.epa.gov/work/HQ/401637.pdf
   b. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the “best achievable detection limit” or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Resident Soil and NYS Unrestricted Use SCO, then the PAL is set to the higher value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Resident Soil and NYS Unrestricted Use SCO.

NA = Not available; mg/kg = milligrams per kilogram

Table 15.16 – Project Action Limits and SGS Orlando Reference Limits for Perchlorate in Groundwater and Surface Water (when Human Health Risk evaluated) (Method SW-846 6850)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference	Achievable Laboratory Limits LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Perchlorate	NA/**15**	NYS/**EPA MCL**	0.200	0.100	0.050

(1) To be conservative, the PAL is based on the OSWER recommendation that where no federal or state applicable or relevant and appropriate (ARAR) requirements exist under federal or state laws, 15 µg/L (or 15 ppb) is recommended as the PRG for perchlorate when making CERCLA site-specific cleanup decisions where there is an actual or potential drinking water exposure pathway. EPA MCL (TR=1E-06, THQ=1) (November, 2023). Values in grey font are for reference.
   a. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

µg/L = Micrograms per liter

Table 15.17 – Project Action Limits and SGS Orlando Reference Limits for Perchlorate in Surface Water (Ecological) (Method SW-846 6850)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference	Achievable Laboratory Limits LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Perchlorate	NA	NA	0.200	0.100	0.050

µg/L = Micrograms per liter

Table 15.18 – Project Action Limits and SGS Orlando Reference Limits for Perchlorate in Soil and Sediment (Method SW-846 6850)

Analyte	Project Action Limit (µg/kg) (1)	PAL Reference	Achievable Laboratory Limits LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
Perchlorate	5,500	EPA RES SOIL	2.0	1.0	0.50

(1) PAL is the EPA RSL Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil.
   a. https://semspub.epa.gov/work/HQ/199626.pdf

µg/kg = micrograms per kilogram

Table 15.19 – Project Action Limits and Katahdin Reference Limits for Orthophosphate as P in Groundwater and Surface Water (When Human Health Risk evaluated and Ecological) (EPA Method SM4500P-E)

Analyte	Project Action Limit (mg/L) (1)	PAL Reference	Achievable Laboratory Limits LOQ (mg/L)	LOD (mg/L)	DL (mg/L)
Orthophosphate as P	NA	NA	0.05	0.030	0.015

mg/L = Milligrams per liter

Table 15.20 – Project Action Limits and Katahdin Reference Limits for Orthophosphate as P in Soil and Sediment (EPA Method SM4500P-E)

Analyte	Project Action Limit (mg/kg) (1)	PAL Reference	Achievable Laboratory Limits LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Orthophosphate as P	NA	NA	0.50	0.25	0.04

mg/kg = milligrams per kilogram

Table 15.21 – Project Action Limits and Katahdin Reference Limits for Total and Dissolved Phosphorus in Groundwater and Surface Water (When Human Health Risk evaluated and Ecological) ((EPA Method 365.2)

Analyte	Project Action Limit (µg/L) (1)	PAL Reference	Achievable Laboratory Limits LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Total and Dissolved Phosphorus	20/NA	NYS(2)/EPA Tap	10	10	4.0

(1) NYS, 2011. New York State Nutrient Standards Plan. July 2011. Values in grey font are for reference.
    a. https://extapps.dec.ny.gov/docs/water_pdf/nutrientstds2011.pdf
(2) Based on aesthetic effects for primary and secondary contact recreation.
µg/L = Micrograms per liter

Table 15.22 – Project Action Limits and Katahdin Reference Limits for Total Phosphorus in Sediment and Soil (EPA Method 365.4)

Analyte	Project Action Limit (mg/kg) (1)	PAL Reference	Achievable Laboratory Limits LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Total Phosphorus	NA	NA	12.5	6.25	3.25

mg/kg = milligrams per kilogram

Table 15.23 – Project Action Limits and SGS Orlando Reference Limits for Hexavalent Chromium in Groundwater and Surface Water (when Human Health Risk evaluated) (EPA Method 7196A)

			Achievable Laboratory Limits(3)		
Analyte	Project Action Limit (µg/L) (1)	PAL Reference(2)	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Hexavalent Chromium(4)	10 50/0.035	LOQ NYS/EPA Tap	10	10	8

(1) PAL was determined by selecting the lower of either the NYS Class GA (6 CRR-NY 703.5) or the EPA RSL Tap Water (TR=1E-06, THQ=0.1), November 2023 was selected. Values in grey font are for reference.
  a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)
  b. https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants
  https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the “best achievable detection limit” or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Tapwater and NYS GA Standard, then the PAL is set to the higher value between EPA RSL Tapwater and NYS GA Standard.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Tapwater and NYS GA Standard.

(4) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

µg/L = Micrograms per liter

Table 15.24 – Project Action Limits and SGS Orlando Reference Limits for Hexavalent Chromium in Surface Water (Ecological) (EPA Method 7196A)

			Achievable Laboratory Limits		
Analyte	Project Action Limit (µg/L) (1)	PAL Reference	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Hexavalent Chromium(2)	11	NYS	10	10	8

(1) PAL was determined by selecting the NYS 6 CRR-NY 703.5 Class C, Aquatic (Chronic) water quality standards and, if not available, the EPA Region 4 Surface Water Screening Values [Freshwater Screening Values; Chronic].
  a. https://govt.westlaw.com/nycrr/Document/I4ed90418cd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
  b. https://www.epa.gov/sites/production/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf

(2) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

µg/L = Micrograms per liter

Table 15.25 – Project Action Limits and SGS Orlando Reference Limits for Hexavalent Chromium in Soil and Sediment (EPA Method 7196A)

			Achievable Laboratory Limits(3)		
Analyte	Project Action Limit (mg/kg) (1)	PAL Reference(2)	LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Hexavalent Chromium(4)	2 1/0.30	LOQ NYS/EPA Res Soil	2.0	N/A	0.88

(1) PAL was determined by selecting the lower of NYS 6 CRR-NY 375-6.8 (a), Unrestricted Use Soil Cleanup Objectives or EPA RSL Summary Table (TR=1E-06, HQ=0.1) November 2023 Resident Soil. Values in grey font are for reference.
   a. https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29
   b. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

(2) Per USACE-Huntsville guidance, in situations where the available screening level is lower than the “best achievable detection limit” or limit of quantitation (LOQ), the PAL was set to the LOQ. If the LOQ falls between the EPA RSL Resident Soil and NYS Unrestricted Use SCO, then the PAL is set to the higher value between EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(3) Grey highlighted cells indicate that the laboratory limit value is greater than or equal to the lowest value between the EPA RSL Resident Soil and NYS Unrestricted Use SCO.

(4) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

mg/kg = milligrams per kilogram

Table 15.26 – Project Action Limits ELLE Reference Limits for PFAS in Water Matrices (Draft Method 1633)

					Achievable Laboratory Limits[2]		
Analyte	**CAS Number**	**Acronym**	**PAL[1] (ng/L)**	**PAL Reference**	**LOQ (ng/L)**	**LOD (ng/L)**	**DL (ng/L)**
Perfluoroalkyl carboxylic acids							
Perfluorobutanoic acid	375-22-4	PFBA	1,800[3]	EPA RSL	--	--	--
Perfluoropentanoic acid	2706-90-3	PFPeA	NE[3]	NA	--	--	--
Perfluorohexanoic acid	307-24-4	PFHxA	990[3]	EPA RSL	--	--	--
Perfluoroheptanoic acid	375-85-9	PFHpA	NE[3]	NA	--	--	--
Perfluorooctanoic acid	335-67-1	PFOA	6 6.7	EPA RSL NYSDEC[4]	--	--	--
Perfluorononanoic acid	375-95-1	PFNA	5.9	EPA RSL	--	--	--
Perfluorodecanoic acid	335-76-2	PFDA	NE[3]	NA	--	--	--
Perfluoroundecanoic acid	2058-94-8	PFUDA	600	EPA RSL	--	--	--
Perfluorododecanoic acid	307-55-1	PFDoDA	100	EPA RSL	--	--	--
Perfluorotridecanoic acid	72629-94-8	PFTrDA	NE[3]	NA	--	--	--
Perfluorotetradecanoic acid	376-06-7	PFTetA	2000	EPA RSL	--	--	--
Perfluoroalkyl sulfonic acids (Acid Form)							
Perfluorobutanesulfonic acid	375-73-5	PFBS	600	EPA RSL	--	--	--
Perfluoropentansulfonic acid	2706-91-4	PFPeS	NE[3]	NA	--	--	--
Perfluorohexanesulfonic acid	355-46-4	PFHxS	39	EPA RSL	--	--	--
Perfluoroheptanesulfonic acid	375-92-8	PFHpS	NE[3]	NA	--	--	--
Perfluorooctanesulfonic acid	1763-23-1	PFOS	4 2.7	EPA RSL NYSDEC[4]	--	--	--
Perfluorononanesulfonic acid	68259-12-1	PFNS	NE[3]	NA	--	--	--
Perfluorodecanesulfonic acid	335-77-3	PFDS	NE[3]	NA	--	--	--
Perfluorododecanesulfonic acid	79780-39-5	PFDoS	NE[3]	NA	--	--	--
Fluorotelomer sulfonic acids							
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2FTS	NE[3]	NA	--	--	--
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2FTS	NE[3]	NA	--	--	--
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2FTS	NE[3]	NA	--	--	--
Perfluorooctane sulfonamides							
Perfluorooctanesulfonamide	754-91-6	PFOSA	NE[3]	NA	--	--	--

Analyte	CAS Number	Acronym	PAL(1) (ng/L)	PAL Reference	Achievable Laboratory Limits(2)		
					LOQ (ng/L)	LOD (ng/L)	DL (ng/L)
N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA	NE(3)	NA	--	--	--
Perfluorooctane sulfonamidoacetic acids							
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	NE(3)	NA	--	--	--
Perfluorooctane sulfonamide ethanols							
N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMeFOSE	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtFOSE	NE(3)	NA	--	--	--
Per- and Polyfluoroether carboxylic acids							
Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA	1.5	EPA RSL	--	--	--
4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	NE(3)	NA	--	--	--
Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA	NE(3)	NA	--	--	--
Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA	NE(3)	NA	--	--	--
Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA	NE(3)	NA	--	--	--
Ether sulfonic acids							
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	NE(3)	NA	--	--	--
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	NE(3)	NA	--	--	--
Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA	NE(3)	NA	--	--	--
Fluorotelomer carboxylic acids							
3-Perfluoropropyl propanoic acid	356-02-5	3:3FTCA	NE(3)	NA	--	--	--
2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3FTCA	NE(3)	NA	--	--	--
3-Perfluoroheptyl propanoic acid	812-70-4	7:3FTCA	NE(3)	NA	--	--	--

(1) GW PAL is the EPA RSL (TR=1E-06, HQ=0.1) November 2023 based on OSD (2023). Values in grey font are for reference.
    a. https://semspub.epa.gov/work/HQ/404332.pdf
(2) Refer to HGLs' Final PFAS UFP QAPP, for the ELLE achievable laboratory limits (HGL, 2023).

(3) Health-based screening values have not been established. The compounds are being analyzed to monitor for presence in water samples.

(4) Guidance ambient water quality guidance values from NYSDEC, Draft Technical and Operational Guidance Series (NYSDEC, 2022). Note: At this time, per DoD guidance, state standards cannot be used for risk evaluation.

NE = Not established; NA = Not available; ng/L = nanograms per liter or parts per trillion (ppt)

Table 15.27 – Project Action Limits ELLE Reference Limits for PFAS in Solid Matrices (Draft Method 1633)

					Achievable Laboratory Limits(2)		
Analyte	CAS Number	Acronym	PAL(1) (ng/g)	PAL Reference	LOQ (ng/g)	LOD (ng/g)	DL (ng/g)
Perfluoroalkyl carboxylic acids							
Perfluorobutanoic acid	375-22-4	PFBA	7,800(3)	NA	--	--	--
Perfluoropentanoic acid	2706-90-3	PFPeA	NE2	NA	--	--	--
Perfluorohexanoic acid	307-24-4	PFHxA	3,200(3)	NA	--	--	--
Perfluoroheptanoic acid	375-85-9	PFHpA	NE(3)	NA	--	--	--
Perfluorooctanoic acid	335-67-1	PFOA	19 0.66	EPA RSL NYSDEC(4)	--	--	--
Perfluorononanoic acid	375-95-1	PFNA	19	EPA RSL	--	--	--
Perfluorodecanoic acid	335-76-2	PFDA	NE(3)	NA	--	--	--
Perfluoroundecanoic acid	2058-94-8	PFUDA	1900	EPA RSL	--	--	--
Perfluorododecanoic acid	307-55-1	PFDoDA	320	EPA RSL	--	--	--
Perfluorotridecanoic acid	72629-94-8	PFTrDA	NE(3)	NA	--	--	--
Perfluorotetradecanoic acid	376-06-7	PFTetA	6300	EPA RSL	--	--	--
Perfluoroalkyl sulfonic acids (Acid Form)							
Perfluorobutanesulfonic acid	375-73-5	PFBS	1,900	EPA RSL	--	--	--
Perfluoropentansulfonic acid	2706-91-4	PFPeS	NE(3)	NA	--	--	--
Perfluorohexanesulfonic acid	355-46-4	PFHxS	130	EPA RSL	--	--	--
Perfluoroheptanesulfonic acid	375-92-8	PFHpS	NE(3)	NA	--	--	--
Perfluorooctanesulfonic acid	1763-23-1	PFOS	13 0.88	EPA RSL NYSDEC(4)	--	--	--
Perfluorononanesulfonic acid	68259-12-1	PFNS	NE(3)	NA	--	--	--
Perfluorodecanesulfonic acid	335-77-3	PFDS	NE(3)	NA	--	--	--
Perfluorododecanesulfonic acid	79780-39-5	PFDoS	NE(3)	NA	--	--	--
Fluorotelomer sulfonic acids							
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2FTS	NE(3)	NA	--	--	--
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2FTS	NE(3)	NA	--	--	--
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2FTS	NE(3)	NA	--	--	--
Perfluorooctane sulfonamides							
Perfluorooctanesulfonamide	754-91-6	PFOSA	NE(3)	NA	--	--	--

Analyte	CAS Number	Acronym	PAL(1) (ng/g)	PAL Reference	Achievable Laboratory Limits(2) LOQ (ng/g)	LOD (ng/g)	DL (ng/g)
N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA	NE(3)	NA	--	--	--

Perfluorooctane sulfonamidoacetic acids							
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	NE(3)	NA	--	--	--
Perfluorooctane sulfonamide ethanols							
N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMeFOSE	NE(3)	NA	--	--	--
N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtFOSE	NE(3)	NA	--	--	--
Per- and Polyfluoroether carboxylic acids							
Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA	23	EPA RSL	--	--	--
4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	NE(3)	NA	--	--	--
Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA	NE(3)	NA	--	--	--
Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA	NE(3)	NA	--	--	--
Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA	NE(3)	NA	--	--	--
Ether sulfonic acids							
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	NE(3)	NA	--	--	--
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	NE(3)	NA	--	--	--
Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA	NE(3)	NA	--	--	--
Fluorotelomer carboxylic acids							
3-Perfluoropropyl propanoic acid	356-02-5	3:3FTCA	NE(3)	NA	--	--	--
2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3FTCA	NE(3)	NA	--	--	--
3-Perfluoroheptyl propanoic acid	812-70-4	7:3FTCA	NE(3)	NA	--	--	--

(1) PAL is the EPA RSL (TR=1E-06, HQ=0.1) Resident Soil November 2023 based on OSD (2023). Values in grey font are for reference.

(2) Refer to HGLs' Final PFAS UFP QAPP, for the ELLE achievable laboratory limits (HGL, 2023).

(3) Health-based screening values have not been established. The compounds are being analyzed to monitor for presence in soil and sediment samples.

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(4) Guidance soil cleanup objective from Table 375-6.8(a): Unrestricted Use Soil Cleanup Objectives (NYS, 2022c). Note: At this time, per DoD guidance, state standards cannot be used for risk evaluation.

NE = Not established; NA = Not available; ng/g = nanograms per gram or parts per billion (ppb)

Worksheet #17: Sampling Design and Rationale

(EPA UFP-QAPP Guidance Manual, Section 3.1.1)

17.1 INTRODUCTION

Sampling for VOCs, SVOCs, metals, explosives, perchlorate, total and dissolved phosphorus, orthophosphate, and PFAS will be conducted at the SEDA. The proposed locations for samplings are shown on **Figures 1** and **2**.

This worksheet describes the project design and the tasks that will be required to successfully complete field operations during this project and achieve the DQOs described on **Worksheet #11**. The field operations involve multiple elements, or "definable features of work," that will be required to achieve the project goals. These definable features are listed on **Worksheet #14** and they are explained further in this worksheet, with references to relevant SOPs (**Worksheet #21** and **Appendix A** and **B**), MPCs (**Worksheet #12**), and other sections of the UFP-QAPP, as necessary.

17.2 DEFINEABLE FEATURES OF WORK

17.2.1 MOBILIZATION

It is anticipated that two mobilizations will be necessary to complete the field tasks preformed under this QAPP. Upon receipt of document approval, the field team will be notified, travel and lodging arrangements will be made, and the requisite copies of applicable documents will be assembled. The field management team will have already reviewed the available documentation relating to the site and this UFP-QAPP.

Equipment and materials will either be shipped to the site via commercial carrier, transported to the site by the field team, or obtained locally, as appropriate. Equipment may include, but is not limited to, sampling supplies, sample containers, documents, first aid kits, fire extinguishers, digital cameras, tubing, etc. Site vehicles will be rented and, in most cases, will be four-wheel drive vehicles that will accommodate all site personnel and equipment. A subcontractor with equipment and personnel for drilling will also be mobilized to the site.

The primary means of onsite communication will be achieved using cellular telephones. If separated from one another, each member of the field sampling team will have an operational cell phone available at all times for emergency use. Additional information can be found in the Long-Term Monitoring/Land Use Control Management Accident Prevention Plan (APP) and the Supplemental APP (EA, 2023; Parsons, 2023b).

Prior to field activities, all field team members will be given site-specific training involving:

- Activities to be performed;
- Safe work practices; and
- Installation-specific procedures.

In addition to this training, the field team will be briefed each day prior to commencement of field activities by the field team lead. Daily briefings will include a discussion of weather conditions and the coming day's activities.

17.2.2 SITE PREPARATION

The field teams will utilize the field office on site to prepare for the sample collection and inspection activities. The sampling equipment will be calibrated and inspected daily to ensure proper functionality (**Worksheet #22**). The appropriate number of sample bottles, and the respective bottle labels will also be prepared at the field office (**Worksheet #18**).

17.2.3 DRILLING, WELL INSTALLATION, AND ABANDONMENT

The design and rationale for drilling, well installation, and abandonment are described in Section 3.1 of the Work Plan for the SEDA Background Study.

17.2.4 WELL DEVELOPMENT

The design and rationale for well development are described in Section 3.1 of the Work Plan for the SEDA Background Study.

17.2.5 SAMPLING AND ANALYSIS

The design and rationale for soil, groundwater, surface water, and sediment sampling and analysis are described in Sections 3.2 through 3.4 of the Work Plan for the SEDA Background Study.

Samples from the proposed locations will be collected in accordance with SOPs (**Worksheet #21**). The samples will be analyzed for VOCs, SVOCs, perchlorate, metals, explosives, phosphorus, orthophosphate, and PFAS using the methods listed in **Worksheet #19**. A comprehensive list showing analyses to be performed at each location is included on **Worksheet #18**. Sample concentrations will be compared with PALs (**Worksheet #15**) for comparison and a background dataset will be developed. The samples will be packaged in coolers and shipped to the analytical laboratory as described in **Worksheets #26** and **#27**.

17.2.6 DEMOBILIZATION

Upon completion of the field activities, all equipment and materials will be packaged and removed from the site. All field documentation will be electronically scanned, and the rental sampling equipment will be returned to the vendor. The field office shall be cleaned and organized to facilitate efficient sampling preparation during the next field event.

Worksheet #18: Sampling Locations and Methods

(EPA UFP-QAPP Guidance Manual, Section 3.1.1 and 3.1.2, EPA Guidance 2106-G-05 Section 2.3.1 and 2.3.2)

The sample locations are summarized in **Tables 18.1** and **18.2** and proposed sampling locations are shown in **Figures 1** and **2** of the Work Plan for the SEDA Background Study. Sample ID nomenclature is explained in **Worksheet #26**. Sample locations and IDs are provided in **Tables 18.1** through **18.3**.

Table 18.1 – Surface Water/Sediment Sampling Locations and Methods

Geographic Location	Location ID	Matrix	Sample ID(1)	Type	Analyte / Analytical Group	Sampling Standard Operating Procedure (SOP)	Alternative Sample ID
Silver Creek	BGSWSD_01	SW	SABK30001	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01 ENV-04	
	BGSWSD_01	SD	SABK40001	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01 ENV-04	
Reeder Creek	BGSWSD_02	SW	SABK30002	SA	Same as above	Same as above	
	BGSWSD_02	SD	SABK40002	SA	Same as above	Same as above	
	BGSWSD_03	SW	SABK30003	SA	Same as above	Same as above	
	BGSWSD_03	SD	SABK40003	SA	Same as above	Same as above	
	BGSWSD_04	SW	SABK30004	SA	Same as above	Same as above	
	BGSWSD_04	SD	SABK40004	SA	Same as above	Same as above	
	BGSWSD_05	SW	SABK30005	SA	Same as above	Same as above	
	BGSWSD_05	SD	SABK40005	SA	Same as above	Same as above	
	BGSWSD_06	SW	SABK30006	SA	Same as above	Same as above	
	BGSWSD_06	SD	SABK40006	SA	Same as above	Same as above	
	BGSWSD_07	SW	SABK30007	SA	Same as above	Same as above	
	BGSWSD_07	SD	SABK40007	SA	Same as above	Same as above	
Outlet of Duck Pond into Kendig Creek	BGSWSD_08	SW	SABK30008	SA	Same as above	Same as above	
	BGSWSD_08	SD	SABK40008	SA	Same as above	Same as above	
Duck Pond	BGSWSD_09	SW	SABK30009	SA	Same as above	Same as above	

Geographic Location	Location ID	Matrix	Sample ID(1)	Type	Analyte / Analytical Group	Sampling Standard Operating Procedure (SOP)	Alternative Sample ID
	BGSWSD_09	SD	SABK40009	SA	Same as above	Same as above	
	BGSWSD_10	SW	SABK30010	SA	Same as above	Same as above	
	BGSWSD_10	SD	SABK40010	SA	Same as above	Same as above	
Duck Pond	BGSWSD_11	SW	SABK30011	SA	Same as above	Same as above	
	BGSWSD_11	SD	SABK40011	SA	Same as above	Same as above	
Wilcox Creek	BGSWSD_12	SW	SABK30012	SA	Same as above	Same as above	
	BGSWSD_12	SD	SABK40012	SA	Same as above	Same as above	
Kendaia Creek	BGSWSD_13	SW	SABK30013	SA	Same as above	Same as above	
	BGSWSD_13	SD	SABK40013	SA	Same as above	Same as above	
	BGSWSD_14	SW	SABK30014	SA	Same as above	Same as above	
	BGSWSD_14	SD	SABK40014	SA	Same as above	Same as above	
	BGSWSD_15	SW	SABK30015	SA	Same as above	Same as above	
	BGSWSD_15	SD	SABK40015	SA	Same as above	Same as above	
Indian Creek	BGSWSD_16	SW	SABK30016	SA	Same as above	Same as above	
	BGSWSD_16	SD	SABK40016	SA	Same as above	Same as above	
	BGSWSD_17	SW	SABK30017	SA	Same as above	Same as above	
	BGSWSD_17	SD	SABK40017	SA	Same as above	Same as above	
	BGSWSD_18	SW	SABK30018	SA	Same as above	Same as above	
	BGSWSD_18	SD	SABK40018	SA	Same as above	Same as above	
Unnamed creek; adjacent Seneca Co Jail	BGSWSD_19	SW	SABK30019	SA	Same as above	Same as above	
	BGSWSD_19	SD	SABK40019	SA	Same as above	Same as above	
SEAD 26 Pond	BGSWSD_20	SW	SABK30020	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate	ENV-04	
	BGSWSD_20	SD	SABK40020	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate	Same as above	
	SWSD25_03	SW	SABK30021	SA	PFAS	ENV-01	

Geographic Location	Location ID	Matrix	Sample ID(1)	Type	Analyte / Analytical Group	Sampling Standard Operating Procedure (SOP)	Alternative Sample ID
Upgradient drainage which enters SEAD-25 network	SWSD25_03	SD	SABK40021	SA	PFAS	Same as above	
TBD – DU 1	TBD	SW	SABK30022	DU	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01, ENV-04	
TBD – DU 2	TBD	SW	SABK30023	DU	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	Same as above	
TBD – DU 1	TBD	SD	SABK40022	DU	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	Same as above	
TBD – DU 2	TBD	SD	SABK40023	DU	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	Same as above	
TBD – MS/MSD 1	TBD	SW	SABK300##-MS SABK300##-MSD	MS/MSD	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	Same as above	
TBD – MS/MSD 1	TBD	SD	SABK400## MS SABK400## MSD	MS/MSD	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	Same as above	
As Needed, one per cooler shipped	n/a	AQ	SABK000## (e.g., SABK00001)	TB	VOCs	ENV-04	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK001## (e.g., SABK00101)	EB	VOCs, SVOCs, perchlorate, metals, explosives, phosphorus, and orthophosphate as P	Same as above	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK010## (e.g., SABK01001)	FB	For PFAS only	ENV-01	

Key: SW = Surface water; SD = Sediment; SA = Sample; DU = Duplicate; MS/MSD = Matrix Spike / Duplicate; EB = Equipment Blank; TB = Trip Blank; FB = Field Blank; AQ = Aqueous; TBD = To Be Determined.

(1) MS/MSDs and field duplicates will be collected from each matrix at the frequency described in Worksheet 20. The locations of the MS/MSD and field duplicate will be determined in the field based on site conditions. One of the existing sample IDs in the table above will be appended with MS and MSD. The field duplicates will be collected at the same location as a normal field sample and the sample ID will be one larger than the last ID shown in the table.

(2) Samples collected during additional (seasonal) rounds of sampling will be identified by advancing the last used sample ID by 1 (e.g., the second round of surface water samples would start with sample ID SABK30024). Database storage of the analytical data also includes the sample date.

Table 18.2 – Groundwater Sampling Locations and Methods

Geographic Location	Location ID	Matrix	Sample ID(1)	Type	Analyte / Analytical Group	Sampling SOP	Alternative Sample ID
New Shallow Well	BGMW-01	GW	SABK20001	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01 ENV-03	
New Shallow Well	BGMW-02	GW	SABK20002	SA	Same as above	Same as above	
Deep Well	BGMW-02D	GW	SABK20003	SA	Same as above	Same as above	
New Shallow Well	BGMW-03	GW	SABK20004	SA	Same as above	Same as above	
New Shallow Well	BGMW-04	GW	SABK20005	SA	Same as above	Same as above	
New Shallow Well	BGMW-05	GW	SABK20006	SA	Same as above	Same as above	
Deep Well	BGMW-05D	GW	SABK20007	SA	Same as above	Same as above	
Existing Shallow Well	MW45-BG1	GW	SABK20008	SA	Same as above	Same as above	
Existing Deep Well	MW45-BG1D	GW	SABK20009	SA	Same as above	Same as above	
Existing Shallow Well	MW45-BG2	GW	SABK20010	SA	Same as above	Same as above	
Existing Deep Well	MW45-BG2D	GW	SABK20011	SA	Same as above	Same as above	
Existing Shallow Well	MW25-24	GW	SABK20012	SA	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate	ENV-03	
TBD – DU 1	TBD	GW	SABK200##	DU	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01 ENV-03	
TBD – DU 2	TBD	GW	SABK200##	DU	Same as above	Same as above	
TBD – MS/MSD 1	TBD	GW	SABK200##-MS SABK200##-MSD	MS/MSD	Same as above	Same as above	
As Needed, one per cooler shipped	n/a	AQ	SABK000## (e.g., SABK00001)	TB	VOCs	ENV-03	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK001## (e.g., SABK00101)	EB	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01 ENV-03	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK010## (e.g., SABK01001)	FB	For PFAS only	ENV-01	

Key: GW = Groundwater; SA = Sample; DU = Duplicate; MS/MSD = Matrix Spike / Duplicate; EB = Equipment Blank; FB = Field Blank; AQ = Aqueous; TBD = To Be Determined

(1) MS/MSDs and field duplicates will be collected from each matrix at the frequency described in Worksheet 20. The locations of the MS/MSD and field duplicate will be determined in the field based on site conditions. Existing sample IDs will be appended with MS and MSD as seen in the table above. The field duplicates will be collected at the same location as a normal field sample and the sample ID will be one larger than the last ID shown in the table.

(2) Samples collected during additional (seasonal) rounds of sampling will be identified by advancing the last used sample ID by 1 (e.g., the second round of groundwater samples would start with sample ID SABK20015). Database storage of the analytical data also includes the sample date.

Table 18.3 – Soil Sampling Locations and Methods

Geographic Location	Location ID	Matrix	Sample ID (1, 2)	Type	Analyte / Analytical Group	Sampling SOP	Alternative Sample ID
Northeast edge SEDA	BGSO_01	SO	SABK10001	SA	VOCs, SVOCs, perchlorate, metals, explosives, T phosphorus, orthophosphate, PFAS	ENV-01 ENV-02	
	BGSO_02	SO	SABK10002	SA	Same as above	Same as above	
	BGSO_03	SO	SABK10003	SA	Same as above	Same as above	
	BGSO_04	SO	SABK10004	SA	Same as above	Same as above	
	BGSO_05	SO	SABK10005	SA	Same as above	Same as above	
Eastern SEDA boundary, north of the former Admin area	BGSO_06	SO	SABK10006	SA	Same as above	Same as above	
	BGSO_07	SO	SABK10007	SA	Same as above	Same as above	
	BGSO_08	SO	SABK10008	SA	Same as above	Same as above	
	BGSO_09	SO	SABK10009	SA	Same as above	Same as above	
	BGSO_10	SO	SABK10010	SA	Same as above	Same as above	
Undisturbed portion of Admin Area	BGSO_11	SO	SABK10011	SA	Same as above	Same as above	
	BGSO_12	SO	SABK10012	SA	Same as above	Same as above	
	BGSO_13	SO	SABK10013	SA	Same as above	Same as above	
NW of OD Grounds	BGSO_14	SO	SABK10014	SA	Same as above	Same as above	
	BGSO_15	SO	SABK10015	SA	Same as above	Same as above	
Warehouse Area (NE of former Reservoir)	BGSO_16	SO	SABK10016	SA	Same as above	Same as above	
	BGSO_17	SO	SABK10017	SA	Same as above	Same as above	
	BGSO_18	SO	SABK10018	SA	Same as above	Same as above	
	BGSO_19	SO	SABK10019	SA	Same as above	Same as above	
	BGSO_20	SO	SABK10020	SA	Same as above	Same as above	
NE of former warehousing area	BGSO_21	SO	SABK10021	SA	Same as above	Same as above	
	BGSO_22	SO	SABK10022	SA	Same as above	Same as above	
	BGSO_23	SO	SABK10023	SA	Same as above	Same as above	
	BGSO_24	SO	SABK10024	SA	Same as above	Same as above	
	BGSO_25	SO	SABK10025	SA	Same as above	Same as above	
Collected during install of BGMW-01	BGSO_26	SO	SABK10026	SA	Same as above	Same as above	

Geographic Location	Location ID	Matrix	Sample ID [1, 2]	Type	Analyte / Analytical Group	Sampling SOP	Alternative Sample ID
Collected during install of BGMW-02	BGSO_27	SO	SABK10027	SA	Same as above	Same as above	
Collected during install of BGMW-03	BGSO_28	SO	SABK10028	SA	Same as above	Same as above	
Collected during install of BGMW-04	BGSO_29	SO	SABK10029	SA	Same as above	Same as above	
Collected during install of BGMW-05	BGSO_30	SO	SABK10030	SA	Same as above	Same as above	
TBD – DU 1	TBD	SO	SABK100##	DU	Same as above	Same as above	
TBD – DU 2	TBD	SO	SABK100##	DU	Same as above	Same as above	
TBD – DU 3	TBD	SO	SABK100##	DU	Same as above	Same as above	
TBD – MS/MSD 1	TBD	SO	SABK100##-MS SABK100##-MSD	MS/MSD	Same as above	Same as above	
TBD – MS/MSD 2	TBD	SO	SABK100##-MS SABK100##-MSD	MS/MSD	Same as above	Same as above	
As Needed, one per cooler shipped	n/a	AQ	SABK000## (e.g., SABK00001)	TB	VOCs	ENV-02	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK001## (e.g., SABK00101)	EB	VOCs, SVOCs, perchlorate, metals, explosives, T/D phosphorus, orthophosphate, PFAS	ENV-01, ENV-02	
Once per week for non-PFAS; Daily when PFAS collected	TBD	AQ	SABK010## (e.g., SABK01001)	FB	For PFAS only	ENV-01	

Key: SO = Soil; SA = Sample; DU = Duplicate; MS/MSD = Matrix Spike / Duplicate; EB = Equipment Blank; FB = Field Blank; AQ = Aqueous; TBD = To Be Determined

- MS/MSDs and field duplicates will be collected from each matrix at the frequency described in Worksheet 20. The locations of the MS/MSD and field duplicate will be determined in the field based on site conditions. Existing sample IDs will be appended with MS and MSD as seen in the table above. The field duplicates will be collected at the same location as a normal field sample and the sample ID will be one larger than the last ID shown in the table.

- Soil samples from multiple depths have a Top and Bottom depth value incorporated in the sample ID, such as SABK10001-0.5-2.5 and SABK10001-2.5-4.5. These would represent two soil boring samples collected at location SABK10001; one sample at a depth of 0.5-2.5 ft bgs, and the other sample at a depth of 2.5-4.5 ft bgs. If shallower depths are being sampled, inches may be used such as SABK10001-06-30 and SABK10001-30-54. If multiple sampling rounds are required for the same sampling location and depth, and extension will be added to the sample ID, such as -01, -02, etc. to distinguish the soil samples.

Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times

(EPA UFP-QAPP Guidance Manual, Section 3.1.1)

This worksheet summarizes the analytical methods for each sampling matrix, including the required sample volume, containers, preservation, and holding time requirements. Details concerning sampling handling are included on **Worksheets #26 & 27**. All samples will be delivered to SGS, located in Orlando, FL with exception of Total and Dissolved Phosphorus, and Orthophosphate which will be shipped directly to Katahdin in Scarborough, ME. PFAS samples will be sent to ELLE. All samples will be sent on ice via UPS or FedEx next day delivery.

Analyte/ Analytical Group	Matrix	Method/SOP Reference (1)	Accreditation Expiration Date (2)	Containers (Number, Size, And Type) (3)	Preservation Requirements	Lab Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
VOCs	Water	8260D / MS020.4, OP021.15	12/15/2024	3, 40-ml VOA vials w/ Teflon lined caps		Not applicable	14 days	21 days
VOCs	Solid	8260D / MS020.4, OP020.16	12/15/2024	1 – 40 ml VOC vial with MeOH 2 – 40 ml VOC vials with water Teflon lined caps	0-6°C	Cool to 4 ± 2ºC Freeze to -10ºC within 48 hours	14 days	21 days
SVOCs	Water	8270E / MS021.2, OP006.13	12/15/2024	2, 1000 mL amber glass, Teflon lined cap	0-6°C	7 days	40 days	21 days
SVOCs	Solid	8270E / MS021.2, OP007.11	12/15/2024	1 – 8 oz glass jar with Teflon lined cap	0-6°C	14 days	40 days	21 days
ICP-MS Metals	Water	6020B / MET107.05, MET103.18	12/15/2024	1, 500 mL polyethylene bottle	Nitric Acid, pH<2	Not applicable	180 days	21 days
ICP-MS Metals	Solid	6020B / MET107.05, MET104.16	12/15/2024	1, 8oz. amber glass jar	0-6°C	Not applicable	180 days	21 days
Mercury	Water	7470A/MET106.14	12/15/2024	1 – 500 ml plastic bottle	Nitric Acid, pH<2	Not applicable	28 days	21 days
Mercury	Solid	7471B/MET105.14	12/15/2024	1, 8 oz. glass jar	0-6°C	Not applicable	28 days	21 days
Hexavalent Chromium	Water	7196 / GN110.12	12/15/2024	1 – 500 ml plastic bottle	0-6°C	Not applicable	24 hours	21 days
Hexavalent Chromium	Solid	7196 / GN171.07	12/15/2024	1, 4oz. glass jar	0-6°C	30 days	7 days	21 days

Analyte/ Analytical Group	Matrix	Method/SOP Reference (1)	Accreditation Expiration Date (2)	Containers (Number, Size, And Type) (3)	Preservation Requirements	Lab Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Orthophosphate as P	Water	SM4500P-E/CA-771	2/1/2025	1, 100 mL polyethylene bottle	0-6°C	Not applicable	48 hours	21 days
Explosives	Water	8330B/GC034.10	12/15/2024	2 – 1 L or 250 ml amber glass bottle with Teflon lined cap	Protected from light, Cool to 0-6°C	7 days	ASAP after preparation. No analysis allowed > 40 days after preparation	21 days
Explosives	Solid	8330B/ GC034.10	12/15/2024	1, 4 oz. glass jar	0-6°C	14 days	40 days	21 days
Perchlorate	Water	6850/MS013.8	12/15/2024	1, 125 mL polyethylene bottle 1/3 headspace (mandatory)	0-6°C	Not applicable	28 days	21 days
Perchlorate	Solid	6850/MS013.8	12/15/2024	1 – 4 oz plastic jar with 1/3 headspace (mandatory)	0-6°C	28 days	28 days	21 days
Orthophosphate as P	Solid	SM4500P-E/CA-771	2/1/2025	1, 2oz. glass jar	0-6°C	Not applicable	48 hours	21 days
Total Phosphorus	Solid	EPA 365.4/CA-715	2/1/2025	1, 2oz. glass jar	0-6°C	Not Applicable	28 days	21 days
Total and Dissolved Phosphorus	Water	EPA 365.2/ CA-781	2/1/2025	1, 100-ml glass or plastic bottle	0-6°C, H2SO4 to pH < 2	Not Applicable	28 days	21 days
PFAS	Solid	EPA Draft Method 1633/ WI48593 (4)	11/30/2022	1, 4.5oz polyethylene bottle with no Teflon liner in lid Note: collect samples as grab, fill no more than ¾ full.	Maintain solid samples protected from light (in HDPE containers) at 0 - 6 ºC from the time of collection until receipt at the laboratory. The laboratory must confirm that the sample temperature is 0 - 6 ºC upon receipt. Once received by the laboratory, the samples must be stored	28 days protected from light (or 90 days at -20°C)	28 days	21 days

Analyte/ Analytical Group	Matrix	Method/SOP Reference (1)	Accreditation Expiration Date (2)	Containers (Number, Size, And Type) (3)	Preservation Requirements	Lab Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
					at ≤ -20 °C until sample preparation.			
PFAS	Water	EPA Draft Method 1633/ WI46412 (4)	11/30/2022	1, 500 mL polyethylene bottle, with no Teflon liner in cap Note: Do not fill bottle past shoulder to allow room for expansion during frozen storage.	Maintain all aqueous samples protected from light at 0 - 6 °C from the time of collection until shipped to the laboratory. Samples must be shipped as soon as practical with sufficient ice to maintain the sample temperature below 6 °C during transport and be received by the laboratory within 48 hours of collection. The laboratory must confirm that the sample temperature is 0 - 6 °C upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 °C until sample preparation.	28 days protected from light (or 90 days at -20°C)	28 days	21 days

(1) Laboratory SOPs (Appendix B) are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.
(2) Accreditation Expiration date refers to the DoD ELAP certification. NY certifications for SGS, ELLE and Katahdin expire 04/01/2024.
(3) Sample size is a minimum, the containers listed will be filled to compensate for any required re-analysis or re-extractions. For samples requiring Matrix Spike/Matrix Spike Duplicate (MS/MSD) containers listed should be tripled.
(4) Refer to HGLs' Final PFAS UFP QAPP for the current SOP information (HGL, 2023).

Worksheet #20: Field Quality Control

(EPA UFP-QAPP Guidance Manual, Section 3.1.1)

This worksheet summarizes the QC samples to be collected and analyzed for the project. It shows the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix. Note if samples are collected over the estimated number shown, additional QC samples will be collected at the rate shown.

Table 20.1 – Non-PFAS Field and Quality Control Samples

Site	Matrix	Analytical Group	Estimated No. of Field Samples	Trip Blank (For VOC only)	Equipment Blank(1)	Field Duplicates	Matrix Spike / Matrix Spike Duplicates	Estimated Number of Total Analyses
SEDA	Soil	All parameters(2)	60	1 per cooler	1 per week	10%	5%	74
	Groundwater		24(3)					36
	Surface Water		40(4)					49
	Sediment		40(4)					53

(1) For non-PFAS analytes, equipment blanks will not be applicable if dedicated tubing or disposable equipment is used to collect samples
(2) Full list of parameters includes VOCs, SVOCs, metals, explosives, perchlorate, total and/or dissolved phosphorus, and orthophosphate.
(3) Two rounds of 12 samples each.
(4) Two rounds of 20 samples each.

Table 20.2 – PFAS Field and Quality Control Samples

Site	Matrix	Analytical Group	Estimated No. of Field Samples	Field Blank(1)	Equipment Blank(2)	Field Duplicates	Matrix Spike / Matrix Spike Duplicates	Estimated Number of Total Analyses
SEDA	Soil	PFAS	60	1 per day	1 per day	10%	5%	81
	Groundwater		24(3)					47
	Surface Water		40(4)					52
	Sediment		40(4)					58

(1) Field Blanks are shared between surface water and sediment since samples are taken at approximately the same time.
(2) For PFAS analytes, all equipment which may come into contact with sample media must be PFAS-free.
(3) Two rounds of 12 samples each.
(4) Two rounds of 20 samples each.

Worksheet #21: Field Standard Operating Procedures

(EPA UFP-QAPP Guidance Manual, Section 3.1.2)

The SOPs to be used for analysis of samples collected during the investigation are listed in the below table. Copies of these field SOPs are provided in Appendix A.

Table 21.1 – Field SOPs

Reference Number	Title, Revision Date, and/or Number	SOP Originating Organization	Related Equipment Types	Modified for Project? (Y/N)	Comments
CHEM-01	Chemistry Data Review and Management, Rev 01, 7/27/2018	Parsons	N/A	N	Appendix A
ENV-01	PFAS Sampling Guidance, Rev 01, 12/12/2022	Parsons	N/A	N	Appendix A
ENV-02	Soil Sampling, Rev 00, 04/22/2022	Parsons	Ref. Section 4, SOP ENV-02	N	Appendix A
ENV-03	Groundwater Sampling, Rev 00, 04/20/2022	Parsons	Ref. Section 4, SOP ENV-03	N	Appendix A
ENV-04	Surface Water and Sediment Sampling, Rev 00, 04/20/2022	Parsons	Ref. Section 4, SOP ENV-04	N	Appendix A
ENV-05	Monitoring Well Development, Rev 00, 04/20/2022	Parsons	Ref. Section 4, SOP ENV-05	N	Appendix A
ENV-06	Soil Borings and Monitoring Well Installation, Rev 00, 02/24/2022	Parsons	Ref. Section 4, SOP ENV-06	N	Appendix A
MEC-03	Munitions and Explosives of Concern (MEC) Avoidance and Escort, Rev 00, 02/18/2015	Parsons	Ref. Section 4, SOP MEC-03	N	Appendix A

Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

(EPA UFP-QAPP Guidance Manual, Section 3.1.2.4)

This worksheet describes the field equipment needed for the project and the associated calibration, maintenance, testing, and inspection procedures for that field equipment. This worksheet also documents the field equipment's frequency of activity, acceptance criteria, and corrective action requirements.

Field Equipment	Calibration, Verification, Testing, or Maintenance Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference (1)
Water Level Indicator	Visual inspection, Decontamination	Daily, between sampling locations	Equipment is clean and operating as expected	Replace batteries; request replacement	Sample Team Lead	ENV-03, -04, (Appendix A)
PID	Calibration and Visual inspection	Daily, prior to sampling	Standard calibration to Isobutylene	Recalibrate; reference user's manual; request replacement/ use alternative equipment.	Sample Team Lead	ENV-02, -03, -04, (Appendix A)
Metal Detector (MEC Avoidance)	Visual inspection, Function Test	Daily, prior to any MEC escort or anomaly avoidance activities	Detect surface and/or subsurface metallic items	Replace batteries or use alternative equipment	UXO Technician	MEC-03 (Appendix A)
GPS	Visual inspection, Function Test	Daily	Measured position of control point within tolerance of GPS unit	Document questionable information in field notebook, use alternative equipment	Sample Team Lead	ENV-02, -03, -04, (Appendix A)
Water Quality Meter	Calibration and Visual inspection	Daily, prior to sampling	Within 5% of standard calibration solution values for pH, ORP, and Spec. Cond.	Recalibrate or use alternative equipment	Sample Team Lead	ENV -03, ENV-04, (Appendix A)
DO Meter	Calibration and Visual inspection	Daily, prior to sampling	Standardize DO to atmospheric pressure	Recalibrate or use alternative equipment	Sample Team Lead	ENV-03, ENV-04, (Appendix A)
Turbidity Meter	Calibration and Visual inspection	Daily, prior to sampling	Within 5% of standard calibration solution values for NTU	Recalibrate or use alternative equipment	Sample Team Lead	ENV -03, ENV-04 (Appendix A)
Submersible Pump	Visual inspection, Maintenance, and Decontamination	Between sampling locations	Equipment is clean	Decontaminate bladder pump, replace bladder, seals, and tubing prior to sampling	Sample Team Lead	ENV-03, (Appendix A)

Field Equipment	Calibration, Verification, Testing, or Maintenance Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference (1)
Peristaltic Pump	Visual inspection, Maintenance, and Decontamination	Between sampling locations	Equipment is clean	Replace tubing prior to sampling	Sample Team Lead	ENV-03, ENV-04, (Appendix A)

(1) See Project SOP Reference Table (**Worksheet #21**) for SOP titles.

(2) All downhole pumps and equipment coming into contact with sample media will be PFAS-free or if unknown will be tested prior to use with a PFAS equipment blank and then approved for use by the project team. Reference SOP ENV-1 – PFAS Sampling Guidance.

Worksheet #23: Analytical Standard Operating Procedures

(EPA UFP-QAPP Guidance Manual, Section 3.2.1)

The applicable SOPs to be used for analysis of samples collected during the investigation are listed in the below tables. The laboratory SOP references were provided by SGS and Katahdin and are presented in **Appendix B**. Refer to HGLs' Final PFAS UFP QAPP, for the ELLE laboratory SOPS (HGL, 2023).

SOP #	Title, Date, and/or Number	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project?
MS020 (SGS)	Analysis of Volatile Organics by GC/MS, Revision 4, 05/2023	Definitive	Water and Solid/VOCs	Agilent 6890 or 7890 (GC) with Agilent 5973 or 5975 (MSD)	N
OP021 (SGS)	The Introduction of Volatile Organics Analytes in Soil Using Closed System Purge-And-Trap, Revision 15, 09/2023	Definitive	Water/VOCs	Purge and Trap	N
OP020 (SGS)	The Introduction of Volatile Organics Analytes in Soil Using Closed System Purge-And-Trap Revision 16, 09/2023	Definitive	Solid/VOCs	Closed System Purge and Trap	N
MS021 (SGS)	Analysis of Semivolatile Organics by GC/MS, Revision 2, 10/2020	Definitive	Water and Solid/SVOCs	Agilent 6890 or 7890 (GC) with Agilent 5973 or 5975 (MSD)	N
OP006 (SGS)	The Extraction of Base-Neutral and Acid (BNAs)Extractables from Water Samples, Revision 13, 8/2023	Definitive	Water/SVOCs	Separatory Funnel LLE	N
OP007 (SGS)	The Extraction of Base-Neutral and Acid (BNAs)Extractables from Solid Samples, Revision 11 06/2022	Definitive	Solid/SVOCs	Sonic Disrupter	N
MET107 (SGS)	Metal and Trace Elements by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS), Revision 05, 05/2023	Definitive	Water and Solid/Metals	Inductively Coupled Plasma (ICP)/MS	N
MET103 (SGS)	Digestion of Water Samples for ICP/MS Analysis Revision 18, 05/2023	Definitive	Water/Metals	Hot Block	N
MET104 (SGS)	Digestion of Soils for ICP/MS Analysis, Revision 16, 05/2023	Definitive	Solid/Metals	Hot Block	N
MET106 (SGS)	Cold Vapor Analysis of Mercury for Water Samples, Revision 14, 05/2023	Definitive	Water/Mercury	Leeman Hydra AA II	
MET105 (SGS)	Cold Vapor Analysis of Mercury for Soils, Revision 14, 05/2023	Definitive	Solid/Mercury	Leeman Hydra AA II	N

SOP #	Title, Date, and/or Number	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project?
GN110(1) (SGS)	Chromium, Hexavalent (Water), Revision 12, 09/17	Definitive	Water / Hexavalent Chromium	UV Spectrophotometry	N
GN171(1) (SGS)	Hexavalent Chromium in Soils, Revision 7, 11/2021	Definitive	Solid/ Hexavalent Chromium	UV Spectrophotometry	N
SAM101 (SGS)	Sample Receipt and Storage, Revision 22, 07/2023	NA	NA	NA	N
SAM108 (SGS)	Sample and Laboratory Waste Disposal, Revision 11, 08/2020	NA	NA	NA	N
CA-771 (Katahdin)	Colorimetric Analysis of Orthophosphate Using the Automated Konelab Multiwavelength Photometric Analyzer, Revision 4, 02/2019	Definitive	Water and Solid/Orthophosphate as P	Konelab	N
GC034 (SGS)	Analysis of Nitroaromatics, Nitramines, and Nitrate Esters by HPLC Method SW-8330B, Revision 10, 01/2021	Definitive	Water and Solid / Explosives	Agilent 1100 or 1260 (HPLC)	N
OP018 (SGS)	The Extraction of Explosives (Nitroaromatics, Nitramines, and Nitrate Esters) From Water Samples for HPLC Analysis, Revision 12, 06/2022	Definition	Water / Explosives	SPE	N
OP046 (SGS)	Standard Operating Procedure for the Extraction of Nitroaromatics and Nitramines from Solid Samples for HPLC Analysis by SW-846 8330B. ISM Samples via Ring and Puck Mill Discreet Samples via Mortar and Pestle, Rev. 06/22	Definitive	Solid / Explosives	Shaker Table	N
MS013 (SGS)	Analysis of Perchlorate By LC/MS/MS, Revision 8, 12/20/20	Definitive	Water and Solid/Perchlorate	Agilent 1260 (HPLC) with Agilent 6460A and 6470 (MSD)	N
CA-715 (Katahdin)	Analysis of TPO4 (Total Phosphorus) Using Block Digestion and Flow Injection Colorimetry (Lachat): EPA Method 365.4, Revision 10, 02/2021.	Definitive	Solid/Total Phosphorus	Lachat	N
CA-781 (Katahdin)	Colorimetric Determination Low Level Total Phosphorus (LL TPO4) In Aqueous Samples Method: EPA 365.2 & SM 4500P E, 11/19, Revision 0.	Definitive	Water / Total and Dissolved Phosphorus	Spectrophotometer	N
SD-902 (Katahdin)	Sample Receipt and Internal Control, Revision 14, May 2020	NA	NA	NA	N
SD-903 (Katahdin)	Sample Disposal, Revision 6, 04/2023	NA	NA	NA	N

(1) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

Worksheet #24: Analytical Instrument Calibration

(EPA UFP-QAPP Guidance Manual, Section 3.2.2)

The Analytical Instrument Calibration Table and the specific analytical method SOP references are provided in Appendix B.

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE(1)
Agilent 6890 or 7890 (GC) with Agilent 5973 or 5975 (MSD) SW-846 8260D SW-846 8270E	VOC - Tune Verification – 4-Bromofluorobenzene (BFB) SVOC - Decafluorotriphenyl - phosphine (DFTPP)	At the beginning of each 12-hour analytical sequence	Must meet ion abundance criteria required by the method. No samples may be accepted without a valid tune.	Retune and/or clean source	Analyst, Department Manager	MS020 (VOC) MS021 (SVOC) (SGS Orlando)
GC/MS (8270 analysis only)	Breakdown Check – Injection Port Performance Compounds	Daily prior to sample analysis	Degradation ≤ 20% for DDT, Benzidine, and Pentachlorophenol shall be present at their normal responses, and shall not exceed a tailing factor of 2.	Perform maintenance on the injection port. The performance check must be passed before any samples or standards can be analyzed.	Analyst, Department Manager	MS021 (SVOC) (SGS Orlando)
GC/MS	Initial Calibration (ICAL) – Minimum of a 5-point calibration curve is prepared	After major instrument maintenance and upon second consecutive continuing calibration verification (CCV) failure	Relative standard deviation (RSD) for each analyte must be ≤ 15%, or the linear least squares regression correlation coefficient (r) must be ≥ 0.995, or the coefficient of determination (r2) must be ≥ 0.990 (6 points required for second order).	Correct problem then repeat ICAL.	Analyst, Department Manager	MS020 (VOC) MS021 (SVOC) (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
GC/MS	Initial Calibration Verification (ICV) – second source	Once after each ICAL, analysis of a second source standard prior to sample analysis	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Analyst, Department Manager	MS020 (VOC) MS021 (SOVC) (SGS Orlando)
GC/MS	Continuing Calibration Verification (CCV)	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate and reanalyze all samples since last acceptable CCV.	Analyst, Department Manager	MS020 (VOC) MS021 (SOVC) (SGS Orlando)
GC/MS	Establish Retention Time (RT) Window Position	After major instrument maintenance and upon second consecutive continuing calibration verification (CCV) failure	Average response factor (RF) must be ≥ 0.010 for all low-level PAHs. Relative standard deviation (RSD) for each analyte must be ≤ 15%, or the linear least squares regression correlation coefficient (r) must be ≥ 0.995, or the coefficient of determination (r2) must be ≥ 0.99 (6 points required for second order).	Repeat calibration if criterion is not met	Analyst, Department Manager	MS020 (VOC) MS021 (SOVC) (SGS Orlando)
GC/MS	Evaluation of Relative Retention Times (RRTs)	With each sample	RRT of each target analyte must be within ± 0.06 RRT units.	Correct problem then rerun ICAL	Analyst, Department Manager	MS020 (VOC) MS021 (SOVC) (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
SW-846 6020B Agilent 7700x (ICP-MS) SW-846 6020B Metals	Tuning	Prior to ICAL	Mass calibration must be within 0.1 atomic mass unit (amu) from the true value. Resolution must be <0.9 amu full width at 10% peak height. Injections %RSD must be <5%.	Retune instrument and verify. Flagging not appropriate, no samples should be analyzed w/o valid tune.	Analyst, Department Manager	MET107 (SGS Orlando)
ICP/MS	Initial Calibration (ICAL) – daily prior to sample analysis	At beginning of each day, or if QC is out of criteria	Multi point calibration plus a blank. r must be ≥ 0.998.	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected samples	Analyst, Department Manager	MET107 (SGS Orlando)
ICP/MS	ICV	Once after each ICAL, and before beginning a sample run	%R must be within 90–110% of the true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	MET107 (SGS Orlando)
ICP/MS	CCV	At beginning and end of sequence and after every 10 samples	%R must be within 90–110% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Department Manager	MET107 (SGS Orlando)
ICP/MS	Low-Level Check Standard (LLCCV)	Daily after ICAL and before samples.	The %R must be within 80–120% of true value.	Investigate and perform necessary equipment maintenance; recalibrate and reanalyze all affected samples	Analyst, Department Manager	MET107 (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
ICP/MS	Continuing Calibration Blank	After the initial CCV, after every 10 field samples; and at end of sequence	No analytes detected > ½ LOQ, or < 1/10 of the amount measured in the sample	Correct the problem, then re-prepare and reanalyze calibration blank associated samples and a CCV	Analyst, Department Manager	MET107 (SGS Orlando)
ICP/MS	Interference Check Standards (ICS – ICS A and ICS B)	After ICAL and prior to sample analysis.	ICS A recoveries must be within the absolute value of < 1/2 LOQ; and ICS B recoveries must be within 80–120 %R of the true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze affected samples.	Analyst, Department Manager	MET107 (SGS Orlando)
Leeman Hydra II SW-846 7470A 7471B Mercury	ICAL - 5 points plus a calibration blank	Daily	Correlation coefficient of calibration curve ≥0.995	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected samples	Analyst, Department Manager	MET105 MET106 (SGS Orlando)
Leeman Hydra II	ICV	Following ICAL, prior to samples analysis	%R must be within 90–110% of the true value.	Investigate reasons for failure, reanalyze once; if still unacceptable, repeat ICAL	Analyst, Department Manager	MET105 MET106 (SGS Orlando)
Leeman Hydra II	CCV	At beginning and end of sequence and after every 10 samples	%R must be within 90–110% of true value.	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected samples	Analyst, Department Manager	MET105 MET106 (SGS Orlando)
Leeman Hydra II	Initial Calibration Blank (ICB)	Before beginning a sample sequence.	No analytes detected > ½ LOQ.	Correct the problem, re-digest and reanalyze	Analyst, Department Manager	MET105 MET106 (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE(1)
Leeman Hydra II	LLCCV	Daily after ICAL and before samples.	The %R must be within 80–120% of true value.	Investigate and perform necessary equipment maintenance; recalibrate and reanalyze all affected samples	Analyst, Department Manager	MET105 MET106 (SGS Orlando)
UV/VIS Spectro-photometer SW-846 7196A Hexavalent Chromium	ICAL- the instrument is calibrated by a minimum 5-point curve and a blank	Minimum monthly, or if QC is out of criteria	If multiple calibration standards are used, r must be ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data	Analyst, Department Manager	GN110(AQ) GN171(SO) (SGS Orlando)
UV/VIS	ICV and CCV	Following ICAL, prior to samples analysis and every 10 readings	%R must be within 90–110% of the true value.	Investigate reasons for failure, reanalyze once; if still unacceptable, repeat ICAL	Analyst, Department Manager	GN110(AQ) GN171(SO) (SGS Orlando)
UV/VIS	Initial Calibration Blank (ICB) and Continuing Calibration Blank (CCB)	Before beginning a sample sequence.	No analytes detected >1/2 LOQ.	Correct the problem, then re-prepare and reanalyze calibration blank and previous 10 samples.	Analyst, Department Manager	GN110(AQ) GN171(SO) (SGS Orlando)
Agilent 1100 or 1260 (HPLC) SW-846 8330B Explosives	ICAL	Major maintenance (per method) or second consecutive failure of opening CCV	%RSD ≤ 15%, or Correlation coefficient R ≥ 0.995	Instrument maintenance, leak check, Lamp test, pump test, standard inspection, recalibration	Analyst, Department Manager	GC034 (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
		warrants recalibration				
HPLC	ICV	1 per ICAL, analyzed after ICAL, before field samples	All reported analytes within ± 20% of the expected value	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed	Analyst, Department Manager	GC034 (SGS Orlando)
HPLC	CCV	Opening CCV, then every 10 samples, with closing CCV	All reported analytes and surrogates within ± 20% of true value.	If the criterion has not achieved through corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples.	Analyst, Department Manager	GC034 (SGS Orlando)
Agilent 1260 (HPLC) with Agilent 6460A and 6470 (MSD) SW-846 6850 Perchlorate	ICAL	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	%RSD ≤ 15%, or Correlation Coefficient R ≥ 0.995	Hardware tuned per manufacturer's instructions, Instrument maintenance and leak check, standard inspection, retuning and recalibration	Analyst, Department Manager	MS013 (SGS Orlando)
HPLC	ICV	1 per ICAL, analyzed after ICAL, before field samples	%D ≤ 15%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed	Analyst, Department Manager	MS013 (SGS Orlando)
HPLC	CCV	Opening CCV, then every 10 samples, with closing CCV	Mid-point %D ≤ 15% Low point %D ≤ 30%	If the criterion has not achieved through corrective action, re-calibration is performed before any samples may be analyzed. Corrective	Analyst, Department Manager	MS013 (SGS Orlando)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
				action may include re-analysis of the samples.		

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[1]
Konelab	ICAL - Minimum of a 5-pt calibration curve plus blank	Initial calibration prior to sample analysis.	ICAL must meet r ≥0.995	Correct problem then repeat initial calibration. No samples shall be analyzed until ICAL has passed.	Analyst, Department Manager	CA-771 (Katahdin)
Konelab	ICV	Once immediately following three-point initial calibration.	All analytes within 80-120%.	Correct problem and/or prepare fresh ICV, then rerun ICV. If that fails, repeat initial calibration. No samples shall be analyzed until ICV has passed.	Analyst, Department Manager	CA-771 (Katahdin)
Konelab	CCV	CCV a daily before samples and then after every 10 injections and at the end of the analysis sequence.	All reported analytes within 80-120%	Correct problem, repeat calibration verification and reanalyze all samples since last successful calibration verification or immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s), and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst, Department Manager	CA-771 (Katahdin)
Konelab	Calibration Blank	Immediately after the ICV and every CCV.	The absolute value of all analytes must be < LOQ or <1/10th the amount measured in any sample. Samples <LOQ may be reported with a failed blank without qualification.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable	Analyst, Department Manager	CA-771 (Katahdin)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
				calibration blank must be reanalyzed except samples <LOQ.		
Lachat	ICAL - Minimum of a 6-pt calibration curve plus blank.	Prior to sample analysis	cc ≥ 0.995	Recalibrate	Analyst, Department Manager	CA-715 (Katahdin)
Lachat	ICV	Once after each ICAL, prior to beginning a sample run	R must within 80-120%	(1) If the ICV fails high, report samples that are <PQL. (2) Redigest, recalibrate and/or reanalyze other samples	Analyst, Department Manager	CA-715 (Katahdin)
Lachat	CCV	Every 10 samples and at the end of the analytical sequence	R must within 90%-110%	(1) If the CCV fails high, report samples that are <PQL. (2) Redigest, recalibrate and/or reanalyze other samples back to last acceptable CCV recovery	Analyst, Department Manager	CA-715 (Katahdin)
Lachat	Calibration Blank	Immediately after the ICV and every CCV.	The absolute value of all analytes must be < LOQ or <1/10th the amount measured in any sample. Samples <LOQ may be reported with a failed blank without qualification.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed except samples <LOQ.	Analyst, Department Manager	CA-715 (Katahdin)
Spectrophotometer –Total and Dissolved Phosphorus	ICAL – Minimum of a 6-pt calibration	Prior to sample analysis	Linear Regression Correlation Coefficient ≥0.995	(1) Investigate source of problem (2) Recalibrate	Analyst, Department Manager	CA-781 (Katahdin)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE(1)
	curve plus a blank.					
Spectrophotometer –Total and Dissolved Phosphorus	ICV	Once after each ICAL, prior to beginning a sample run.	%R must within 80-120%	(1) If the ICV fails high, report samples that are not detected. (2) Redigest, recalibrate and/or reanalyze other samples.	Analyst, Department Manager	CA-781 (Katahdin)
Spectrophotometer –Total and Dissolved Phosphorus	CCV	One after every 10 samples	%R must within 80-120%	(1) If the CCV fails high, report samples that are not detected. (2) Redigest, recalibrate and/or reanalyze other samples back to last acceptable CCV recovery	Analyst, Department Manager	CA-781 (Katahdin)
Spectrophotometer –Total and Dissolved Phosphorus	Calibration Blank	Immediately after the ICV and every CCV.	The absolute value of all analytes must be < LOQ or <1/10th the amount measured in any sample. Samples <LOQ may be reported with a failed blank without qualification.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed except samples <LOQ.	Analyst, Department Manager	CA-781 (Katahdin)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Mass Calibration	Initially, annually, and after performing major maintenance	Per manufacturer specifications	NA	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table	Tuning	When masses fall outside ± 0.5 amu of true masses	Within 0.5 amu of true value	Retune and verify. If tuning fails acceptance criteria, perform a mass calibration and repeat the tune check.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[(1)]
B-24 (Draft Method 1633)						
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Mass Spectral Acquisition Rate	Each analyte, labeled analyte, and injection internal standard	A minimum of 10 spectra scans are acquired across each chromatographic peak	NA	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Initial calibration with a minimum 6 points	At instrument set-up and initial calibration verification (ICV) or calibration verification (CV) failure, prior to sample analysis	The isotopically labeled analog of an analyte (EIS) must be used for quantitation if commercially available (isotope dilution quantitation). Commercial PFAS standards available as salts are acceptable providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labeled analog is not commercially available, the EIS analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation) Analytes must be within 70-130% of their true value for each calibration standard. Signal-to-noise ratio must be ≥ 10:1 for all ions used for quantification. ICAL must meet one of the two options below: Option 1: The relative standard deviation of the response factors for all analytes must be ≤ 20%.	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE(1)
			Option 2: Linear or non-linear calibrations must have r2 ≥ 0.99 for each analyte.			
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Instrument Sensitivity Check (ISC)	Daily, prior to analysis with analyte concentration at the lowest calibration level.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values. Signal-to noise ratio must be ≥ 3:1 for all ions used for confirmation.	Correct problem and rerun ISC. If problem persists, repeat ICAL	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	ICV Standard	Once with every ICAL	Within ±30% of their true value	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	LOD standard	Quarterly	All compounds must be detected	Reprep and reanalyze LOD.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	LOQ Verification	Quarterly	Within 50% of true value	Reprep and reanalyze LOQ.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE(1)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	CCV Standard	Every 10 samples and at the end of a sequence	Analyte concentration at the mid-level of the calibration curve. Recover within ±30% of their true value	Reanalyze CCV in duplicate immediately. If both pass, samples can be report. If either fails or if immediate reanalysis of CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high any associated samples that are ND can be reported.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Instrument Blanks	Immediately following the highest standard analyzed, daily at start of a sequence, and after each CCV.	Concentration of each analyte must be ≤1/2 LOQ	If criteria not met after highest calibration standard, must decrease that standard's concentration until criteria is met. If criteria not met for sample, run additional instrument blanks until criteria is met.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Ion transitions (Precursor --> Product)	Every field sample, standard, blank and QC samples	Use ion transitions from Table 2 of Draft Method EPA 1633.	N/A	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table	Extracted Internal Standard (EIS) Compounds	Every field sample, standard, blank,	1) Isotopically labeled analogs of analytes must be used when they are commercially available. 2) QC samples and field samples must recover within in-house limits if project	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	TITLE/POSITION FOR RESPONSIBLE CORRECTIVE ACTION	SOP REFERENCE[1]
B-24 (Draft Method 1633)		and QC sample.	limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 20-150% must be used until inhouse limits are generated in accordance with Sections 9.4.1 and 9.4.2 of EPA Draft Method 1633. 3) The lower limit of inhouse acceptance criteria cannot be < 20%.	the failure confirms, follow the requirements listed in EPA Draft Method 1633, Section 15.3.2. If EIS recoveries still fall outside of the acceptance range, the client must be contacted for additional measures to be taken.		
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Non-extracted Internal Standard (NIS) Compounds	Every field sample, standard, blank, and QC sample.	1) NIS areas must be greater than 30% of the average area of the calibration standards in undiluted sample extracts and sample extracts that required additional NIS to be added. 2) NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, examine the project-specific requirements. Contact the client as to additional measures to be taken.	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)
LC/MS/MS - PFAS for QSM 5.4, Table B-15 and/or Table B-24 (Draft Method 1633)	Bile Salt Standard	Daily, prior to analysis of all matrix types.	The retention time of the bile salt peak must fall out of the retention time window of PFOS by at least one minute	N/A	ELLE analyst	WI48593 (solids) / WI46412 (waters) (HGL, 2023)

(1) Refer to the Analytical SOP References table (Worksheet #23) and HGLs' Final PFAS UFP QAPP for the current SOP information (HGL, 2023).

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

(EPA UFP-QAPP Guidance Manual, Section 3.2.3)

This worksheet provides information on analytical instruments and equipment, maintenance, testing, and inspection. To ensure that the analytical instruments and equipment are available and in working order when needed, all laboratory analytical equipment will undergo maintenance and testing procedure in accordance with the laboratory SOPs (provided in **Appendix B**).

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference (1)
Agilent 6890 or 7890 (GC) with Agilent 5973 or 5975 (MSD)	Injector port, column maintenance, source cleaning	SW-846 8260D Volatile Organic Compounds	Leak test, column and injector port inspection, source insulator integrity	Need for maintenance determined by passing calibration and BFB	Passing BFB and CCV, passing Internal Standard response	Column clipping and/or reconditioning, seal and liners replacement, filaments and insulators as needed	Laboratory Analyst	MS020 (SGS Orlando)
Agilent 6890 or 7890 (GC) with Agilent 5973 or 5975 (MSD)	Injector port, column maintenance, source cleaning	SW-846 8270E Semivolatile Organic Compounds	Leak test, column and injector port inspection, source insulator integrity	Need for maintenance determined by passing calibration, DFTPP tune check, and system integrity indicators	Passing DFTPP, system integrity indicators, CCV, and passing Internal Standard response	Column clipping and/or reconditioning, seal and liners replacement, filaments and insulators as needed	Laboratory Analyst	MS021 (SGS Orlando)
Leeman HYDRA AA II	Pump tubing, absorption cell, and lens cleaning.	SW-846 7471B Mercury (SO)	Check connections, flush sample lines	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Reconnect sample pathways, recalibrate, reanalyze affected samples	Laboratory Analyst	MET106 (SGS Orlando)
Agilent 7700x (ICP-MS)	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed.	SW-846 6020B Metals	Torch, nebulizer chamber, pump, pump tubing.	Prior to ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Laboratory Analyst	MET107 (SGS Orlando)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference (1)
	Clean nebulizer, check argon, replace peristaltic pump tubing as needed.							
UV Spectrophotometer	Cuvette and lamp	SW-846 7196A Hexavalent Chromium	Cuvette inspection for cracks and deposits	Frequency determined by instrument remaining in calibration	Passing calibration check	Replace lamp. Send for maintenance to the manufacturer	Laboratory Analyst	GN110 (AQ) GN171 (SO) (SGS Orlando)
Konelab	Check and clean segments weekly, clean reagent tubes monthly. Change lamp, change diluent, and wash tubes, change mixing paddles and syringes, change dispensing needle, all as needed.	Orthophosphate as P	Reagent tubes, lamp, wash tubes, paddles, syringes, dispensing needles.	Prior to initial calibration and/or as necessary.	Must meet initial and/or continuing calibration criteria, no carryover	Repeat maintenance activity or remove from service.	Analyst, Department Manager	CA-771 (Katahdin)
HPLC	Check and sonicate pump valves as needed. Backflush column as needed. Replace analytical column or guard column as needed. Sonicate and replace solvent with every use. Replace the UV lamp as needed. Check and replace seal-pak as needed	Explosives	Column flow, pressure	Prior to initial calibration and/or as necessary.	Acceptable calibration or CV	Correct the problem and repeat calibration or CV	Analyst, Department Manager	GC034 (SGS Orlando)
LC/MS/MS	Access column performance, signal, and needle spray	Perchlorate	Inspect for excessive system pressure and changes to chromatography; Noticeable decrease in signal; Inspect for irregular needle spray or noticeable decrease in signal	Ongoing monitoring and when decrease in signal is apparent	System pressure normalized. Peak shape good and acceptable retention time, normal signal, and normal spray pattern	Back flush analytical column; remove and clean curtain cone and inlet assembly per manufacturer's instructions; Replace electroneedle	Analyst, Department Manager	MS013 (SGS Orlando)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference (1)
						or clean the needle sheath if pray appears irregular or signal decreases noticeably.		
Lachat	Change the pump tubing monthly, replace capillary tubing, clean valves, and flow cells.	Total Phosphorus	Pump tubing, capillary tubing, reagent bottles, manifolds	Daily or as needed	Acceptable calibration or CCV	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst, Department Manager	CA-715 (Katahdin)
Spectrophotometer	Clear cuvettes and lens as necessary. Outside calibration annually.	Total and Dissolved Phosphorus	Cuvettes, cuvette holder, lenses	As necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-781 (Katahdin)
LC/MS/MS	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual inspection	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	ELLE Analysts	WI23588 (HGL, 2023)

(1) Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. All Katahdin and SGS SOPS are found in Appendix B. Refer to HGLs' Final PFAS QAPP for the current SOP information (HGL, 2023).

Worksheets #26 & 27: Sample Handling, Custody, and Disposal

(EPA UFP-QAPP Guidance Manual, Section 3.3)

26.1 SAMPLE NUMBERING

The sample numbering system will continue to be implemented to identify each sample collected. This numbering system will ensure that each sample is uniquely labeled and will provide a tracking procedure to allow retrieval of information about each sample collected. QC samples will be numbered using the same sequential system and notes will be made in the field notebook to record which samples are QC samples; however, duplicates will not be identified to the laboratory. When existing sampling locations are used, the location will use the TYLO-## nomenclature, where TY = Sample type, LO = Location (e.g., SEAD number), and ## location numerical code. For the background study, the samples are generally not associated with an AOC (specific SEAD) therefore the nomenclature will be BGTY-## where BG denotes a background location and no location will be provided (**Table 26.1**). The sample numbering will use the AAST##### nomenclature, where AA = Area/Site Code, ST = Study ID, and ##### = 5-digit numerical code (**Table 26.2**).

Table 26.1 – Location Number Nomenclature

TY = Sample Type	LO= Location	## = Location Numerical Code
SO = Soil MW = Monitoring Well SW = Surface Water SD = Sediment	45 = SEAD-45 (OD Grounds)	## = Location number starting with 01
	25 = SEAD-25	

Table 26.2 – Sample Numbering Nomenclature

AA = Area/Site Code	ST = Study ID	##### = 5-digit Numerical Code
SA = Seneca Activity	BK = Background Investigation	000## = Field QC items (e.g., Trip Blanks)
		001## = Shipment QC samples (e.g., Equip/Field Blanks)
		1#### = Soil Samples
		2#### = Groundwater Samples
	--	3#### = Surface Water Samples
	--	4#### = Sediment Samples

Every sample number will be preceded by the site name designation to identify the site from which the sample was collected. The numerical component for each sample will build upon previous rounds. For database consistency, the next event sample sequence will begin with a sample ID that is one increment higher than the last sample from the previous event. Sample name/numbering examples are shown in **Table 26.2**, and the complete sample list for the next round of sampling for each site is detailed on **Worksheet #18**.

Table 26.3 – Sample Name/Numbering System by Matrix

Site	Site Name Designation	Matrix	Example Sample ID
Background	SABK	Soil	SABK10001
Background	SABK	Groundwater	SABK20001
Background	SABK	Surface Water	SABK30001
Background	SABK	Sediment	SABK40001

26.2 SAMPLE HANDLING

To ensure sample authenticity and data defensibility, proper sample handing system procedures will be followed from the time of sample collection to final sample disposal. The Subcontractor Sample Team Lead or designee is responsible for completing the sample bottle label and chain of custody (CoC) form, sample collection, sample packing, and coordination of sample shipment. The Total and Dissolved Phosphorus and Orthophosphate samples will be sent for analytical testing to Katahdin in Scarborough, Maine via FedEx or UPS Next Day Delivery service. All other non-PFAS samples will be sent to the analytical laboratory, SGS North America Inc. in Orlando, FL (SGS) via FedEx or UPS Next Day Delivery service. PFAS samples will be sent to ELLE in Lancaster, Pennsylvania.

PFAS samples will immediately be placed on ice and will be kept chilled during the workday until packaged for shipment to the laboratory. An onsite freezer is available to store sample containers prior to shipping. The samples will be shipped packed on ice.

The laboratory receiving staff and/or custodians will acknowledge the sample receipts upon arrival. The laboratory analytical technicians will prepare and analyze the field samples in accordance with the analytical SOPs. The field samples and all extracts will be stored at the laboratory for 60 days after sample receipt. The laboratory hazardous waste manager will be responsible for the final sample disposal upon notice from the Subcontractor Project Chemist.

Table 26.4 – Responsibilities for Sample Handling, Custody, and Disposal

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization)	Parsons Field Lead or designee
Sample Packaging (Personnel/Organization)	Parsons Field Lead or designee
Coordination of Shipment (Personnel/Organization)	Parsons Project Chemist
Type of Shipment/Carrier	FedEx or UPS Next Day Delivery
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization)	Sample receiving supervisor, SGS/Katahdin/ELLE
Sample Custody and Storage (Personnel/Organization)	Sample receiving supervisor, SGS/Katahdin/ELLE
Sample Preparation (Personnel/Organization)	Analyst, SGS/Katahdin/ELLE
Sample Determinative Analysis (Personnel/Organization)	Analyst, SGS/Katahdin/ELLE
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample receipt)	60 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion)	40 days
SAMPLE DISPOSAL	
Personnel/Organization	Sample receiving supervisor, SGS/Katahdin/ELLE
Number of Days from Sample Receipt	60 days, or when notified by Parsons project chemist

26.2.1 Sample Labeling

Sample labels will include, at a minimum, project name, project number, sample ID, date/time collected, analysis group or method, preservative, and sampler's name. Labels will be taped to the jar or sample bag prior to sample collection to ensure that they do not separate.

26.3 FIELD SAMPLE CUSTODY PROCEDURES (SAMPLE COLLECTION, PACKAGING, SHIPMENT, AND DELIVERY TO LABORATORY)

Samples will be collected by field team members under the supervision of the Subcontractor Field Team Lead. The sampling team will document the sample collection in a field logbook. Samples will be cushioned, if necessary, with packaging material and placed into coolers along with the CoC. Coolers will be shipped to the laboratory via next day delivery, with the bill number indicated on the CoC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples.

The following address will be used for sample shipments of orthophosphate and total and dissolved phosphorus:
Katahdin Analytical Services
600 Technology Way
Scarborough, ME 04074
Tel.: (207) 874-2400

The following address will be used for sample shipments of PFAS:

Eurofins Lancaster Laboratories Environmental Testing, LLC
2425 New Holland Pike
Lancaster, PA 17601
Tel.: (717) 556-9762

The following address will be used for all other sample shipments:

SGS North America, Inc. - Orlando
4405 Vineland Rd, Ste C-15
Orlando, FL 32811
Tel.: (407) 425-6700

26.3.1 LABORATORY SAMPLE CUSTODY PROCEDURES (RECEIPT OF SAMPLES, ARCHIVING, DISPOSAL)

All laboratory sample receipt, internal custody and sample archiving, and disposal procedures shall be completed in accordance with Katahdin SOPs: SD-902 and SD-903, SGS Orlando SOPs: SAM101 and SAM 108 and ELLE SOPs: WI10725 and WI12042 (HGL, 2023). The SOPs are included in Appendix B.

26.3.2 SAMPLE IDENTIFICATION PROCEDURES

Upon opening the cooler at the analytical laboratory, the receiving clerk will sign the CoC. Then the sample containers in the cooler will be unpacked and checked against the client's CoC. Any discrepancies noted with the samples will be noted on the COC upon receipt. The clerk will deliver the CoC (and any other paperwork) to the Laboratory PM for entry into the LIMS and for client notification.

The laboratory will send sample login forms to the subcontractor data validator to check sample IDs and parameters are correct. The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the CoC.

26.3.3 CHAIN-OF-CUSTODY (COC) PROCEDURES

CoC forms will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The CoC will also have the sampler's name and signature. The CoC will link the location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the LIMS database for each sample.

26.3.4 NON-CONFORMANCE

The Laboratory Project Managers will contact the Subcontractor Project Chemist to resolve any issues encountered during sample receipt and login. The Subcontractor Project Chemist will coordinate with the Contractor Sample Team Lead and other personnel as necessary to resolve the issues.

Worksheet #28: Analytical Quality Control and Corrective Action

(EPA UFP-QAPP Guidance Manual, Section 3.4 and Tables 4, 5, and 6)

The tables in this worksheet describe the requirements for laboratory analysis of QC samples (e.g., laboratory control samples, method blanks, matrix spikes, etc.) for each analytical method used. The tables below detail the QC sample frequency, method/SOP QC acceptance criteria, corrective actions to be taken in the event analyses do not meet the acceptance criteria and the person(s) responsible for implementing corrective actions, and measurement performance criteria.

28.1 VOCs BY EPA SW-846 METHOD 8260C

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	VOCs
Analytical Method:	EPA SW-846 Method 8260D
SOP:	MS020

Table 28.1a – Quality Control and Corrective Actions for Analysis of VOCs

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific Measurement Performance Criteria (MPC)
Method Blank (MB)	One per preparatory batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Surrogate	All field and QC samples	QSM 5.4 Appendix C limits as listed in the table 28.1b and 28.1c below.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, or historical results verify interference reanalysis may not be necessary.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific Measurement Performance Criteria (MPC)
Laboratory Control Sample (LCS) or Blank Spike (BS)	One per preparation batch of 20 or fewer samples of similar matrix.	QSM 5.4 Appendix C Limits used for batch control. See table 28.1b and 28.1c below.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, sample data associated with the failed LCS must be qualified and explained in the case narrative	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	Recovery QC acceptance criteria same as LCS. RPD of all analytes ≤ 20% (between MS and MSD	Recovery - assume matrix interference if LCS is acceptable. Apply Flag to parent sample. RPD - Examine chromatogram for interferences. Examine sample for possible heterogeneity. Flag parent sample and narrate.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Internal Standard (IS)	Every field sample, standard, and QC sample	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	Not applicable (NA)	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Field duplicate (FD)	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific Measurement Performance Criteria (MPC)
Equipment Blank (EB)	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e., if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12
Trip Blank (TB)	1 per cooler	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e., if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12.

Table 28.1b – LCS/MS/MSD Control Limits for VOCs in water

Compounds	LCS/MS/MSD Control Limits (%R)
1,1,1,2-Tetrachloroethane	78-124
1,1,1-Trichloroethane	74-131
1,1,2,2-Tetrachloroethane	71-121
1,1,2-Trichloroethane	80-119
1,1-Dichloroethane	77-125
1,1-Dichloroethene	71-131
1,1-Dichloropropene	79-125
1,2,3-Trichlorobenzene	69-129
1,2,3-Trichloropropane	73-122
1,2,4-Trichlorobenzene	69-130
1,2,4-Trimethylbenzene	76-124
1,2-Dibromo-3-Chloropropane	62-128
1,2-Dibromoethane	77-121
1,2-Dichlorobenzene	80-119
1,2-Dichloroethane	73-128
1,2-Dichloropropane	78-122
1,3,5-Trimethylbenzene	75-124
1,3-Dichlorobenzene	80-119
1,3-Dichloropropane	80-119
1,4-Dichlorobenzene	79-118
2,2-Dichloropropane	60-139
2-Butanone (MEK)	56-143
2-Chlorotoluene	79-122
2-Hexanone	57-139
4-Chlorotoluene	78-122
4-Methyl-2-pentanone (MIBK)	67-130
Acetone	39-160
Benzene	79-120
Bromobenzene	80-120
Bromochloromethane	78-123
Bromodichloromethane	79-125
Bromoform	66-130
Bromomethane	53-141
cis-1,2-Dichloroethene	78-123
cis-1,3-Dichloropropene	75-124
Carbon disulfide	64-133
Carbon tetrachloride	72-136
Chlorobenzene	82-118

Compounds	LCS/MS/MSD Control Limits (%R)
Chloroethane	60-138
Chloroform	79-124
Chloromethane	50-139
Dibromochloromethane	74-126
Dibromomethane	79-123
Dichlorodifluoromethane	32-152
Ethylbenzene	79-121
Hexachlorobutadiene	66-134
Isopropylbenzene	72-131
m-, p-Xylenes	80-121
Methylene Chloride	74-124
MTBE	71-124
Naphthalene	61-128
n-Butylbenzene	75-128
o-Xylene	78-122
p-Isopropyltoluene	77-127
n-Propylbenzene	76-126
sec-Butylbenzene	77-126
Styrene	78-123
trans-1,2-Dichloroethene	75-124
trans-1,3-Dichloropropene	73-127
tert-Butylbenzene	78-124
Tetrachloroethene	74-129
Toluene	80-121
Trichloroethene	79-123
Trichlorofluoromethane	65-141
Vinyl Acetate	54-146
Vinyl chloride	58-137
Xylenes, total	79-121
1,2-Dichloroethane-d4 (Surrogate)	81-118
4-Bromofluorobenzene (Surrogate)	85-114
Dibromofluoromethane (Surrogate)	80-119
Toluene-d8 (Surrogate)	89-112

Table 28.1c – LCS/MS/MSD Control Limits for VOCs in soil/sediment

Compounds	LCS/MS/MSD Control Limits (%R)
1,1,1,2-Tetrachloroethane	78-125
1,1,1-Trichloroethane	73-130
1,1,2,2-Tetrachloroethane	70-124
1,1,2-Trichloroethane	78-121
1,1-Dichloroethane	76-125
1,1-Dichloroethene	70-131
1,1-Dichloropropene	76-125
1,2,3-Trichlorobenzene	66-130
1,2,3-Trichloropropane	73-125
1,2,4-Trichlorobenzene	67-129
1,2,4-Trimethylbenzene	75-123
1,2-Dibromo-3-Chloropropane	61-132
1,2-Dibromoethane	78-122
1,2-Dichlorobenzene	78-121
1,2-Dichloroethane	73-128
1,2-Dichloropropane	76-123
1,3,5-Trimethylbenzene	73-124
1,3-Dichlorobenzene	77-121
1,3-Dichloropropane	77-121
1,4-Dichlorobenzene	75-120
2,2-Dichloropropane	67-133
2-Butanone (MEK)	51-148
2-Chlorotoluene	75-122
2-Hexanone	53-145
4-Chlorotoluene	72-124
4-Methyl-2-pentanone (MIBK)	65-135
Acetone	36-164
Benzene	77-121
Bromobenzene	78-121
Bromochloromethane	78-125
Bromodichloromethane	75-127
Bromoform	67-132
Bromomethane	53-143
cis-1,2-Dichloroethene	77-123
cis-1,3-Dichloropropene	74-126
Carbon disulfide	63-132
Carbon tetrachloride	70-135
Chlorobenzene	79-120

Compounds	LCS/MS/MSD Control Limits (%R)
Chloroethane	59-139
Chloroform	78-123
Chloromethane	50-136
Dibromochloromethane	74-126
Dibromomethane	78-125
Dichlorodifluoromethane	47-155
Ethylbenzene	76-122
Hexachlorobutadiene	61-135
Isopropylbenzene	68-134
m-, p-Xylenes	77-124
Methylene Chloride	70-128
MTBE	73-125
Naphthalene	62-129
n-Butylbenzene	70-128
o-Xylene	77-123
p-Isopropyltoluene	73-127
n-Propylbenzene	73-125
sec-Butylbenzene	73-126
Styrene	76-124
trans-1,2-Dichloroethene	74-125
trans-1,3-Dichloropropene	71-130
tert-Butylbenzene	73-125
Tetrachloroethene	73-128
Toluene	77-121
Trichloroethene	77-123
Trichlorofluoromethane	62-140
Trichlorofluoromethane	62-140
Vinyl Acetate	50-141
Vinyl chloride	56-135
Xylenes, total	78-124
1,2-Dichloroethane-d4 (Surrogate)	71-136
4-Bromofluorobenzene (Surrogate)	79-119
Dibromofluoromethane (Surrogate)	78-119
Toluene-d8 (Surrogate)	85-116

28.2 SVOCs BY EPA SW-846 METHOD 8270D

Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group:	SVOCs
Analytical Method:	EPA SW-846 Method 8270E
SOP:	MS021

Table 28.2a – Quality Control and Corrective Actions for Analysis of SVOCs

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MB	One per preparatory batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Surrogate	All field and QC samples	QSM 5.4 Appendix C limits as listed in the tables 28.2b and 28.2c below.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, or historical results verify interference reanalysis may not be necessary.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
LCS or BS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the QSM 5.4 Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. See table 28.2b and 28.2c below.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, sample data associated with the failed LCS must be qualified and explained in the case narrative	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	Recovery QC acceptance criteria same as LCS. See table 28.2b and 28.2c below. RPD of all analytes ≤ 20% (between MS and MSD	Recovery - assume matrix interference if LCS is acceptable. Apply Flag to parent sample. RPD - Examine chromatogram for interferences. Examine sample for possible heterogeneity. Flag parent sample and narrate.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
IS	Every field sample, standard, and QC sample	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
Results between DL and LOQ	Not applicable (NA)	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e. if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

Table 28.2b – LCS/MS/MSD Control Limits for SVOCs in water

Compounds	LCS/MS/MSD Control Limits (%R)
1,2,4-Trichlorobenzene	29-116
1,2-Dichlorobenzene	32-111
1,2-Diphenylhydrazine (Azobenzene)	49-122
1,3-Dichlorobenzene	28-110
1,4-Dichlorobenzene	29-112
1-Methylnaphthalene	41-119
2,4,5-Trichlorophenol	53-123
2,4,6-Trichlorophenol	50-125
2,4-Dichlorophenol	47-121
2,4-Dimethylphenol	31-124
2,4-Dinitrophenol	23-143
2,4-Dinitrotoluene	57-128
2,6-Dichlorophenol	50-118
2,6-Dinitrotoluene	57-124
2-Chloronaphthalene	40-116
2-Chlorophenol	38-117
2-Methylnaphthalene	40-121
2-Methylphenol	30-117
2-Nitroaniline	55-127
2-Nitrophenol	47-123
3,3'-Dichlorobenzidine	27-129
3/4-Methylphenol	29-110
3-Nitroaniline	41-128
4,6-Dinitro-2-Methylphenol	44-137
4-Bromophenyl-phenylether	55-124
4-Chloro-3-Methylphenol	52-119
4-Chloroaniline	33-117
4-Chlorophenyl-phenylether	53-121

Compounds	LCS/MS/MSD Control Limits (%R)
4-Nitroaniline	54-133
4-Nitrophenol	10-126
Acenaphthene	47-122
Acenaphthylene	41-130
Anthracene	57-123
Benzidine	10-99
Benzo(a)anthracene	58-125
Benzo(a)pyrene	54-128
Benzo(b)fluoranthene	53-131
Benzo(g,h,i)perylene	50-134
Benzo(k)fluoranthene	57-129
Benzoic acid	10-94
Benzyl alcohol	31-112
Bis(2-Chloroethoxy)methane	48-120
Bis(2-Chloroethyl)ether	43-118
Bis(2-ethylhexyl)phthalate	55-135
Butyl benzyl phthalate	53-134
Carbazole	60-122
Chrysene	59-123
Dibenzo(a,h)anthracene	51-134
Dibenzofuran	53-118
Diethyl phthalate	56-125
Dimethyl phthalate	45-127
Di-n-butyl phthalate	59-127
Di-n-octyl phthalate	51-140
Fluoranthene	57-128
Fluorene	52-124
Hexachlorobenzene	53-125
Hexachlorobutadiene	22-124

Compounds	LCS/MS/MSD Control Limits (%R)
Hexachlorocyclopentadiene	10-99
Hexachloroethane	21-115
Indeno(1,2,3-cd)pyrene	52-134
Isophorone	42-124
Naphthalene	40-121
Nitrobenzene	45-121
n-Nitrosodimethylamine	23-120
n-Nitrosodi-n-propylamine	49-119
n-Nitrosodiphenylamine	51-123
Pentachlorophenol	35-138
Phenanthrene	59-120
Phenol	34-121
Pyrene	57-126
2,4,6-Tribromophenol (Surrogate)	43-140
2-Fluorobiphenyl (Surrogate)	44-119
2-Fluorophenol (Surrogate)	19-119
Nitrobenzene-d5 (Surrogate)	44-120
p-Terphenyl-d14 (Surrogate)	50-134
Phenol-d6 (Surrogate)	10-107

Table 28.2c – LCS/MS/MSD Control Limits for SVOCs in soil and sediment

Compounds	LCS/MS/MSD Control Limits (%R)
1,2,4-Trichlorobenzene	34-118
1,2-Dichlorobenzene	33-117
1,2-Diphenylhydrazine (Azobenzene)	41-125
1,3-Dichlorobenzene	30-115

Compounds	LCS/MS/MSD Control Limits (%R)
1,4-Dichlorobenzene	31-115
1-Methylnaphthalene	40-119
2,4,5-Trichlorophenol	41-124
2,4,6-Trichlorophenol	39-126
2,4-Dichlorophenol	40-122
2,4-Dimethylphenol	30-127
2,4-Dinitrophenol	10-148
2,4-Dinitrotoluene	48-126
2,6-Dichlorophenol	41-117
2,6-Dinitrotoluene	46-124
2-Chloronaphthalene	41-114
2-Chlorophenol	34-121
2-Methylnaphthalene	38-122
2-Methylphenol	32-122
2-Nitroaniline	44-127
2-Nitrophenol	36-123
3,3'-Dichlorobenzidine	22-121
3/4-Methylphenol	34-119
3-Nitroaniline	33-119
4,6-Dinitro-2-Methylphenol	29-132
4-Bromophenyl-phenylether	46-124
4-Chloro-3-methylphenol	45-122
4-Chloroaniline	17-106
4-Chlorophenyl phenyl ether	45-121
4-Nitroaniline	27-102
4-Nitrophenol	30-132
Acenaphthene	40-123
Acenaphthylene	32-132
Anthracene	47-123

Compounds	LCS/MS/MSD Control Limits (%R)
Benzidine	30-130
Benzo(a)anthracene	49-126
Benzo(a)pyrene	45-125
Benzo(b)fluoranthene	45-132
Benzo(g,h,i)perylene	43-134
Benzo(k)fluoranthene	47-132
Benzoic acid	10-92
Benzyl alcohol	29-122
bis (2-Chloroethoxy) methane	36-121
bis (2-Chloroethyl)ether	31-120
bis (2-Ethylhexyl)phthalate	51-133
Butyl benzyl phthalate	48-132
Carbazole	50-123
Chrysene	50-124
Dibenzo(a,h)anthracene	45-134
Dibenzofuran	44-120
Diethyl phthalate	50-124
Dimethyl phthalate	48-124
Di-n-butyl phthalate	51-128
Di-n-octyl phthalate	45-140
Fluoranthene	50-127
Fluorene	43-125
Hexachlorobenzene	45-122
Hexachlorobutadiene	32-123
Hexachlorocyclopentadiene	10-133
Hexachloroethane	28-117
Indeno(1,2,3-cd)pyrene	45-133
Isophorone	30-122
Naphthalene	35-123

Compounds	LCS/MS/MSD Control Limits (%R)
Nitrobenzene	34-122
n-Nitrosodimethylamine	23-120
n-Nitrosodi-n-propylamine	36-120
n-Nitrosodiphenylamine	38-127
Pentachlorophenol	25-133
Phenanthrene	50-121
Phenol	34-131
Pyrene	47-127
2,4,6-Tribromophenol (Surrogate)	39-132
2-Fluorobiphenyl (Surrogate)	44-115
2-Fluorophenol (Surrogate)	35-115
Nitrobenzene-d5 (Surrogate)	37-122
p-Terphenyl-d14 (Surrogate)	54-127
Phenol-d6 (Surrogate)	10-145

28.3 METALS BY EPA SW-846 METHOD 6020B

Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group:	Metals
Analytical Method:	EPA SW-846 Method 6020B
SOP:	MET1076020B/200.8

Table 28.3a – Quality Control and Corrective Actions for Analysis of Metals

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MB	One per preparatory batch of 20 or fewer samples of similar matrix.	The absolute values of all analytes must be < ½ LOQ, <1/10 the amount measured in any sample, or <1/10 the regulatory limit, whichever is greater. Samples < LOD may be reported with failed MB.	Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
LCS or BS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the QSM 5.4 Appendix C Limits for batch control. See Table 28.4b below.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, sample data associated with the failed LCS must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Duplicate Sample (DUP)	One per preparation batch of 20 or fewer samples of similar matrix	RPD ≤ 20	Narrate any results that are outside control limits.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	Recovery QC acceptance criteria same as LCS. RPD of all analytes ≤ 20% (between MS and MSD	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise J-Flag parent sample and narrate.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Post Digestion Spike	One is performed when MS/MSD fails or analyte concentration(s) in all samples < 50x LOD.	The result must agree within ± 20% of expected result.	Run all associate sample in the preparatory batch by method of standard additions or qualify results.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
Serial Dilution	One is performed for each preparation batch with sample concentration(s) > 50x LOQ when MS/MSD fails.	The five-fold dilution result must agree within ± 10% of the original sample result.	Qualify the results.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
IS	Every field sample, standard, and QC sample	IS intensity in the samples within 30-120% of the intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5-fold dilutions until criteria is met. For failed QC samples, correct problem, and rerun all associated failed field samples.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

Table 28.3b – LCS/MS/MSD Control Limits for 6020B Metals in Water Matrix

Compounds	LCS/MS/MSD Control Limits (%R)
Aluminum	84-117
Antimony	85-117
Arsenic	84-116
Barium	86-114
Beryllium	83-121
Cadmium	87-115
Calcium	87-118
Chromium	85-116
Cobalt	86-115
Copper	85-118
Iron	87-118
Lead	88-115
Magnesium	83-118
Manganese	87-115
Nickel	85-117
Potassium	87-119
Selenium	80-120
Silver	85-116
Sodium	85-117
Thallium	82-116
Vanadium	86-115
Zinc	83-119

Table 28.3c – LCS/MS/MSD Control Limits for 6020B Metals in Solid Matrix

Compounds	LCS/MS/MSD Control Limits (%R)
Aluminum	78-124
Antimony	72-124
Arsenic	82-118
Barium	86-116
Beryllium	80-120
Cadmium	84-116
Calcium	86-118
Chromium	83-119
Cobalt	84-115
Copper	84-119
Iron	81-124
Lead	84-118
Magnesium	80-123
Manganese	85-116
Nickel	84-119
Potassium	85-119
Selenium	80-119
Silver	83-118
Sodium	79-125
Thallium	83-118
Vanadium	82-116
Zinc	82-119

28.4 MERCURY BY EPA SW-846 METHOD 7470A/7471B

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	Mercury
Analytical Method:	EPA SW-846 Method 7470A/7471B
SOP:	MET106

Table 28.4 – Quality Control and Corrective Actions for Analysis of Mercury

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
MB	One per preparation batch of 20 or fewer samples of similar matrix	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be qualified (B-flag) and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
LCS or BS	One per preparation batch of 20 or fewer samples of similar matrix	82-119%R for waters and 80-124% for solids per the DoD QSM5.4.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, sample data associated with the failed LCS must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Duplicate Sample (DUP)	One per preparation batch of 20 or fewer samples of similar matrix	RPD ≤ 20	Narrate any results that are outside control limits.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	Recovery QC acceptance criteria same as LCS. RPD of all analytes ≤ 20% (between MS and MSD.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise J-Flag parent sample and narrate.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Post Digestion Spike	One is performed when MS/MSD fails or analyte concentration(s) in all samples < 50x LOD.	The result must agree within ± 20% of expected result.	Run all associate sample in the preparatory batch by method of standard additions or qualify results.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
Serial Dilution	One is performed for each preparation batch with sample concentration(s) > 50x LOQ when MS/MSD fails.	The five-fold dilution result must agree within ± 10% of the original sample result.	Qualify the results.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
IS	Every field sample, standard, and QC sample	IS intensity in the samples within 30-120% of the intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5-fold dilutions until criteria is met. For failed QC samples, correct problem, and rerun all associated failed field samples.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e., if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

28.5 ORTHOPHOSPHATE AS P BY SM4500P-E

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	Orthophosphate as P
Analytical Method:	SM4500P-E
SOP:	CA-771

Table 28.5 – Quality Control and Corrective Actions for Analysis of Orthophosphate as P

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
MB	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected >1/2 LOQ or >1/10 sample concentration or >1/10 regulatory limit, whichever is greater.	Correct the problem. **Report sample results that are <LOD or >10x the blank concentration.** Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch of 20 or fewer samples of similar matrix	80-120%R	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <PQL, narrate. (3) Recalibrate and/or reanalyze other samples.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	75-125%R RPD of all analytes ≤ 20% (between MS and MSD).	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
Lab Duplicate	One sample duplicate per 20 samples.	RPD <20 for samples >3X the PQL, <100% RPD for samples <3X the PQL	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
FD	1 per 10 field samples collected	30%R for waters and 50%R for soils	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e., if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

28.6 PERCHLORATE BY EPA SW-846 METHOD 6850

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	Perchlorate
Analytical Method:	EPA SW-846 Method 6850
SOP:	MS013

Table 28.6 – Quality Control and Corrective Actions for Analysis of Perchlorate

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
IS	Addition of 18O-labeled perchlorate to every sample, batch QC sample, standard, instrument blank, and Method Blank.	Measured 18O IS area within ± 50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0 ± 2% (0.98 – 1.02).	Rerun the sample at increasing dilutions until the ± 50% acceptance criteria are met. If criteria cannot be met with dilution, the interference is suspected, and the sample must be re-prepped using additional pretreatment steps.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits or DoD QSM Table B-13
MB	One per preparatory batch of 20 or fewer samples of similar matrix.	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. Reprep and reanalyze the method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, sample data associated with the failed MB must be qualified and explained in the case narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits or DoD QSM Table B-13
LCS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the QSM 5.4 Appendix C Limits as follows: Soil = 84-121% Water= 84-119%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, sample data associated with the failed LCS must be qualified and explained in the case narrative	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits or DoD QSM Table B-13

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	A laboratory must use the QSM 5.4 Appendix C Limits as follows: Soil = 84-121% Water= 84-119% RPD ≤ 15% (between MS and MSD)	If RPD indicates obvious extraction/analysis difficulties, sample volume available and reanalyze MS/MSD. Qualify the specific analyte(s) in the parent sample if acceptance criteria are not met and explain in the Case Narrative.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits or DoD QSM Table B-13
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e. if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged “J” by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), “J” flag the detected result and “UJ” the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, “J” flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged “B” if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12
Isotope Ratio	Every sample, batch QC sample and standard	Check the ratio of m/z 83 to m/z 85. Ion mass must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample must be re-extracted using cleanup procedures. If after cleanup, the ratio still fails, confirm presence of perchlorate using a post spike sample or dilution to reduce interference.	Parsons Data Validator or Project Chemist	Decisions to report data failing ratio check, and cleanup procedures (post dilution sample or dilutions) must be documented in the case narrative.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
ICS	1 per 20 field samples collected and 1 per day	± 20% of its true value	Correct the problem and reanalyze all samples and QC samples in the batch. If poor recovery from the cleanup filter is suspected, a different lot must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before sample are reanalyzed.	Parsons Data Validator or Project Chemist	No samples may be reported that are associated with a failing ICS.

28.7 EXPLOSIVES BY EPA SW-846 METHOD 8330B

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	Explosives
Analytical Method:	EPA SW-846 Method 8330B
SOP:	GC034

Table 28.7a – Quality Control and Corrective Actions for Analysis of Explosives

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MB Grinding Blank (GB - blank soil)	MB - One per preparation batch of 20 or fewer samples of similar matrix GB – Between each soil sample	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: Samples ND – report with qualification Samples >10X contamination level – report with qualification. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
LCS or BS	One per preparation batch of 20 or fewer samples of similar matrix.	A laboratory must use the QSM 5.4 Appendix C Limits as seen in Table 28.8b and 28.8c below.	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1.Biased high, samples ND – report with qualifications. 2.Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
External Control Sample/Laboratory Sample Triplicate – soils only	One for each batch of up to 20 samples	RSD of ≤ 20%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1.Biased high, samples ND – report with qualifications. 2.Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
Surrogate	Each field and QC sample	1,2-Dinitrobenzene used as surrogate. Lab limits of 78-119 (solids) and 83-119 (waters)	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples ND – report with qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	%R should be within the same limits as for the LCS, refer to Tables 28b and 28c, below. RPD ≤ 30% (between MS and MSD)	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Confirmation of positive results (second column)	All results > the DL must be confirmed.	Results between primary and second column RPD ≤40%	Report both columns Apply J-flag if RPD >40% and discuss in the case narrative	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e. if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged “B” if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

Table 28.7b – LCS/MS/MSD Control Limits for Explosives in Solid Matrix

Compounds	LCS/MS/MSD Control Limits (%R)
1,3,5-Trinitrobenzene	80 – 116
1,3-Dinitrobenzene	73 – 119
2,4,6-Trinitrotoluene	71 – 120
2,4-Dinitrotoluene	75 – 121
2,6-Dinitrotoluene	79 – 117
2-Amino-4,6-dinitrotoluene	71 – 123
2-Nitrotoluene	70 – 124
3,5-Dinitroaniline	86 – 118
3-Nitrotoluene	67 – 129
4-Amino-2,6-dinitrotoluene	64 – 127
4-Nitrotoluene	71 – 124
HMX	74 – 124
Nitrobenzene	67 – 129
Nitroglycerin	73 – 124
Pentaerythritol tetranitrate (PETN)	72 – 128
RDX	67 – 129
Tetryl	68 – 135

Table 28.7c – LCS/MS/MSD Control Limits for Explosives in Water Matrix

Compounds	LCS/MS/MSD Control Limits (%R)
1,3,5-Trinitrobenzene	73 - 125
1,3-Dinitrobenzene	78 – 120
2,4,6-Trinitrotoluene	71 – 123
2,4-Dinitrotoluene	78 – 120
2,6-Dinitrotoluene	77 – 127
2-Amino-4,6-dinitrotoluene	79 – 120
2-Nitrotoluene	70 – 127
3,5-Dinitroaniline	71 – 117
3-Nitrotoluene	73 – 125
4-Amino-2,6-dinitrotoluene	76 – 125
4-Nitrotoluene	71 – 127
HMX	65 – 135
Nitrobenzene	65 – 134
Nitroglycerin	74 – 127
Pentaerythritol tetranitrate (PETN)	73 – 127
RDX	68 – 130
Tetryl	64 - 128

28.8 TOTAL PHOSPHORUS BY EPA METHOD 365.4

Matrix:	Soil and Sediment
Analytical Group:	Total Phosphorus
Analytical Method:	EPA Method 365.4
SOP:	CA-715

Table 28.8 – Quality Control and Corrective Actions for Analysis of Total Phosphorus

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
MB	One per preparation batch of 20 or fewer samples of similar matrix.	No analytes detected > LOQ.	(1) Investigate source of contamination (2) Report all sample results <LOQ. (3) Report sample results >10X the blank result and flag results with a "B". (4) Redigest and reanalyze all other samples associated with the failing blank.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch of 20 or fewer samples of similar matrix	90-110%R	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <LOQ, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 10 or fewer samples of similar matrix.	85-115%R RPD of all analytes ≤ 20% (between MS and MSD.	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One per preparation batch of 20 samples	RPD ≤10 for samples >3X the PQL and < 100 RPD for samples <3X LOQ.	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e. if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

28.9 TOTAL AND DISSOLVED PHOSPHORUS BY EPA SW-365.2

Matrix:	Groundwater and Surface Water
Analytical Group:	Total and Dissolved Phosphorus (LL)
Analytical Method:	EPA 365.2
SOP:	CA-781

Table 28.9 – Quality Control and Corrective Actions for Analysis of Total and Dissolved Phosphorus

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MB	One per analytical batch of 20 or fewer samples.	No analyte detected >LOQ	(1) Investigate source of contamination (2) Report all sample results <LOQ. (3) Report sample results >10X the blank result and flag results with a "B". (4) Redigest and reanalyze all other samples associated with the failing blank.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	%R must be within 80-120	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <LOQ, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
MS	One for every set 10 samples	%R must be within 75-125	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One sample duplicate per 10 samples.	RPD <20 for samples >3X the LOQ and < 100 RPD for samples <3X LOQ.	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
					result is >LOQ and the other result is <LOQ, “J” flag will be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged “B” if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

28.10 HEXAVALENT CHROMIUM BY EPA SW-846 METHOD 7196A

Matrix:	Groundwater, Surface water, Soil and Sediment
Analytical Group:	Hexavalent Chromium(1)
Analytical Method:	EPA SW-846 Method 7196A
SOP:	GN110, GN171

Table 28.10 – Quality Control and Corrective Actions for Analysis of Hexavalent Chromium

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Apply B-qualifier to all affected analytes. Reanalyze if necessary.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
LCS or BS	One per preparation batch of 20 or fewer samples of similar matrix	Within DoD QSM 5-series Appendix C Tables Statistical limits if not listed in DoD QSM	Evaluate and reanalyze if possible. If LCS recoveries are high but the sample results are < LOQ, narrate. Otherwise, re-prepare and reanalyze.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
Sample Duplicate (Dup)	One per preparation batch of 20 or fewer samples of similar matrix	RPD ≤ 20	Determine and correct cause of the poor Reproducibility.	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
MS/MSD	As specified on the chain-of-custody by Parsons or one pair per 20 or fewer samples of similar matrix.	85-115%R for waters and 75-125 for solids. RPD of all analytes ≤ 20% (between MS and MSD).	Evaluate and reanalyze if possible. Qualify results for all associated samples	Analyst, Laboratory Department Manager	Same as Method/SOP QC Acceptance Limits.
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e., if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project Specific MPC
					be applied to the result >LOQ
EB	1 per week if non-disposable equipment is used.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e., if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

(1) Trivalent chromium is calculated by the SGS LIMS using the total chromium (SW6020B) and hexavalent chromium (SW7196A) results. The trivalent chromium results are reviewed by the section supervisor prior to reporting them.

28.11 PFAS BY EPA DRAFT METHOD 1633

Matrix:	Groundwater, Surface Water, Soil and Sediment
Analytical Group:	PFAS
Analytical Method:	EPA Draft Method 1633
SOP:	WI48593 and WI46412$^{(1)}$

Table 28.11a – Quality Control and Corrective Actions for Analysis of PFAS

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
MB	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples. MS is not required for aqueous samples prepared by serial dilution instead of SPE.	In-house LCS limits unless project specific limits. If analytes are not listed use in-house limits; preliminary inhouse acceptance criteria of 40- 150% from Table B-24 of QSM 5.4 must be used until in-house limits are generated. For MSD: Sample spiked with all analytes at a concentration > LOQ and < the mid-level calibration concentration. For matrix evaluation, use LCS recovery criteria; RPD <30% (between MS and MSD or sample and MD).	Flag outliers	ELLE Analyst	Results within acceptance limits
LCS/OPR and LLLCS/LLOPR (include LCS duplicate [LCSD] if MS/MSD not performed)	1 set prep batch of up to 20 samples	Preliminary in-house acceptance criteria of 40-150% from Table B-24 QSM 5.4 must be used until in-house limits are generated.	Correct problem, reanalyze LCS, OPR, LLLCS/LLOPR, and associated samples. Analytes that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	Project-Specific MPC
Isotopically Labeled Extraction Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Preliminary in-house acceptance criterion of 20-150% must be used until in-house limits are generated.	If fails for QC sample, but the native compounds are within specification, report data. If fails for sample, re-extract and reanalyze and/or consult a supervisor for course of action.	ELLE Analyst	Results within acceptance limits
Non-extracted Internal Standards (NIS)	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	NIS areas must be greater than 30% of the average areas of the calibration standards in undiluted sample extracts and sample extracts that require NIS to be added.	If fails, repeat the analysis using a fresh aliquot of the extract. If the failure confirms examine project requirements and contact the client.	ELLE Analyst	Results within acceptance limits
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of <LOQ for analyte(s).	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of <LOQ in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the <LOQ value). When analyte concentrations are calculated as <LOQ, the spike must recover within 70-130% of its true value.	When analyte concentrations are calculated as <LOQ, and the spike recovery does not meet the 70- 130% acceptance criteria, the sample, sample duplicate, and post-spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	ELLE Analyst	Results within acceptance limits
FD	1 per 10 field samples collected	See Worksheet #12	NA for Laboratory. Parsons project chemist will discuss with field personnel if necessary (i.e. if a trend is noticed). The parent sample and field duplicate sample will be qualified as estimated and flagged "J" by the data validator when both sample results are ≥ to the LOQ.	Parsons Data Validator or Project Chemist	If one result is > LOQ and the other non-detect (ND), "J" flag the detected result and "UJ" the non-detect (ND) result. If one result is >LOQ and the other result is <LOQ, "J" flag will be applied to the result >LOQ
EB	1 per day on all equipment that comes into contact with sample media.	See Worksheet #12	NA for laboratory Parsons project chemist will discuss with field personnel or the laboratory if necessary (i.e. if a trend is noticed). The associated field sample results will be qualified/flagged "B" if the result is <5x lab non-common contaminant or <10x lab common contaminant.	Parsons Data Validator or Project Chemist	See Worksheet #12

(1) Refer to HGLs' Final PFAS UFP QAPP for the current SOP information (HGL, 2023).

Table 28.11b – LCS/MS/MSD Control Limits for PFAS in Soil and Sediment

Compounds	Acronym	CAS #	LCS/MS/MSD Control Limits (%R)
Perfluorobutanoic acid	PFBA	375-22-4	71-135
Perfluoropentanoic acid	PFPeA	2706-90-3	69-132
Perfluorohexanoic acid	PFHxA	307-24-4	70-132
Perfluoroheptanoic acid	PFHpA	375-85-9	71-131
Perfluorooctanoic acid	PFOA	335-67-1	69-133
Perfluorononanoic acid	PFNA	375-95-1	72-129
Perfluorodecanoic acid	PFDA	335-76-2	69-133
Perfluoroundecanoic acid	PFUDA	2058-94-8	66-139
Perfluorododecanoic acid	PFDoDA	307-55-1	69-135
Perfluorotridecanoic acid	PFTrDA	72629-94-8	64-136
Perfluorotetradecanoic acid	PFTetA	376-06-7	69-133
Perfluorobutanesulfonic acid	PFBS	375-73-5	72-128
Perfluoropentansulfonic acid	PFPeS	2706-91-4	73-123
Perfluorohexanesulfonic acid	PFHxS	355-46-4	67-130
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	70-132
Perfluorooctanesulfonic acid	PFOS	1763-23-1	68-136
Perfluorononanesulfonic acid	PFNS	68259-12-1	69-125
Perfluorodecanesulfonic acid	PFDS	335-77-3	59-134
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	40-150
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	62-145
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2	64-140
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4	65-137
Perfluorooctanesulfonamide	PFOSA	754-91-6	67-137
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	40-150
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	40-150
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	63-144
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	61-139
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	40-150
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	40-150
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	40-150
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4	40-150
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	40-150
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	40-150
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	40-150
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	40-150
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9	40-150
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	40-150
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	40-150
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-49-3	40-150
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	40-150

Table 28.11c – LCS/MS/MSD Control Limits for PFAS in Water

Compounds	Acronym	CAS #	LCS/MS/MSD Control Limits (%R)
Perfluorobutanoic acid	PFBA	375-22-4	40-150
Perfluoropentanoic acid	PFPeA	2706-90-3	40-150
Perfluorohexanoic acid	PFHxA	307-24-4	40-150
Perfluoroheptanoic acid	PFHpA	375-85-9	40-150
Perfluorooctanoic acid	PFOA	335-67-1	40-150
Perfluorononanoic acid	PFNA	375-95-1	40-150
Perfluorodecanoic acid	PFDA	335-76-2	40-150
Perfluoroundecanoic acid	PFUDA	2058-94-8	40-150
Perfluorododecanoic acid	PFDoDA	307-55-1	40-150
Perfluorotridecanoic acid	PFTrDA	72629-94-8	40-150
Perfluorotetradecanoic acid	PFTetA	376-06-7	40-150
Perfluorobutanesulfonic acid	PFBS	375-73-5	40-150
Perfluoropentansulfonic acid	PFPeS	2706-91-4	40-150
Perfluorohexanesulfonic acid	PFHxS	355-46-4	40-150
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	40-150
Perfluorooctanesulfonic acid	PFOS	1763-23-1	40-150
Perfluorononanesulfonic acid	PFNS	68259-12-1	40-150
Perfluorodecanesulfonic acid	PFDS	335-77-3	40-150
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	40-150
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	4:2FTS	757124-72-4	40-150
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	6:2FTS	27619-97-2	40-150
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	8:2FTS	39108-34-4	40-150
Perfluorooctanesulfonamide	PFOSA	754-91-6	40-150
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	40-150
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	40-150
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	40-150
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	40-150
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	40-150
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	40-150
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	40-150
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4	40-150
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	40-150
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	40-150
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	40-150
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	40-150
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9	40-150
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	40-150
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	40-150
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-49-3	40-150
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	40-150

Worksheet #29: Project Documents and Records

(EPA UFP-QAPP Guidance Manual, Section 3.5.1)

29.1 PROJECT DOCUMENT AND RECORDS

All final document files, including reports, figures, and tables will be submitted in electronic format (both Microsoft Office 2007 or later and portable document format (.pdf)) on compact disk (CD)-read-only format (ROM). The tables below list the project documents and records associated with the groundwater sampling to support the background study.

Table 29.1 – Sample Collection and Field Records[(1)]

Document/Record	Generation	Verification	Storage location/archival
Field logbook or data collection sheets	Field Team Member, Parsons	Second Field Team Member, Parsons Field Team Lead, Parsons Office Support Member, Parsons	Project File/Parsons-Boston Office
Chain-of-Custody Forms	Field Team Member, Parsons	Field Team Member, Parsons Field Team Lead, Parsons Office Support Member, Parsons	Project File/Parsons-Boston Office
Bills	Field Team Member, Parsons	Field Team Lead, Parsons	Project File/Parsons-Boston Office
Contractor Daily QC Reports	Field Team Lead, Parsons	Field Team Member, Parsons Office Support Member, Parsons	Project File/Parsons-Boston Office
Deviations	Field Team Lead, Parsons	Field Team Member, Parsons Office Support Member, Parsons	Project File/Parsons-Boston Office
Corrective Action Reports	Field Team Lead Parsons	Field Team Member, Parsons Office Support Member, Parsons	Project File/Parsons-Boston Office
Correspondence	Various Project Team Members	Various Project Team Members	Project File/Parsons-Boston Office

Table 29.2 – Laboratory Records (Katahdin, SGS)(4)

Document/Record	Generation	Verification	Storage location/archival
Sample Log-in	Sample Management Technician	Log-In Technician	Digitized image, stored on local area network
Instrument Print-Out and Raw Data	Bench Analyst	Section Supervisor	Digitized image, stored on local area network
Review Checklists (Analyst)	Bench Analyst	Section Supervisor	Digitized image, stored on local area network
Review Checklists (Section Supervisor)	Section Supervisor	10-15% of data by QA staff	Digitized image, stored on local area network
PM Review Checklists	Log-in supervisor	Project Manager	Archived with project/ sampling event folder
Correspondence	Analytical or QA Laboratory Project Manager	Project Chemist, Parsons	Project File/Parsons-Boston Office

Table 29.3 – Laboratory Records (Eurofins - Lancaster)(4)

Document/Record	Generation	Verification	Storage location/archival
Sample Log-in	Sample Management Technician	Log-In Technician	Digitized image, stored in LIMS
Instrument Print-Out and Raw Data	Bench Analyst	Section Supervisor or designee	Digitized image, stored in LIMS
Review Checklists (Analyst)	Bench Analyst	Section Supervisor or designee	Digitized image, stored in LIMS
Review Checklists (Section Supervisor)	Section Supervisor or designee	At least 10% of data by QA staff or designee	Digitized image, stored on centralized servers
Correspondence	Analytical or QA Laboratory Project Manager	Project Chemist, Parsons	Project File/Parsons-Boston Office

(1) All project documents will be retained for 7 years. Project documents will either be stored on site at the Boston or Austin office or on the secure server until project closeout and then the documents will be moved to an off-site storage location.

(2) All project documents will be retained and archived by the laboratories for a minimum of 7 years before disposal.

Worksheets #31, 32, & 33: Assessments and Corrective Action

(EPA UFP-QAPP Guidance Manual, Section 4.1.1)

These tables provide information on the required periodic assessments that will be performed during the course of the project to ensure the planned project activities are implemented in accordance with this UFP-QAPP. The type, frequency, and responsible parties of planned assessment activities to be performed for the project are summarized in the table below.

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due Date
Non-Conformance Report from the field[1]	Parsons	When there is an issue	Within 24 hours from the occurrence	Non-Conformance Report	Will submit to USACE within 30 days from the occurrence
Field Record Verification	Parsons	At the end of each sampling day	Each sampling day	At the end of each sampling event	Field Record Verification
Corrective Action Report (CAR)	Field Related: Parsons Project Lead Lab Related: Lab's QA Manager	When occur	Within 48 hours from the occurrence	CAR	Will submit to USACE within 30 days from the occurrence
Approval of the Proposed Corrective Action	Field Related: Parsons Project Lead Lab Related: Lab Director	When occur	Within 48 hours from the completion of the issuing of the CAR	CAR with approver's signature	Will submit to USACE within 30 days from the occurrence
Implementation of Corrective Action	Field Related: Parsons Project Lead Lab Related: Lab Director	When occur	Immediately after the approval of the CAR	Same as above	Will submit to USACE within 30 days from the occurrence
Verification of the Corrective Action	Field Related: Parsons Project QC Manager Lab Related: Lab's QA Manager	When occur	30 days from the approval of the CAR	Completed CAR	Will submit to USACE within 30 days from the occurrence
Laboratory Analysis Data Validation	Parsons data validator	Each data package	Labs will submit data package on before 21 calendar days from sample receiving day. Parsons will complete data validation 14 calendar days from data package receiving date.	Data validation report	Will submit to USACE

(1) The field program has been operating for many years using the same field procedures as outlined in the QAPP. Field events are short in duration. No field audits are proposed.

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for response	responsibility for implementing Corrective action	responsible for monitoring corrective action implementation
Non-Conformance Report from the field(1)	Parsons Project Lead	Internal Memo	Within 24 hours from the occurrence	As directed by Project Lead	Parsons Project Lead and Field Team Member
Field Record Verification	Parsons Field Team Member Parsons Project Lead	Internal Memo	Each sampling day	As directed by Project Lead	Parsons Project Lead and Field Team Member
Corrective Action Report (CAR)	Field Related: Parsons Project Lead Lab Related: Lab's QA Manager	Corrective action reports (if the error is severe), updated case narratives, and corrected data submissions	Within 48 hours from the occurrence	Field Related: As directed by Project Lead Lab Related: As directed by Lab Director	Parsons Project Lead and Lab Director
Approval of the Proposed Corrective Action	Field Related: Parsons Project Lead Lab Related: Lab Director	Internal Memo	Within 48 hours from the completion of the issuing of the CAR	Field Related: Parsons Project Lead Lab Related: Lab Director	Parsons Project Lead and Lab Director
Implementation of Corrective Action	Field Related: Parsons Project Lead Lab Related: Lab Director	Responses to comments and report revisions	Immediately after the approval of the CAR	Field Related: Parsons Field Team Member Lab Related: Lab Technical Director	Parsons Field Team Member and Lab Technical Director
Verification of the Corrective Action	Field Related: Parsons Project QC Manager Lab Related: Lab's QA Manager	Internal Memo	30 days from the approval of the CAR	Field Related: Parsons Project Lead Lab Related: Lab Director and Lab's QA Manager	Parsons Project Lead and Lab Director
Laboratory Analysis Data Validation	Parsons data validator	Internal Memo	Labs will submit data package on before 21 calendar days from sample receiving day. Parsons will complete data validation 14 calendar days from data package receiving date.	Parsons Data Validator	Parsons Data Validator and Parsons Project Lead

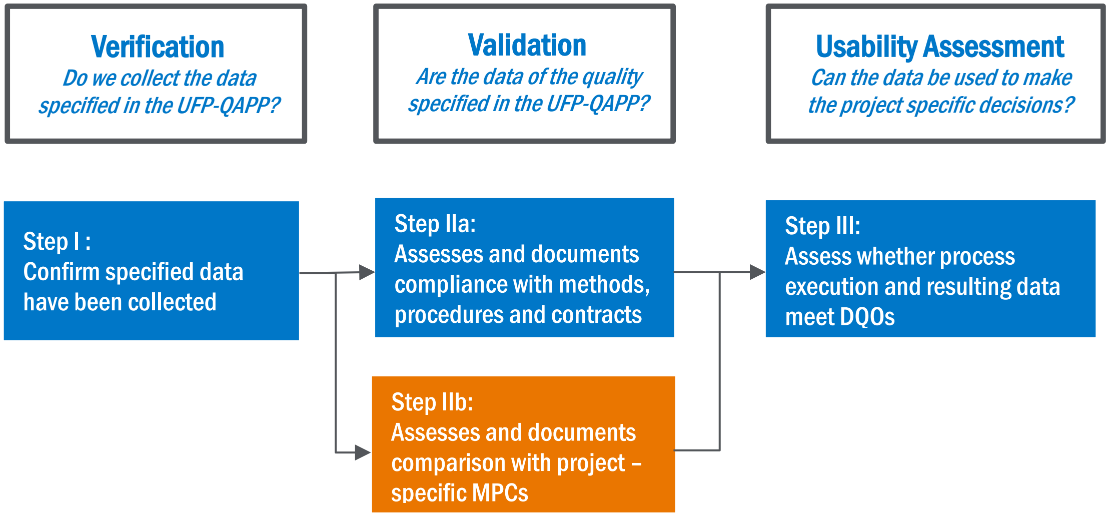
(1) The field program has been operating for many years using the same field procedures as outlined in the QAPP. Field events are short in duration. No field audits are proposed.

Worksheet #34: Data Verification & Validation Inputs

(EPA UFP-QAPP Guidance Manual, Section 5.2.1)

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs and the UFP-QAPP. Data validation includes evaluation of the data against the project–specific MPCs (**Worksheet #12**). Data verification and validation procedures and responsibilities are described on Worksheet #35 and Worksheet #36, respectively. Once verification and validation have been completed, a usability assessment is conducted to evaluate whether process execution and resulting data meet DQOs. Usability assessment procedures are described on Worksheet #37. The data verification, validation, and usability assessment process is summarized in **Figure 34-1**.

Figure 34-1 - Data Verification, Validation, and Usability Assessment Process



Verification
Do we collect the data specified in the UFP-QAPP?

Validation
Are the data of the quality specified in the UFP-QAPP?

Usability Assessment
Can the data be used to make the project specific decisions?

Step I : Confirm specified data have been collected

Step IIa: Assesses and documents compliance with methods, procedures and contracts

Step IIb: Assesses and documents comparison with project – specific MPCs

Step III: Assess whether process execution and resulting data meet DQOs

34.1 VERIFICATION AND VALIDATION INPUTS

Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records		
Approved QAPP	X	
Contract	X	
Field SOPs	X	
Laboratory SOPs	X	
Field Records		
Field logbooks	X	X
Equipment calibration records	X	X
Chain-of-Custody Forms	X	X
Relevant Correspondence	X	X
Change orders/deviations, when applicable	X	X
Field corrective action reports, when applicable	X	X
Analytical Data Package		
Cover sheet (laboratory identifying information)	X	X
Case narrative	X	X
Internal laboratory chain-of-custody	X	X
Sample receipt records	X	X
Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
Communication records	X	X
DL/LOD/LOQ establishment and verification	X	X
Standards Traceability	X	X

Description	Verification (completeness)	Validation (conformance to specifications)
Instrument calibration records	X	X
Definition of laboratory qualifiers	X	X
Results reporting forms	X	X
QC sample results	X	X
Corrective action reports, when applicable	X	X
Raw data	X	X
Electronic data deliverable	X	X

Worksheet #35: Data Verification Procedures

(EPA UFP-QAPP Guidance Manual, Section 5.2.2)

"Verification" is a completeness check that is performed before the data review process is conducted to determine whether the required information is available for validation. It involves a review of all data inputs to ensure that they are present. This step of the data review process answers whether or not the required data inputs are present. The following table summarizes the methods for data verification. Refer to HGLs' Final PFAS UFP QAPP, for the PFAS laboratory deliverables and corrective action reports (HGL, 2023).

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook or data collection sheets	UFP-QAPP, WP, SOPs	Verify that records (e.g., field notebook, field forms, e-data) are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample IDs are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field measurement was performed, and results are documented.	Daily – Parsons Second Field Team Member or Field Team Lead At conclusion of field activities – Parsons Parsons Field Team Lead or Office Support Member
Chain-of-custody forms	UFP-QAPP, WP, SOPs	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily – Parsons Second Field Team Member or Field Team Lead Daily prior to samples being sent to the lab – Parsons Parsons Field Team Lead or Office Support Member
Laboratory Deliverable	UFP-QAPP, WP, SOPs	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the CoCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – Lab Project Manager, SGS/Katahdin/ELLE Upon receipt – Parsons Project chemist and Data Validator
Corrective Action Reports	UFP-QAPP, WP, SOPs	For any non-compliance noted, verify that corrective action was implemented according to plan.	Parsons Project Chemist and Data Validator

Worksheet #36: Data Validation Procedures

(EPA UFP-QAPP Guidance Manual, Section 5.2.2)

"Validation" is performed to identify and qualify data that do not meet the MPCs specified on **Worksheet #12**. Data requiring validation are summarized on **Worksheet #34**. The information in these tables shows what data inputs are required for data validation as well as the processes used to conduct the validation.

36.1 VALIDATION PROCESS

Data validation will be performed in accordance with the DoD "General Data Validation Guidelines" (EDQW 2019) General procedures for chemistry data review and management are described in SOP CHEM-01, Chemistry Data Management (Appendix A). Refer to HGLs' Final PFAS UFP QAPP, for the PFAS validation process (HGL, 2023). Project specific elements for data validation on this project are summarized in **Tables 36.1** and **36.2** below.

Table 36.1 – Overview of Analytical Data Validation

Data Validators: Parsons	
Analytical Group/Method:	All Chemical Analyses
Data deliverable requirements:	Stage 4 data packages and EDDs
Analytical specifications:	Per UFP-QAPP, DoD QSM version 5.4 (or current version laboratory is certified under) and Laboratory SOPs
Measurement performance criteria:	Per UFP-QAPP and DoD QSM version 5.4 (or current version laboratory is certified under)
Percent of data packages to be validated:	100%- Stage 2b and 10%-Stage 3 data validation as required in DoD General Data Validation Guidelines (EDQW 2019).
Percent of raw data reviewed:	As needed[1]
Percent of results to be recalculated:	0%
Validation procedure:	Per UFP-QAPP, DoD General Data Validation Guidelines (EDQW 2019), and USEPA Region 2 SOPs for organic and inorganic data review, current revisions, in conjunction with NFG and NYSDEC guidance Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, dated April 2023. (Validation preference given to DoD guidance.)
Data validation codes:	See table 36.2 below
Electronic validation program/version:	EDDs

(1) Review of raw data will be performed as needed in support of any issues discovered during the data validation process

Table 36.2 – Data Validation Codes and Definitions

Data Validation Codes	Definitions
U	Analyte was not detected and is reported as less than the Limit of Detection (LOD). The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
UJ	The analyte was not detected and was reported as less than the LOD. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Note: Labs will report all concentration down to DL and flag any results between DL and LOQ with “J”. All non-detected will be reported as <LOD, per DoD QSM.

Worksheet #37: Usability Assessment

(EPA UFP-QAPP Guidance Manual, Section 5.2.3)

This worksheet documents procedures that will be used to perform the data usability assessment. The data usability assessment is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process, and, like the systematic planning process, involves participation by key members of the project team. The data usability assessment evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

37.1 USABILITY ASSESSMENT

37.1.1 SUMMARY OF USABILITY ASSESSMENT PROCESSES

The first step of the data usability assessment is to review the sampling design and data collection documentation for consistency and completeness with the project objectives observing any potential discrepancies. Data Validation will be the second step of the usability assessment. See **Worksheet #28** for data quality indicators associated with the analytical measurements to be used on the project. The statistical analysis step will not be performed for this project because there are not enough historical data to perform this step in the data usability assessment; however, the available data for this project will be reviewed for any indication of trends for project compounds of concern. The last step in the assessment process is to determine if the data can be used as intended. All data qualifiers will be evaluated and any possible impact to the overall data quality will be discussed in data validation reports. Any data gap due to the field and/or lab error will be pointed out in the validation report and possible impact to the project will be discussed.

37.1.2 DOCUMENTATION GENERATED

A data validation report will be created for each sample delivery group (SDG), including a summary of all QA/QC results associated with the SDG to provide documentation whether data generated were in control throughout sample analysis. Topics of discussion include all accuracy and precision exceedances as well as the extent of the exceedance and the acceptance criteria for Accuracy/Biased Contamination, Precision of all laboratory and field QA/QC results. The field samples affected by the exceedance and the qualifiers applied to the samples will also be documented. Criteria listed in the **Worksheet #12** will be examined to determine if the Measurement Performance Criteria were met. Any lab trending in the QC samples, such as high biased lab control sample for a particular analyte will also be discussed. Data summary tables will be generated in order for data reviewer to review the results in an organized manner. Footnotes will include all flag definitions.

An overall data usability report describing the rationale for the data used and any data limitations will be provided upon request to the NYSDEC. The individual data validation reports will include a discussion of the accuracy, precision, representativeness, completeness and comparability of the data set and deviations from planned procedures and analysis and the impact on the project objectives. Maps will be generated with validated data and will be presented in the respective annual or letter reports for each site.

37.1.3 PROCEDURES TO ASSESS PROJECT-SPECIFIC OVERALL MEASUREMENT ERROR

The Subcontractor will determine if quality control data is within specifications through the data validation process (**Worksheet #36**).

37.1.4 PERSONNEL RESPONSIBLE FOR PERFORMING USABILITY ASSESSMENT

The following personnel are responsible for performing usability assessments:

- Subcontractor Project Manager
- Subcontractor Project Chemist
- Subcontractor Project Field Lead
- USACE PM, as needed

37.1.5 IMPACTS OF QUALIFIED DATA AND PLAN DEVIATIONS

The subcontractor will use all data not rejected during validation to determine the nature and extent of contamination, and to support the risk assessment. In the event that the data validator applied ‘X’ flags to the data, the Contractor will work with the Army and project regulators to determine if there is a concern about the statistical validity of the sample results or to determine if sample locations with rejected data need to be re-sampled.

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NYS, 2022c. Amendments to 6 NYCRR Part 375 Environmental Remediation Programs, Proposed Rule-Making. Table 375-6.8(a): Unrestricted Use Soil Cleanup Objectives. https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375exterms.pdf

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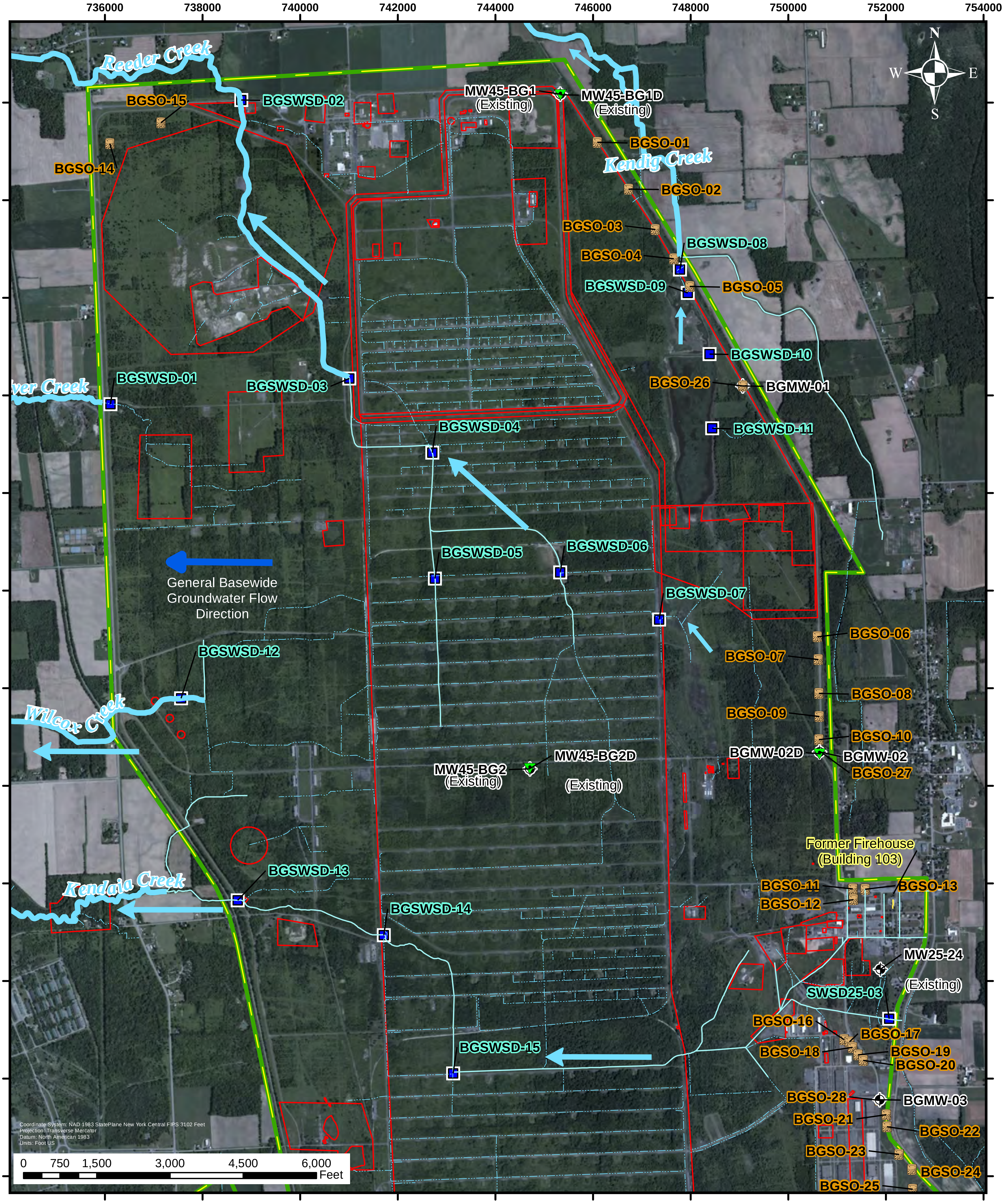
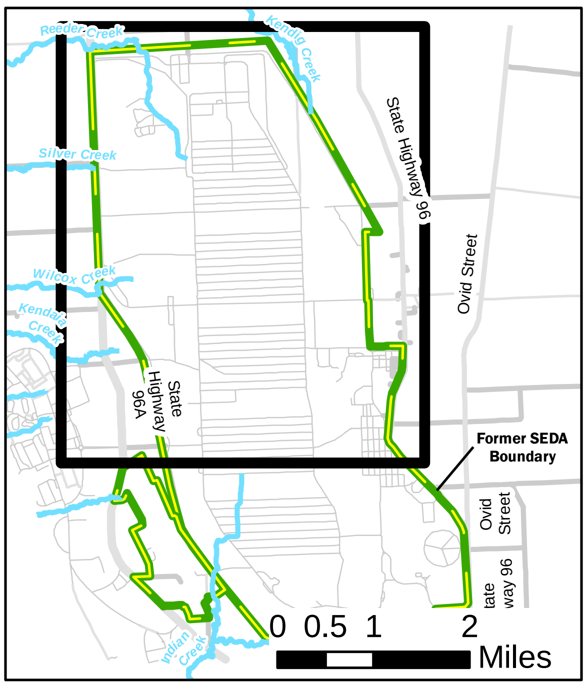
Figures





Legend

Surface Water

- Major Drainage
- Minor Drainage
- Stream
- ⊕ Proposed Shallow Well
- ▼ Proposed Bedrock Well
- ▨ Proposed Soil Sample
- ■ Proposed Surface Water / Sediment Sample
- 🟥 SEAD Boundary
- 🟩 Former SEDA Boundary
- → Predominant Groundwater Flow Direction
- → Surface Water Flow Direction

Notes:
1) Five new wells will be installed in the upper water bearing zone (till / weathered bedrock) and two new wells will be installed in the lower water bearing zone (shale bedrock).
2) Three existing till / weathered bedrock and two existing bedrock wells will be sampled.
3) Two rounds of sampling will be conducted for groundwater, surface water and sediment locations.
4) Soil samples will be collected from two depth intervals: 6 to 24 inches and from just above the water table, top of competent bedrock, or ten feet below ground surface, whichever is encountered first.
5) Soil samples will be collected during well installation at locations noted below.
6) Locations are subject to adjustment dependent on field conditions.
7) Regional groundwater flow is towards the west. Localized flow direction may be influenced by nearby water bodies or bedrock topography.
8) Major streams flow west and discharge to Seneca Lake. The exception is Kendig Creek which flows north and discharges into the Cayuga-Seneca Canal.

Well Installations with Soil Samples
BGMW-01 / BGSO-26
BGMW-02 / BGSO-27
BGMW-03 / BGSO-28

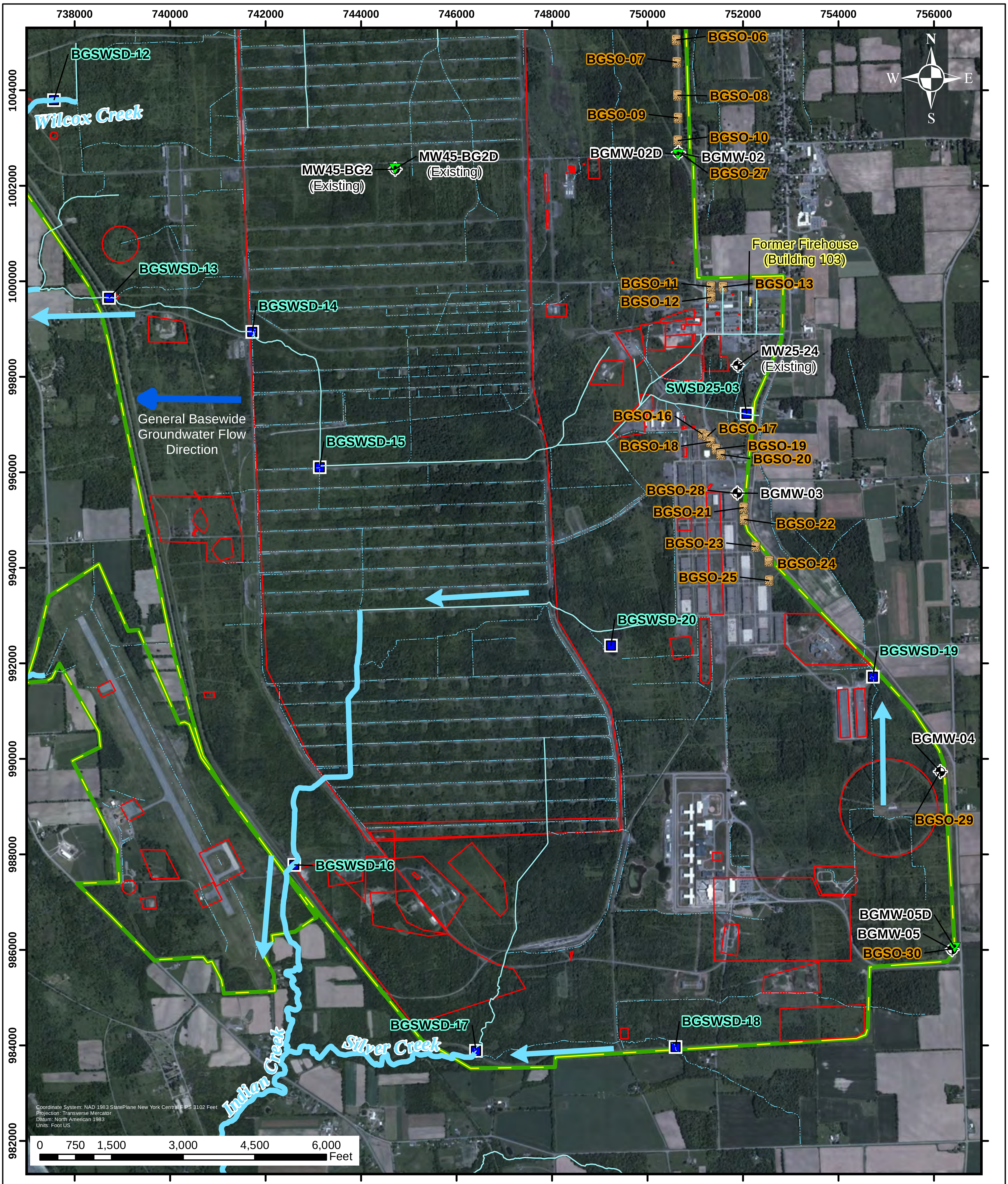
Paired Shallow / Deep Monitoring Wells
MW45-BG1 / MW45-BG1D (Existing)
MW45-BG2 / MW45-BG2D (Existing)
BGMW-02 / BGMW-02D (new)

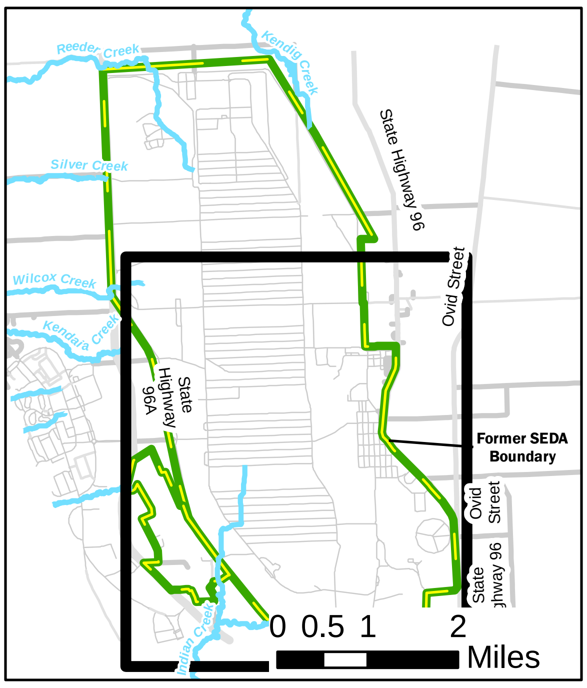
SENECA ARMY DEPOT ACTIVITY
BACKGROUND STUDY

FIGURE 1 - PROPOSED BACKGROUND LOCATIONS, NORTH DEPOT

1 inch = 2,000 feet	MARCH 2024

Path: \\Wabos07fs01\pit\Projects\Huntsville WERS\Seneca LTM, TO 23102 - GIS\Background\Maps\BG_WP_Prop_Locs_North_100523_v2.mxd





Legend

Surface Water

- Major Drainage
- Minor Drainage
- Stream
- ⊕ Proposed Shallow Well
- ▼ Proposed Bedrock Well
- ▨ Proposed Soil Sample
- ■ Proposed Surface Water / Sediment Sample
- 🟥 SEAD Boundary
- 🟩 Former SEDA Boundary
- → Predominant Groundwater Flow Direction
- → Surface Water Flow Direction

Notes:
1) Five new wells will be installed in the upper water bearing zone (till / weathered bedrock) and two new wells will be installed in the lower water bearing zone (shale bedrock).
2) Three existing till / weathered bedrock and two existing bedrock wells will be sampled.
3) Two rounds of sampling will be conducted for groundwater, surface water and sediment locations.
4) Soil samples will be collected from two depth intervals: 6 to 24 inches and from just above the water table, top of competent bedrock, or ten feet below ground surface, whichever is encountered first.
5) Soil samples will be collected during well installation at locations noted below.
6) Locations are subject to adjustment dependent on field conditions.
7) Regional groundwater flow is towards the west. Localized flow direction may be influenced by nearby water bodies or bedrock topography.
8) Major streams flow west and discharge to Seneca Lake.

Well Installations with Soil Samples
BGMW-02 / BGSO-27
BGMW-03 / BGSO-28
BGMW-04 / BGSO-29
BGMW-05 / BGSO-30

Paired Shallow / Deep Monitoring Wells
MW45-BG2 / MW45-BG2D (Existing)
BGMW-02 / BGMW-02D (new)
BGMW-05 / BGMW-05D (new)

SENECA ARMY DEPOT ACTIVITY
BACKGROUND STUDY

FIGURE 2 - PROPOSED BACKGROUND LOCATIONS, SOUTH DEPOT

1 inch = 2,000 feet | MARCH 2023

Path: \\Mabos07fs01\pit\Projects\Huntsville WERS\Seneca LTM, TO 23102 - GIS\Background\Maps\BG_WP_Prop_Locs_South_100523_v2.mxd

Appendices

APPENDIX A – SUBCONTRACTOR SOPS

APPENDIX B – ANALYTICAL SOPS AND CERTIFICATIONS

Appendix A - Subcontractor SOPs

STANDARD OPERATING PROCEDURES (SOPS)

CHEM-01	**Chemistry Data Review and Management**
ENV-01	**PFAS Sampling Guidance**
ENV-02	**Soil Sampling**
ENV-03	**Groundwater Sampling**
ENV-04	**Surface Water and Sediment Sampling**
ENV-05	**Monitoring Well Development**
ENV-06	**Soil Borings and Monitoring Well Installation**
MEC-03	**MEC Avoidance and Escort**

Procedure # CHEM‑01	Title: CHEMISTRY DATA REVIEW AND MANAGEMENT	Revision # 01
Effective Date: 02/24/2020	**Approved By:** Maryanne Kosciewicz, Project Chemist	**Last Revised:** 07/27/2018

1. PURPOSE

The purpose of this SOP is to describe the general procedures involved in analytical chemistry data review and management. The elements described in this SOP include data verification, data validation, data usability assessment, data validation qualifiers, electronic data deliverables, and data archiving.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Ensures laboratory analytical data are provided, reviewed, validated, managed, and stored in accordance with project requirements. Responsible for documenting data validation procedures, details, and issues found in a comprehensive data validation report.
Data Manager	Verifies laboratory electronic data deliverables are provided in the correct format, error free, and meet all project requirements. Ensures electronically submitted data is managed and maintained in accordance with project requirements.

3. RELEVANT DEFINITIONS

Term	Definition
Data Verification	The first step in the data review process. Data verification is a completeness check to determine whether the analytical laboratory has provided the information required to perform adequate data validation and review.
Data Validation	Data validation is the systematic process of evaluating whether data comply with pre-defined, project-specific requirements and criteria, also known as measurement quality objectives (MQOs). Elements of data validation include precision, accuracy, representativeness, completeness, and comparability.
Data Usability Assessment	The final step in the data review process. The usability assessment is an evaluation of whether data is of sufficient quality to meet the project Data Quality Objectives (DQOs). Data usability includes evaluation of data qualified as a result of data validation, data gaps, systematic issues, and analytical sensitivity.
Data Qualifiers	Standardized notations applied to individual analytical results that provide the data user with a qualitative assessment of the data (e.g., estimated, biased low, biased high, rejected, etc.). Data qualifiers are also referred to as “flags”.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
None	Not applicable.

Procedure # CHEM-01	Title: CHEMISTRY DATA REVIEW AND MANAGEMENT	Revision # 01
Effective Date: 02/24/2020	**Approved By:** Maryanne Kosciewicz, Project Chemist	**Last Revised:** 07/27/2018

5. PROCEDURE

5.1. Overview

The Project Chemist will ensure all data generated by the analytical laboratory is reviewed and managed in accordance with project-specific requirements, as detailed in the approved Quality Assurance Project Plan (QAPP) and/or work plan, and as required by the laboratory subcontract. Data verification, data validation, and assessment of data usability are the three steps of the data review process by which data compliance, quality, and usability are examined and evaluated. These procedures and the various levels of data validation are detailed in the sections below.

5.2. Data Verification

The Project Chemist or designee will perform data verification on project data as the first step in the data review process. Data verification consists of conducting a completeness check to determine whether the analytical laboratory has provided the required data deliverables and to ensure that requested data is included in those deliverables. The project-specific work plan and/or QAPP provide details regarding the specific type and content of the data deliverables necessary to meet project DQOs. If any required data are missing, corrective action must be taken to resolve the omission. This may include revision of the data package, resampling, and/or documentation of issues that cannot be resolved.

5.3. Data Validation

Following verification, the Project Chemist or designee will perform data validation at the level or levels required by the project. Data validation is the systematic review of laboratory data to identify sampling and analytical uncertainty. Data validation consists of evaluating whether the data comply with the pre-defined requirements and criteria (i.e., MQOs) for the project with regard to precision, accuracy, representativeness, completeness, and comparability. Based on the laboratory data deliverables and data validation requirements identified in the project QAPP, the analytical data validation may be performed at a level from “Stage 1” through “Stage 4”, or any combination of these. The level of data validation required is based on the project DQOs. Laboratory data deliverables provided should meet or exceed the minimum requirements to perform the designated stage of data validation. The level of data validation required for the project and the project-specific validation criteria to be used are described in the project-specific work plan and/or QAPP. The stages of data validation, as defined by the USDOD/USDOE Environmental Data Quality Workgroup “General Data Validation Guidelines” are detailed in the sections below.

5.3.1. Stage 1

Stage 1 consists of verification and evaluation of the completeness and compliance of sample specific information and field quality control (QC) samples. **Table 1** summarizes the steps included in Stage 1.

TABLE 1
ELEMENTS OF STAGE 1 VALIDATION

Item	Activity
Data Package	Verify the data package includes a Cover Page, Table of Contents, Case Narrative, and all supporting documentation to complete Stage 1 validation.
Field Samples	Verify sample IDs, analyses performed, and target analyte lists reported match those listed on the chain-of-custody and associated project documents.
Sample Receipt Information	Verify sample receipt conditions are documented, including temperature, preservation, and any issues that might compromise sample integrity.
Holding Times	Verify all holding times were met for the required analyses.
Limits and Units	Verify the reported concentrations and units for limits of detection and quantitation met project requirements.
Field QC	Verify field QC samples were collected and analyzed at the frequency required by the project.

5.3.2. Stage 2A

Stage 2A includes all elements of Stage 1 plus the evaluation of preparation and analytical batch QC results. **Table 2** summarizes the steps included in Stage 2A. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 2
ELEMENTS OF STAGE 2A VALIDATION

Item	Activity
Case Narrative	Verify the method-specific case narrative includes a discussion of all significant issues encountered during analysis, including hold time exceedances, QC failures, and any problems encountered that may have adversely impacted sample integrity or data quality.
Methodology	Verify all batch QC required by the analytical methods were performed, including preparation and cleanup when needed.
Sample results	Determine which result should be used to make project decisions if multiple analyses were performed for any analyte.
Batch QC	Evaluate all sample-related batch QC samples against designated acceptance criteria for spike list, frequency, accuracy, and precision as applicable. Batch QC includes but is not limited to, method blanks, laboratory control samples, matrix spikes, surrogate spikes, analytical duplicates, serial dilutions, and post digestion spikes.

5.3.3. Stage 2B

Stage 2B includes all elements of Stage 2A plus the evaluation of instrument related QC elements and results. **Table 3** summarizes the steps included in Stage 2B. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 3
ELEMENTS OF STAGE 2B VALIDATION

Item	Activity
Instrument Elements	Verify the method required instrument performance checks were performed and met criteria. These include, but are not limited to, instrument tunes, breakdown standard checks, peak tailing factors, interference check standards, etc.
Calibration	Verify all calibration criteria were met, including frequency, response factors, and fit criteria.
Calibration Verification	Verify initial and continuing calibration verifications were performed at the required frequency and met all criteria.
Internal Standards	Verify internal standard response and retention time criteria were met.
Instrument Blanks	Verify instrument blanks were performed at the required frequency and met criteria.
Confirmation Analyses	For applicable methods, verify confirmation analysis was performed for all positive results using a secondary column or detector. Verify the percent difference between original and confirmation results met applicable criteria.

5.3.4. Stage 3

Stage 3 includes all elements of Stage 2B plus the re-quantification and recalculation of selected results. **Table 4** summarizes the steps included in Stage 3.

TABLE 4
ELEMENTS OF STAGE 3 VALIDATION

Item	Activity
Recalculation of data	Select results will be recalculated from raw instrument response at the frequency designated by the project specific work plan and/or QAPP. Recalculated results shall encompass field samples, batch QC data, and instrument QC elements. The percentage of data that must be recalculated shall be designated in the project QAPP. At a minimum, one sample result and one QC-related result shall be recalculated for each method performed for every ten (10) field samples analyzed.

5.3.5. Stage 4

Stage 4 includes all elements of Stage 3 plus qualitative review of non-detect, detected, and tentatively identified compounds (TICs) from instrument outputs. **Table 5** summarizes the steps included in Stage 4. It should be noted that this list is not considered an “all inclusive” list or that all items listed are applicable to every method that is validated.

TABLE 5
ELEMENTS OF STAGE 4 VALIDATION

Item	Activity
Chromatograms	Review chromatograms for peak integration, baseline anomalies, matrix interferences, etc. Verify manual integrations were correctly performed, justified, and documented.
Mass Spectra	Review mass spectra for signal to noise ratios, presence of qualitative mass ion, relative ion abundances for required secondary and tertiary ions, etc.
Retention Times	Ensure retention times or relative retention times meet method requirements for analyte identification.

5.3.6. Data Validation Qualifiers

This section provides an overview of the standard data validation qualifiers applied by the data validator during the data review process. The data qualifiers presented in **Table 6** below should be used, as applicable, unless other data qualifiers are specified in the project related work plan or QAPP. If qualifiers other than those listed in **Table 6** are used, a detailed explanation of those qualifiers should be included in the data validation report. Data qualifiers are applied in accordance with the data validation guidance required by the project work plan and/or QAPP. In the absence of project-specific guidance, the USEPA National Functional Guidelines (most current version) will be used for data review. All qualifiers added, removed, or changed as a result of the data review process should be documented, along with the reason for the change, in the data validation report. All documented data qualifier changes must be appended to the electronic data deliverable to ensure all data queries, data tables, and project databases include the final applicable data qualifiers.

TABLE 6
DATA VALIDATION QUALIFIERS

Qualifier	Definition
U	The analyte was not detected or was changed to non-detect because of blank related contamination. The value reported for DOD/DOE projects must be "<" the Limit of Detection (LOD). The reported LOD has been adjusted for sample-specific factors, including aliquot used, dilution, etc.
J	The reported result was an estimated value with an unknown bias.
J+	The reported result was an estimated value that may be biased high.
J-	The reported result was an estimated value that may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been "tentatively identified" as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD (or as defined by the project). However, the reported numerical value is approximate.
Q	The sample result was affected by serious deficiencies in the ability to analyze the sample and meet method and/or project QC criteria. The presence or absence of the analyte cannot be verified. The project team should decide whether the result is ultimately usable.
R	The project team concluded that the data point is rejected an unusable for the purposes of the project.

5.4. Data Usability Assessment

Data usability is an evaluation of the data set with respect to the overall goals of the project, as outlined in the DQOs. Following the completion of data validation, usability of the data may be assessed. **Table 7** summarizes the elements of evaluating data usability. It should be noted that this list is not considered an "all inclusive" list or that all items listed are applicable to every method that is validated.

TABLE 7
ELEMENTS OF DATA USABILITY

Validation Step (Review Items)	Validation requirement
Patterns and Trends	Review project data for patterns and trends in the sample and/or QC data that may indicate systematic issues/bias across the entire data set.
Data Gaps	Review reported data for potential data gaps, including samples that were not collected, samples that were compromised during shipment or after receipt at the laboratory, data qualified "Q" or "R" that potentially may not be usable, etc.
Qualified Data	Review qualified data to evaluate the impact biased data may have with regard to the comparison to project action limits (PALs). For example, results qualified "J-" as estimated with low bias that fall just below the PAL may need to be further evaluated due to the limitations of the analytical process.
Laboratory Sensitivity	Evaluate laboratory sensitivity by comparing detection limit (DL), LOD, and limit of quantitation (LOQ) values to those required by the project work plan and/or QAPP. Verify that the reported DL, LOD, and/or LOQ values were below the required PALs listed in the project work plan and/or QAPP (as applicable). Determine whether analyte-specific and overall sensitivity of the data set were sufficient to meet project requirements.
Deviations from Project Requirements	Review any deviations from planned activities (e.g. work plan and/or QAPP deviations, method deviations, deviations from planned sampling activities, etc.) and the impact these deviations may have had on data usability.

5.5. Electronic Data Deliverables (EDD)

5.5.1 The Data Manager or designee shall import and store electronic analytical data in a project-specific database using electronic processing as a means to maintain and assure the accuracy, consistency, and integrity of the data. Electronic data will be reviewed using validation software to ensure that electronic data comply with pre-defined project requirements. The Data Manager shall ensure that the electronic data match that reported in the laboratory data package. The electronic data validation and resulting qualifiers shall be compared to the manual validation to ensure all final data validation qualifiers match between the electronic data and those documented in the data validation reports. The Data Manager shall use the validated data to generate data summary tables that include the final validation flags, as required by the project.

5.5.2 The required EDD format and government database submittal deliverables are specific to the project and are described in the project-specific work plan and/or QAPP. The Data Manager is responsible for ensuring data are uploaded to required government databases in accordance with project requirements.

Procedure # **CHEM-01**	**Title:** **CHEMISTRY DATA REVIEW AND MANAGEMENT**	**Revision #** **01**
Effective Date: 02/24/2020	**Approved By:** Maryanne Kosciewicz, Project Chemist	**Last Revised:** 07/27/2018

5.6. Data Archive

Electronic project files, such as laboratory data packages (in PDF format), electronic data deliverables, data validation reports, project database, and data tables shall be stored and maintained as described in the project-specific work plan and/or QAPP. All Department of Defense project related laboratory and validation documents shall be stored for minimum of seven years from the date the data are accepted by the client. Data shall be stored, maintained, and archived in accordance with all federal laws and regulations.

6. REFERENCES

Reference Title (Author)	Description
Uniform Federal Policy for Quality Assurance Project Plans Part 1: UFP-QAPP Manual, Final Version 1 March 2005. (Intergovernmental Data Quality Task Force)	Provides Federal departments, agencies, and programs with policy and guidelines for developing QAPPs for management of environmental data collection and use.
General Data Validation Guidelines, October 2017 (Environmental Data Quality Workgroup)	Provides guidance on the validation of environmental data generated in support of the Department of Defense (DoD)/Department of Energy (DOE) projects.
National Functional Guidelines for inorganic Superfund Methods Data Review, January 2017 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for inorganic parameters, including metals, mercury, and cyanide.
National Functional Guidelines for Organic Superfund Methods Data Review, January 2017 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for organic parameters, including volatiles, semivolatiles, pesticides, and aroclors.
National Functional Guidelines for High Resolution Superfund Methods Data Review, April 2016 or most current version (USEPA)	Provides guidance to evaluate analytical data quality and usability generated for high resolution parameters, including dioxins, furans, and congeners.

7. EXHIBITS

None.

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	05/20/15	Initial Release	n/a
01	07/27/18	Significant revisions throughout to reflect current definitions and guidelines regarding data review procedures.	Previous version out-of-date based on new DoD/DOE guidance.

Procedure # **SOP PFAS ENV-01**	**Title:** **PFAS SAMPLING GUIDANCE**	**Revision #** **01**
Effective Date: 12/6/2018	**Approved By:** Daniel R. Griffiths, PG, CPG	**Last Reviewed/Revised:** 12/12/2022

1. PURPOSE

Many materials used during an environmental investigation can potentially contain per- and polyfluoroalkyl substances (PFAS). There is limited published research or guidance on how certain materials used by field staff may affect sample results. Therefore, a conservative approach will be the default when conducting field investigations during this program.

2. RESPONSIBILITIES

Role	SOP-Specific Responsibilities
Field Staff Sampling for PFAS Compounds	Guidance for all field staff performing activities related to the sampling of PFAS.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	per- and polyfluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Field Equipment used during PFAS Investigations	All field equipment used during PFAS investigations should follow the guidance outlined in this standard operating procedure (SOP). Equipment deviating from this guidance should be discussed with the supplier and/or producer. The equipment should be tested with a rinse blank analysis prior to use to determine if it may be a source of PFAS cross-contamination.

5. PFAS PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The health and safety of the field team is paramount. If the safety of the field crew becomes an issue (e.g., use of insect repellant; inclement weather) an alternative course of action will be discussed with the project team and the result will be noted on the daily PFAS checklist (**Exhibit 4**).

5.2. PFAS Cross-Contamination

5.2.1. Material Avoidance

5.2.1.1. Basic materials that will be avoided during the field investigation:

- Teflon®, polytetrafluoroethylene (PTFE);

- waterproof coatings containing PFAS;
- food containers;
- anything with fluoro in the name;
- fluorinated ethylene propylene (FEP);
- ethylene tetrafluoroethylene (ETFE);
- low density polyethylene (LDPE); and,
- polyvinylidene fluoride (PVDF).

5.2.1.2. The field team will be aware that many waterproof coatings contain PFAS (e.g., water-resistant clothing, shoes, waterproof papers) and these materials will be avoided. If a waterproof material is necessary, alternatives include polyurethane, rubber, or polyvinyl chloride (PVC) and these options will be discussed with the project team prior to use. Due to the ubiquitous nature of PFAS, the sampling crew will review all materials used to avoid contamination. A conservative list of items to avoid and permitted items is provided below in **Exhibit 1** and **Exhibit 2**. General precautions to follow and products to avoid while on-site are outlined in the following subsections (Note that this is not an exhaustive list and any materials to be used on-site should be reviewed with the project team prior to use.)

5.2.2. Field Equipment

- Avoid Teflon® lined tubing or sampling existing wells with dedicated Teflon® tubing.
- Avoid waterproof field notebooks.
- Bladder pumps must use disposable polyethylene bladders.

5.2.3. Food Related

- Paper food packaging is often treated with PFAS to resist wetting. As such, personnel should avoid paper bags, paper food packaging, paper wrapping (e.g., sandwich wrap), paper beverage cups, as well as other coated papers.
- Aluminum foil should not be used on site.
- Food that has been fried in a frying pan due to the potential for contamination from Teflon-coated cooking surfaces.
- Coated textiles of any type should not be used on site.
- Snacks and meals should not be eaten in the field vehicle or in the work area. Field personnel should step-away from the work area by a minimum of 10 meters (downwind whenever possible) when taking breaks for food and beverages.

5.2.4. Field Gear / Clothing

- Water resistant, waterproof, or stain treated clothing such as Gore-Tex should not be worn by field personnel. Clothing worn during field sampling should be made of natural fiber such as cotton or wool.
- Clothing made of synthetic fibers. Clothing worn during field sampling should be made of natural fiber such as cotton or wool.
- Field clothing should ideally be old and well laundered.
- Field clothing should be washed using a minimal use of unscented detergent and no fabric softener or other additives. Once clean the clothing should be washed again in water only before drying. No fabric conditioner or dryer sheets should be used while drying.
- Rite in the Rain field notebooks/paper and similar products are not to be used. Field records should be recorded on loose uncoated paper or electronic forms.

- Field notes, records, and sample labels should be made in pencil or using Rite in the Rain pens (confirmed to be PFAS-free from the manufacturer). Ballpoint pens and markers are not to be used for notes. Sample labels may also be pre-printed by the laboratory; if pencil is used to write on the sample labels, those bottles will be double bagged using LDPE bags (e.g., Ziploc®) that do not come into direct contact with the sample media and do not introduce cross-contamination with samples may be used).
- Clipboards should be made of Masonite or aluminum. Plastic clipboards, binders, and spiral bound notebooks are not acceptable.
- Safety toe boots made from synthetic fibers and treated for water resistance are acceptable for use in order to maintain personnel protection. However, all contact with the boots is to be made at least 10 meters away from the work area. New gloves are to be donned prior to making contact with the boots and are to be disposed immediately afterwards. Boots containing Gore-Tex and/or Tyvek are not to be used on site.
- Disposable, powderless, nitrile gloves must be worn at all times. A new set of gloves will be donned prior to conducting any of the following activities at each sample location:
    - Equipment decontamination,
    - Contact with bottleware and/or PFAS free water containers,
    - Insertion of anything into the well (e.g., samplers, tubing, etc.),
    - Insertion of silicone tubing into peristaltic pump,
    - Completion of well purge, prior to sample collection,
    - Collection/handling of quality control/quality assurance (QA/QC) samples,
    - Following handling any non-dedicated field equipment, contact with non-decontaminated surfaces, and
    - When deemed necessary by field personnel.
- Vehicle seating is often treated with stain resistant products. Therefore, direct contact with vehicle seats should be avoided by covering each seat with a well laundered cotton sheet for the duration of the sampling event.
- Samples should be kept on ice using only regular water ice double-bagged in LDPE bags (e.g., Ziploc®). No chemical ice packs (blue ice) are allowed.

5.2.5. Personal Hygiene

- On the day of sampling, field personnel should not use shampoo, conditioner, body gel, cosmetics, or cosmetic/hand/body creams as part of their personal hygiene routine. The use of bar soap is acceptable; however, bar soaps containing additional moisturizers should be avoided.
- It is recommended that field personnel shower the night before the sampling event and rinse with water only the morning of the sampling event.
- Cosmetics, moisturizers, sunscreens, insect repellant, and dental floss, except for those in **Exhibit 2 and 3**, shall not be used on or off site throughout the duration of the field sampling program.
- For restroom breaks, field personnel shall move at least 10 meters from the work area before removing gloves and overalls. Personnel should wash their hands as normal allowing for extra time for rinsing after soap use. It is preferred to dry hands after washing using a hand dryer rather than paper products whenever possible.

5.2.6. Site Visitors

- All visitors to the site are to be asked to remain a minimum distance of at least 10 meters from all sampling areas.

5.2.7. Rain Events

- The use of rain gear treated with a waterproof coating is not permitted while sampling. Alternatively, PVC rain suits may be worn.
- The use of a pop-up tent is acceptable for use to provide shelter from the rain if the schedule does not allow for work to stop during rain. The gazebo should be erected directly over top of the sampling area taking precautions that water running off the tent does not enter into work areas. Since a waterproof pop-up tent may be treated with PFAS containing materials cross-contamination precautions should be taken when using them. Gloves should be donned whenever contact with the gazebo is made and the gloves should be disposed of immediately following contact.

5.2.8. Material Screening

If alternative materials must be used, screening of the material should include a review of Safety Data Sheets (SDSs). Make sure the review uses current SDSs, because the actual composition of a particular item or material may have changed over time without changing the actual item or material name. All products from the United States or abroad should be screened. Text fragments such as “perfluoro,” “fluoro,” or “fluorosurfactant” may identify the use of PFAS in specific items or materials (MDEQ, 2018). If after review, there is still concern the sampler will contact the manufacturer.

5.3. PFAS Sampling Procedures

5.3.1. Sample Containers, Handling, and Collection

5.3.1.1. All bottles used for PFAS sampling should come from the laboratory that will also be performing the PFAS analysis, as defined by the Quality Assurance Project Plan (QAPP), and be verified by the laboratory to be PFAS-free. Typically, polypropylene or high-density polyethylene (HDPE) bottles with unlined plastic caps are used.

5.3.1.2. Before sampling, staff may come into contact with textiles and fabrics treated with PFAS, such as carpets and car interiors. Staff should be aware that these materials, and any other surfaces that repel water and are stain resistant, have the potential of being treated with PFAS. Although these are materials that do not come into contact with the sample, field personnel should be aware of the possibility for PFAS presence and sample containers and equipment that will be used for sampling should not be stored on or come into contact with materials suspected to contain PFAS.

5.3.1.3. For all environmental media, hands should be well washed before sampling. Clean powderless nitrile gloves must be put on before sample collection, handling of sample containers, and handling sampling equipment. The sample container must be kept sealed at all times and only open during the sample collection. The sampling container cap or lid should never be placed on any surface unless it is PFAS-free. The sampling container cap or lid must never be placed directly on the ground.

5.3.1.4. If published analytical reference methods, other than Environmental Protection Agency (EPA) Draft Method 1633 are used, follow the guidelines or requirements in those methods for sample storage, preservation, and hold times. Otherwise, EPA Draft Method 1633 requires that samples must be protected from light and stored and shipped at 0 to 6 °C. When received by the laboratory, sample temperature must be 0 to 6 °C. Once received by the laboratory, the samples must be stored at less or equal to -20 °C until sample preparation.

5.3.2. *Shake Test*

The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after a sample is collected and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.3.3. *Sample Shipment*

In general, for all environmental media sampled for PFAS, samples must be kept on ice from the time of sample collection to the arrival at the laboratory. The following procedures should be used for sample shipment:

- Regular ice should be used to cool and maintain the sample at or below the proper temperature.
- Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- The samples, ice, and chain of custody (CoC) should always be bagged in LDPE (e.g., Ziploc®) bags.
- Chain of Custody and other forms should be single bagged in LDPE resealable storage bags and taped to the inside of the cooler lid.
- The cooler should be taped closed with a custody seal and shipped by overnight courier.
- Samples should be shipped as soon as possible (e.g., overnight) to ensure the samples arrive within the analytical holding time specified by the lab.

5.4. General Equipment Decontamination Procedures

5.4.1. *PFAS-Free Water*

5.4.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2018). **Note:** The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.4.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.4.2. *Decontamination Procedures*

5.4.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.4.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean PFAS-free water;
4. Second rinse in a bucket of clean PFAS-free water;
5. Final triple rinse with PFAS-free water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e., those that foam during shaking, see Section 5.3.3) will be cleaned as per above in triplicate.

5.4.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.4.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment rinsate blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
Denly, E. et al., (2019). Per- and polyfluoroalkyl substances in environmental sampling products: Fact or fiction? Remediation. 2019;29:65–76.	Guidance on prohibited materials.
Interstate Technology Regulatory Council (ITRC), 2018. PFAS Fact Sheets. Accessed 11/07/18. https://pfas-1.itrcweb.org/fact-sheets/	PFAS guidance on sampling and avoiding cross contamination.
Michigan Department of Environmental Quality (MDEQ). 2018. PFAS Sampling Guidance. Accessed 11/07/18. https://www.michigan.gov/pfasresponse/investigations/sampling-guidance	PFAS guidance and PFAS-free health and safety products.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1:	Summary of Prohibited and Acceptable Items for Sampling of PFAS
Exhibit 2:	Prohibited Field Clothing and PPE Brand and Product Names
Exhibit 3:	Approved Sunscreen and Insect Repellants
Exhibit 4:	PFAS Sampling Checklist

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	12/6/2018	Initial Release	n/a
01	12/12/2022	Sample storage temperature per EPA Draft Method 1633	Release of EPA Draft Method 1633

EXHIBIT 1: SUMMARY OF PROHIBITED AND ACCEPTABLE ITEMS FOR SAMPLING OF PFAS

PROHIBITED ITEMS	ACCEPTABLE ITEMS
FIELD EQUIPMENT	
Teflon® containing materials (**Exhibit 2**)	High-density polyethylene (HDPE), polypropylene, silicone
Low density polyethylene (LDPE)	Acetate liners LDPE bags (e.g., Ziploc®) that do not come into direct contact with the sample media and do not introduce cross-contamination with samples may be used.
Aluminum foil	Silicon tubing
Waterproof field books	Loose paper (non-waterproof), Electronic forms
Plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or Masonite
Ball point pens	Rite in the Rain pens®
Post-It Notes	
Re-usable Chemical (blue) ice packs	Regular ice in polyethylene bags (double bagged)
FIELD CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)	
New cotton clothing or synthetic water resistant, waterproof, or stain- treated clothing, clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferable cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex™ Tyvek®	Boots made with polyurethane and polyvinyl chloride (PVC), or PVC over boots Synthetic or natural fibers (cotton preferred)
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	Reference **Exhibit 3**. Sunscreens and insect repellants should not be applied near the sample collection area. Hands should be well washed after application or handling of these products, and afterwards, powderless nitrile gloves should be worn.
SAMPLE CONTAINERS AND TUBING	
LDPE or glass containers and lined lids	HDPE
Teflon®-lined caps	Unlined polypropylene caps
RAIN EVENTS	
Waterproof or resistant rain gear	PVC Rain Gear and/or tent that is only touched or moved prior to and following sampling activities
EQUIPMENT DECONTAMINATION	
Decon 90	Alconox®, Liquinox® and/or 7th Generation Free & Clear Dish Soap
Water from an on-site well Untested potable water from municipal drinking water supply	Tested potable municipal water (for steam cleaning or initial cleaning) PFAS-free deionized water (small sampling equipment)
FOOD CONSIDERATIONS	
All food and drink, with exceptions noted on the right	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area

EXHIBIT 2: PROHIBITED FIELD CLOTHING AND PPE BRAND AND PRODUCT NAMES

PROHIBITED MATERIALS (DEPA, 2015)	
Advanced Dual Action Teflon® fabric protector.	Release Teflon®
Repel Teflon® fabric protector	High-Performance Release Teflon®
High performance Repel Teflon® fabric protector	Ultra Release Teflon®
NK Guard S series	GreenShield®
Tri-Effects Teflon® fabric protector	Lurotex Protector RL ECO®
Oleophobol CP®	Repellan KFC®
Rucostar® EEE6	UnidyneTM
Bionic Finish®	RUCO-GUARD®
RUCOSTAR®	RUCO-COAT®
RUCO-PROTECT®	RUCOTEC®
RUCO®	Resist Spills™
Resists Spills and Releases Stains™	Scotchgard™ Fabric Protector

EXHIBIT 3: APPROVED SUNSCREEN AND INSECT REPELLANTS

ALLOWABLE INSECT REPELLANTS	
PHOTOS	**INSECT REPELLENT SPRAY**
 	• OFF Deep Woods • Sawyer Permethrin
ALLOWABLE SUNSCREENS	
PHOTOS	**SUNSCREENS**
  	• Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30 • Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Stick SPF 50 • Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50 • Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30 • Coppertone Sunscreen Stick Kids SPF 55 • L'Oréal Silky Sheer Face Lotion 50+ • Meijer Sunscreen Lotion Broad Spectrum SPF 30 • Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30
MATERIALS THAT REQUIRE SCREENING	
• Sunscreens: Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, and baby sunscreens that are "free" or "natural."	
• Insect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, Baby Ganics	
• Sunscreen and Insect Repellent: Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion.	
1) This table is not considered to be a complete listing of allowable materials and materials that require screening. All materials should be evaluated before use during sampling. Some of the sunscreen and insect repellent testing has been performed using a PFAS screening Method known as Particle Induce Gamma-Ray Emission (PIGE). The use of approved gloves should always be used, and the sample should never come into contact with any of the sunscreen or insect repellent products. An Equipment Blank sample could also be collected to verify the product as PFAS-free.	

Procedure # SOP PFAS ENV-01	Title: PFAS SAMPLING GUIDANCE	Revision # 01
Effective Date: 12/6/2018	Approved By: Daniel R. Griffiths, PG, CPG	Last Reviewed/Revised: 12/12/2022

EXHIBIT 4: PFAS SAMPLING CHECKLIST

Site Name: ____________________ Task: ____________________

Weather (temp/precip):____________________ Date: ____________________

***Field Clothing and PPE*:**

☐ Powder-Free Nitrile Gloves ONLY

☐ No clothing or boots containing Gore-Tex™

☐ No clothing or boots treated with water-resistant spray

☐ Safety boots made from polyurethane and PVC, or leather boots covered with overboots

☐ No materials containing Tyvek®

☐ Field crew has not used fabric softener on clothing

☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products this morning

☐ Field crew has not applied unauthorized sunscreen or insect repellant

☐ Samplers don fresh nitrile gloves for each sample collected

***Field Equipment*:**

☐ No Teflon® or LDPE containing materials other than QED brand LDPE

☐ All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene, QED brand LDPE

☐ No waterproof field books, waterproof paper or waterproof bottle labels, waterproof markers/Sharpies®

☐ No plastic clipboards, binders, or spiral hard cover notebooks

☐ No Post-It Notes®

☐

☐ Coolers filled with regular ice only; no chemical (blue) ice packs in possession

☐ No aluminum foil

***Sample Containers*:**

☐ Containers for PFAS shipped in separate cooler from other sample analyses

☐ Sample containers made of HDPE or polypropylene

☐ Caps are unlined and made of HDPE or polypropylene

***Wet Weather (as applicable)*:**

☐ Wet weather gear made of polyurethane and PVC only

***Equipment Decontamination*:**

☐ "PFAS-free" water on-site for decontamination of sample equipment; no other water sources to be used

☐ Alconox® or 7th Generation Free & Clear Dish Soap to be used as decontamination cleaning agents

***Food Considerations*:**

☐ No food or drink on-site with exception of bottled water and/or hydration drinks (*i.e.*, Gatorade® and Powerade®) that is available for consumption only in the staging area

***Vehicle Considerations*:**

☐ Avoid utilizing areas inside vehicle as sample staging area

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If any applicable boxes cannot be checked, the field team leader shall describe the deviations on the back and work with field personnel to address issues prior to commencement of work.

Sampling Equipment and Supply Summary (include brand names and serial numbers where available)

Decontamination Fluid Source(s): ______________________________
Soap and other fluids used: ______________________________
Gloves:______________________________
Rope: ______________________________
Sampling Equipment: ______________________________
Field Team Names: ______________________________
Field Team Leader Signature:______________________________

Procedure # SOP ENV-02	Title: SOIL SAMPLING	Revision # 00
Effective Date: 04/22/2022	Approved By: Todd Belanger	Last Revised:

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting surface or subsurface soil samples for analysis during environmental investigations where PFAS compounds are a part of the subject of investigation. The **SOP PFAS ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Surface soil samples collected during the sampling program are expected to be discrete. Subsurface soil samples may be collected using hand augers or a drilling method. This procedure also applies to the collection of dry sediment samples.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of soil samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	Stainless steel bowls and scoops/spoons, hand auger
Sample containers	Appropriate, pre-cleaned, sample bottles [verified PFAS-free, as appropriate] provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof field books.
GPS Unit	To record sample coordinates.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP PFAS ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, soil type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form. The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, QAPP and **SOP PFAS ENV-01 PFAS Sampling Guidance**. The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.3. Sample Analysis and Quality Control Samples

5.2.3.1. Collected soil samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event.

5.2.3.2. **Shake Test**: The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after the groundwater sample is collected and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated with elevated concentrations of PFAS. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.3. Sampling Methods for Surface Soil

5.3.1. Preparation for Surface Soil Sampling

The following steps shall be completed when preparing for collection of surface soil samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).

3. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
4. The Sampling Team shall don clean, powder free nitrile gloves, as required.
5. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area.

5.3.2. Discrete Sampling Method for Soil (or Dry Sediment)

5.3.2.1. The discrete sampling method is best suited to identifying localized contamination. Discrete sampling may be used to collect a sample from a biased area of soil (e.g. stained soil, within a known area of concern, the bottom of an excavation). Discrete sampling is also used when collecting IDW samples from drums or spoils piles to characterize waste.

5.3.2.2. Following the preparatory actions (Section 5.3.1), the Sampling Team shall complete the following steps to collect discrete surface soil samples:

1. Collect the sample using an approved sampling tool (e.g., stainless steel, trowel, or scoop).
2. Screen the collected sample with a photoionization detector (PID) for the presence of VOCs.
3. Transfer the collected soil from the sample tool directly into the sample container(s). If VOCs are to be collected, they shall be collected first prior to homogenization or compositing.
4. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
5. After sampling is completed, backfill the hole with remaining soil to return the site to as close to original condition as possible.
6. Perform post-sampling activities (Section 5.3.3).

5.3.3. Post Sampling Activities for Surface Soil Sampling

The following steps shall be completed once surface soil sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.4. Preparation for Subsurface Soil Sampling

5.4.1. Preparation for Subsurface Soil Sampling

The following steps shall be completed when preparing for collection of subsurface soil samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Sampling Team Leader will obtain any necessary excavation permits and, if necessary, contact a local underground utility locating service to perform a utility clearance for all subsurface sample locations.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1 and **SOP ENV-07 Drilling and Monitoring Well Installation**).

4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powder free gloves, as required.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the borehole. All equipment entering the borehole shall be decontaminated and shall be PFAS-free as per **SOP PFAS ENV-01 PFAS Sampling Guidance**.
7. The Sampling Team shall calibrate any required equipment and document the calibration on an equipment calibration form.

5.4.2. Boring or Hand Auger Method for Subsurface Soil

5.4.2.1. This section provides procedures for subsurface soil sampling using a drilling rig (e.g., Geoprobe® or hollow stem auger) or hand auger. Similar procedures apply for other drilling methods. If a drilling rig is used, it shall be operated by an appropriately licensed driller.

5.4.2.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect soil samples from the soil borings advanced by hand augering or direct push rig:

1. Spread clean HDPE or polyethylene plastic sheeting or a clean, washed cotton sheet on the ground or table at each sampling location to keep sampling equipment clean and prevent cross-contamination.
2. Advance the hand auger or drill tooling to the desired sample depth.
3. Immediately after opening the sampling device (e.g., split-spoon), screen the collected sample with a PID for the presence of VOCs.
4. Collect the sample using an approved sampling tool (e.g., stainless steel trowel or scoop) and scoop the soil from the auger bucket, acetate liner/split spoon/sample bag (as applicable) from the drilling rig starting at representative depth ranges as detailed in the work plan/QAPP. For hand augering, use a new, clean, decontaminated auger bucket once the top of the sampling depth is reached.
5. If VOCs are to be collected, they shall be collected first prior to homogenization or compositing.
6. Transfer the sample from the auger bucket or trowel into a large stainless-steel bowl and mix the combined soil thoroughly to ensure a representative sample.
7. Collect suitable quantities with the approved sampling tool and transfer directly into the sample container(s).
8. Repeat these steps as necessary to obtain sufficient sample volume.
9. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
10. After sampling is completed, backfill the hole with remaining soil to return the site to as close to original condition as possible.
11. Perform post-sampling activities (Section 5.4.3).

5.4.3. Post Sampling Activities for Subsurface Soil Sampling

The following steps shall be completed once subsurface soil sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.

4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.5. Sampling Equipment Decontamination

5.5.1. PFAS-free Water

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with distilled water.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse with distilled water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e. interface probe) that comes into contact with well water should be decontaminated between uses.

5.5.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.5.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ASTM D4700-15 Soil Sampling from the Vadose Zone	This guide covers procedures that may be used for obtaining soil samples from the vadose zone (unsaturated zone)
ASTM D6640-01 Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations	This practice covers procedures for obtaining soils from core barrel samplers for chemical and physical analysis, with an emphasis on the collection and handling procedures that maintain the representativeness of the chemical contaminants of concern.
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1: Soil Sampling Form

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/22/2022	Initial Release	n/a

PARSONS
SOIL SAMPLING RECORD

SITE NAME: __________
PROJECT NUMBER: __________
SAMPLING DATE / TIME: __________
WEATHER: __________
SAMPLERS: __________ of __________
__________ of __________

SAMPLE ID: __________
SAMPLING METHOD: __________
DEPTH OF SAMPLE: __________

DESCRIPTION OF SAMPLING POINT

LOCATION: __________
PHYSICAL APPEARANCE: __________
VEGETATION: __________
DRAINAGE DIRECTION: __________

SAMPLE DESCRIPTION

TEXTURE: __________
COLOR: __________
ODOR: __________
OTHER: __________

FIELD TESTS

TEMPERATURE: __________ OTHER: __________
pH: __________ OTHER: __________
CONDUCTIVITY: __________ OTHER: __________

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: __________
QA/QC SAMPLE ID: __________
ANALYZE QA/QC SAMPLES FOR: __________
DATE/TIME REFRIGERATED: __________
CHAIN OF CUSTODY NUMBER: __________
SHIPPED VIA: __________
LABORATORY: __________

COMMENTS / MISCELLANEOUS

____
____
____

Procedure # **SOP ENV-03**	**Title:** **GROUNDWATER SAMPLING**	**Revision #** **01**
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting groundwater samples for analysis during environmental investigations where PFAS compounds are the subject of investigation or there is the potential for future investigation of PFAS compounds. This SOP also applies to the collection of groundwater for analysis of other chemical suites (e.g., metals). The **SOP ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Proper collection procedures are necessary to assure the quality and integrity of the PFAS samples or future PFAS sampling. Low-flow techniques to be used when groundwater sampling.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan/QAPP. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	[PFAS-free when applicable] Measuring cups/graduated cylinder, peristaltic pump, PFAS-free bladder pump (stainless steel with disposable polyethylene bladders), PFAS-free submersible pump, clean HDPE or silicon tubing, PFAS-free polypropylene rope, purge buckets, HDPE or cotton sheeting, sampling bottles.
Sample containers	Appropriate, pre-cleaned, verified PFAS-free (if applicable) sample bottles provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof field books when sampling for PFAS compounds.

Procedure # SOP ENV-03	Title: GROUNDWATER SAMPLING	Revision # 01
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

Equipment	Brief Description of Function and Purpose
GPS Unit	To record sample coordinates.
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Water Level Meter	To measure depth to static water level and total depth of well.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. When sampling for PFAS compounds, any health and safety products or PPE will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, sample type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form. The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

5.2.2.1. The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, UFP-QAPP, and **SOP ENV-01 PFAS Sampling Guidance** (when applicable). The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.2.2. Sample purge water and equipment decontamination water may be required to be containerized as investigation-derived waste (IDW) and analyzed. The Sample Team Leader will review the requirements in the Waste Management Plan (included as a part of the work plan) for chemical analysis and proper disposal of IDW.

5.2.3. Sample Analysis and Quality Control Samples

5.2.3.1. Collected samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event. Typical QC samples collected include the following:

5.2.3.2. **Equipment Blank**: Typically collected weekly when sampling for non-PFAS analytes. A daily equipment blank will be collected if sampling for PFAS. A common method to verify that the device is “clean” and acceptable is to analyze a sample (equipment blank) that has been soaked in or passed through the sampling device, or both, to check for the background levels that may result from the sampling materials or from field conditions.

5.2.3.3. **Field Blank (when collecting PFAS samples only)**: Typically collected daily. A field blank is a PFAS sample bottle pre-filled at the laboratory with laboratory verified PFAS-free water and sent with the sample bottles. Prior to sampling, open the PFAS field blank bottle provided by the laboratory and place adjacent to the sample collection area. Gloves should be changed prior to handling other PFAS sample bottles. After the PFAS sample is collected, close the PFAS field blank bottle and return it to the cooler. This sample will be analyzed in the same manner as the normal samples and can indicate whether or not PFAS were introduced during sample collection/handling, as well as if additional factors may exist, such as introduction of contaminated air particulate.

5.2.3.4. **Trip Blank**: One per cooler. Trip blanks will be supplied by the laboratory and will be analyzed only for VOC compounds.

5.2.3.5. **Shake Test (when collecting PFAS samples only)**: The shake test is an informal qualitative field screening method which provides a gross visual analysis of the site contamination. The shake test can apply to both water and soil-water solutions. The shake test will be performed after the groundwater sample is collect and the PFAS field blank bottle is closed. In the shake test, a small sample (10-25 mL) is collected on-site and shaken by a sample collector. After it is shaken, if there is foaming in the sample, it will be noted in the field notes. The presence of foam implies the sample is contaminated. This test is a good indicator for high concentration contamination. It may not be able to detect smaller concentrations of contaminants, so lab testing is still required.

5.2.4. Field Instrument Calibration and Sample Analysis

5.2.4.1. When water samples are being collected, the water quality meter and dissolved oxygen (DO) sensor will be checked at the beginning of each day. The Sampling Team Leader or designee shall bump check the water quality meter to ensure the sensors are within 5 percent of the calibration standards (or as specified in the work plan) for: pH 4, pH 7, pH 10, Zobell’s ORP Solution (or similar), Turbidity 0 NTUs, and Conductivity Standard 1.413 µS. If any parameter is outside 5 percent, that parameter will be calibrated and checked again.

5.2.4.2. If specified in the work plan, the photo ionization detector (PID) will be used to screen the breathing zone around the open well casing. Air monitoring data shall be recorded on a field form or in the field notebook.

5.2.4.3. Collected groundwater samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan. The Sample Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan to ensure proper QC review of each sampling event.

The following steps shall be completed when preparing for collection of groundwater samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample (e.g., peristaltic pump, bladder pumps, PFAS free submersible pumps), unless already specified in the work plan.

3. Decontaminate rental equipment prior to use (e.g., water level meter, bladder pumps, submersible pumps).
4. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
5. When sampling for PFAS compounds, the Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.

   (a) If PFAS is not the subject of the ongoing investigation, but the wells may become the subject of a PFAS investigation in the future, PFAS best-practices will be practices (e.g., Teflon-free tubing and PFAS-free equipment will be used.)

6. The Sampling Team shall don clean, powderfree nitrile gloves before each sampling event. Gloves should be changed between each discrete task in the well purging and sampling process.
7. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment entering the well shall be decontaminated prior to use. Groundwater sampling setup should be placed on HDPE or cotton sheeting on the ground or on a table, if available.
8. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.2.5. Low Flow Techniques for Groundwater

5.2.5.1. This sampling method is designed to ensure that a representative groundwater sample is collected while minimizing the volume of purge water generated. This method dictates that pre-sample purging (the removal of standing water from a well and filter pack immediately prior to sample collection) be done at very low flow rates. Low flow purging and sampling involves the use of a submerged (for water depths greater than approximately 15 feet bgs) or peristaltic pump that can be adjusted to deliver groundwater to the surface at rates from less than 100 ml per minute to a maximum of 1 liter per minute. The purpose of this technique is the recovery of representative samples of the water from the soil formation adjacent to the well screen. Stagnant water above the screen and below will not usually be purged or sampled. This technique eliminates the need for collection and costly disposal of several well volumes of groundwater as investigative derived waste (IDW) from wells containing contaminated water.

5.2.5.2. During low flow purging and sampling the pump intake is placed within the lower depths of the screened interval and the water pumped from the well is monitored for a number of water quality parameters using a flow through cell and field instrumentation. The water level will also be monitored to ensure that draw down is kept to a minimum as specified in the approved work plan. Sampling commences when the measured parameters have stabilized and turbidity is at an acceptable and constant level. Specific procedure for conducting groundwater sampling using low flow techniques are as follows:

5.2.5.3. Preparation: The steps listed in Section 5.3.1 shall be completed prior to sample collection using low flow methods.

5.2.5.4. Groundwater Sampling: Following the preparatory actions described above, the Sample Team shall complete the following steps to collect low flow groundwater samples:

1. Open well and measure depth to static water level and total depth of the well to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing using a decontaminated electronic water level meter. Record these measurements into the project specific log or electronic form or application.

Procedure # SOP ENV-03	Title: GROUNDWATER SAMPLING	Revision # 01
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: 09/15/22

2. Lower pump or tubing slowly into the well to a depth at the middle of the saturated screen section of the well. Consult the well construction log and the total measured water column in step 1 to determine depth.
3. Allow water column to equilibrate then measure static water level again, use this measurement as the reference point for drawdown.
4. Begin purging the well. Using a graduated cylinder (or similar), establish the maximum flow rate that does not cause drawdown of the well (commonly a rate between 100ml and 300ml per minute) or as specified in the approved work plan/QAPP.
5. Connect tubing through the water quality meter, record initial water quality parameters, then continue recording readings every 3 to 5 minutes, or as specified in the approved work plan/QAPP. If using an electronic form or groundwater sampling application (e.g., In-Situ low flow test) ensure all required information has been entered prior to starting the flow to the meter.
6. Monitor groundwater parameters as listed below or as specified in approved work plan. The well will be considered properly purged when all measured parameters have stabilized. Stabilization requirements will be specified in the approved work plan/QAPP or as listed below:

(a) pH:	± 0.2 pH units of prior reading
(b) Specific Conductance:	± 3% of prior reading
(c) Dissolved Oxygen:	± 10% of prior reading
(d) Eh or ORP:	± 10% of prior reading
(e) Turbidity:	± 10% of prior reading (< 10NTU)
(f) Temperature:	± 3% prior reading

7. Pumping wells dry will be avoided whenever practicable; however, if a well is pumped dry at the lowest consistent flow rate the sampler can establish, then the well is considered properly purged regardless of monitored groundwater parameters. In this case, groundwater samples will be collected when 80% of the initial well water volume is recharged.
8. Prior to collecting the sample, the flow-through cell will be disconnected from the tubing and nitrile gloves will be changed. Groundwater will be allowed to flow from the tubing into the sample container carefully to limit aeration of the sample. If preservative is present in a container, the container will not be overfilled.
9. Label each sample container with sample ID, date, time, analysis, and other information required on the sample label. Samples should be double bagged using resealable low-density polyethylene (LDPE) bags (e.g., Ziploc®). Immediately place the filled containers in the coolers(s) on ice.
10. Change gloves prior to closing the PFAS field blank bottle, if applicable.
11. Perform shake test (Section 5.2.3.5), if applicable.
12. Record sample types, amounts collected, time, and date of collection on the field form and on the monitoring well purge and sample log (**Exhibit 1**).
13. Perform post-sampling activities (Section 5.3.5).

5.2.6. *Post Sampling Activities for Groundwater Sampling*

The following steps shall be completed once groundwater sample collection is complete:

1. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
2. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
3. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.4 or as specified in the approved work plan/QAPP.
4. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2). One trip blank per cooler is required for VOC and PFAS samples. One temperature blank per cooler is required. Other

QC samples will be collected as specified in the approved work plan/QAPP and the cooler checked for their presence.

5.3. Sampling Equipment Decontamination

5.3.1. PFAS-free Water (applicable when sampling for PFAS compounds)

5.3.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.3.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project. If PFAS compounds are not the subject of investigation, distilled water will be used for decontamination purposes.

5.3.2. Decontamination Procedures

5.3.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. If applicable, use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment; otherwise use distilled water. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water (when applicable) or distilled water. When applicable, potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water (when applicable) or distilled water immediately before use.

5.3.2.2. Decontamination of reusable sampling equipment:

Upon donning a new pair of nitrile gloves, equipment will be:

1. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
2. Rinsed in a bucket of clean potable water;
3. Second rinse in a bucket of clean potable water;
4. Final rinse with laboratory-provided, "PFAS-free" water (when sampling for PFAS), or distilled water (when not sampling for PFAS);
5. All rinsate should be collected in a sealed pail for disposal.
6. For groundwater sampling, the flow-through cell and any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
7. Field equipment used at locations that are suspected of containing AFFF (i.e., those that foam during shaking) will be cleaned as per above in triplicate.

Procedure # **SOP ENV-03**	**Title:** **GROUNDWATER SAMPLING**	**Revision #** **01**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** 09/15/22

5.3.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
ASTM D6771 – 18: Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. 01 September 2018.	This practice covers the method for purging and sampling wells and devices used for ground-water quality investigations and monitoring programs known as low-flow purging and sampling.
New York State Department of Environmental Conservation (NYSDEC), 2022. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. November 2022.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1: Typical Low-Flow Groundwater Purge and Sample Logs

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a
01	09/15/22	Changed use of peristaltic pump to 15ft or less. Updated NYSDEC PFAS guidance reference.	Army request and new guidance document.

SAMPLING RECORD - GROUNDWATER

SENECA ARMY DEPOT ACTIVITY	**PARSONS**	**WELL #:**

PROJECT: ____________________

LOCATION: ____________________

DATE: __________

INSPECTORS: __________

PUMP #: __________

SAMPLE ID #: __________

WEATHER / FIELD CONDITIONS CHECKLIST (RECORD MAJOR CHANGES)

TIME (24 HR)	TEMP (APPRX)	WEATHER (APPRX)	REL. HUMIDITY (GEN)	WIND (FROM) VELOCITY (APPRX)	WIND (FROM) DIRECTION (0 - 360)	GROUND / SITE SURFACE CONDITIONS

MONITORING INSTRUMENT	MONITORING DETECTOR

WELL VOLUME CALCULATION FACTORS						
DIAMETER (INCHES):	0.25	1	2	3	4	6
GALLONS / FOOT:	0.0026	0.041	0.163	0.367	0.654	1.47
LITERS/FOOT	0.010	0.151	0.617	1.389	2.475	5.564

ONE WELL VOLUME (GAL) = [(POW - STABILIZED WATER LEVEL) X WELL DIAMETER FACTOR (GAL/FT)]

HISTORIC DATA	DEPTH TO POINT OF WELL (TOC)	DEPTH TO TOP OF SCREEN (TOC)	SCREEN LENGTH (FT)	WELL DEVELOPMENT TURBIDITY	WELL DEVELOPMENT pH	WELL DEVELOPMENT SPEC. COND
DATA COLLECTED AT WELL SITE	PID READING (OPENING WELL)	DEPTH TO STATIC WATER LEVEL (TOC)		DEPTH TO STABILIZED WATER LEVEL (TOC)	DEPTH TO PUMP INTAKE (TOC)	PUMPING START TIME
RADIATION SCREENING DATA	PUMP PRIOR TO SAMPLING (cps)			PUMP AFTER SAMPLING (cps)		

MONITORING DATA COLLECTED DURING PURGING OPERATIONS

TIME (min)	WATER LEVEL	PUMPING RATE (ml/min)	CUMULATIVE VOL (GALLONS)	DISSOLVED OXYGEN (mg/L)	TEMP (C)	SPEC. COND (umhos)	pH	ORP (mV)	TURBIDITY (NTU)

SAMPLING ORDER			PRESERVATIVES		BOTTLES		SAMPLE NUMBER	TIME	CHECKED BY/ DATE
					COUNT/ VOLUME	TYPE			

COMMENTS: (QA/QC?)

IDW INFORMATION:

Procedure # **SOP-ENV-04**	**Title:** **SURFACE WATER AND SEDIMENT SAMPLING**	**Revision #** **00**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** n/a

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting surface water and wet sediment samples for analysis during environmental investigations where PFAS compounds are part of the subject of investigation. The **SOP PFAS ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP. Surface water samples are collected using discrete sampling methods. At each surface water sample location, a flow measurement profile will be collected from the stream channel. Wet sediment samples are collected using discrete methods including scoop/trowel method, hand sediment corer method, PVC pipe method, and grab sampler method (e.g., Ponar®). This procedure does not apply to the collection of dry sediment samples, which are collected using soil sampling methods (see **SOP ENV-02, Soil Sampling**).

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Chemist	Specifies the types and quantities of samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan/QAPP. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	<u>Surface water sampling</u>: water quality meter, peristaltic pump, clean HDPE tubing, sampling bottles. <u>Sediment sampling</u>: stainless steel spoon/trowel/scoop, PFAS-free sediment corer, PVC pipe (2-inch) and cap, stainless steel bowls, grab sampler (e.g., Ponar) with winch and steel cable.
Sample containers	Appropriate, pre-cleaned, sample bottles (verified PFAS-free, when appropriate) provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.
GPS Unit	To record sample coordinates.

Procedure # SOP-ENV-04	Title: SURFACE WATER AND SEDIMENT SAMPLING	Revision # 00
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Equipment	Brief Description of Function and Purpose
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.
Water Flow Meter	To collect flow velocity and water depth.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP PFAS ENV-01 PFAS Sampling Guidance.** Additional PPE may be required for sampling personnel such as waders and personal floatation devices. Ensure that these materials that will come in contact with the sampling media do not consist of water-resistant coatings or other PFAS containing materials or substances.

5.2. General Requirements for all Sample Methods

5.2.1. *Documentation*

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, sample type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. The Sampling Team Leader or designee shall also record the sample locations using a global positioning system (GPS) unit (e.g., tablet, Trimble® GeoXT™ or similar) and document sample coordinates on the Field Sampling form (**Exhibits 2 and 3**). The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. *Sample Handling and Shipment*

The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, QAPP and **SOP PFAS ENV-01 PFAS Sampling Guidance**. The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.3. *Sample Analysis and Quality Control Samples*

Collected samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event.

5.2.4. *Field Instrument Calibration and Sample Analysis*

When surface water samples are being collected, the water quality meter and dissolved oxygen (DO) sensor will be checked at the beginning of each day. The Sampling Team Leader or designee shall bump check the water quality meter to ensure the sensors are within 5 percent of the calibration standards (or as specified in the work plan) for: pH 4, pH 7, pH 10, Zobell's ORP Solution (or similar), Turbidity 0 NTUs, and Conductivity Standard 1.413 µS. If any parameter is outside 5 percent, that parameter will be calibrated and checked again.

5.3. Sampling Methods for Surface Water

Surface water includes all water on the surface of the ground directly exposed to the atmosphere, including, but not limited to, lakes, ponds, reservoirs, artificial impoundments, streams, rivers, springs, seeps, and wetlands.

Surface water samples may be collected using various sampling equipment dependent upon the type of surface water being sampled. For pond and lake sampling a pond sampler may be required to collect the sample two to three feet from the bank. Pond samplers generally comprise of a large stainless steel scoop or dipper bolted to a pole. For sampling in a stream or river the sampler can wade to the location and use a stainless steel bowl or the laboratory provided bottleware (if no preservative is present). If wading is not permitted a pond sampler or peristaltic pump may be used from the bank.

If collecting paired surface water/wet sediment samples the surface water sample shall be collected before the wet sediment sample, unless otherwise specified in the work plan. Surface water/wet sediment samples shall also be collected beginning at the location furthest from the contamination source (e.g., downstream) and working to most likely contaminated location to prevent cross contamination of samples by sediments suspended during sample collection.

5.3.1. Preparation for Surface Water Sampling

The following steps shall be completed when preparing for collection of surface water samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample (e.g., stainless-steel dipper, pond sampler), unless already specified in the work plan.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powderfree nitrile gloves before each sampling event.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment utilized shall be decontaminated prior to use.
7. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.3.2. Collection of Surface Water Samples

Following the preparatory actions (Section 5.3.1), the Sampling Team shall complete the following steps to collect surface water samples:

1. With minimal surface disturbance, submerge the appropriate sample collection container. The mouth of the container will be facing upstream (if applicable).

(a) The sample location in the water column should consider the potential stratification of PFAS in solution and their tendency to accumulate at the air/water interface. If possible, the transfer container will be lowered sufficiently below the water surface but above the bottom sediments. Sampling of foam should be avoided unless it meets project objectives.

(b) Transfer containers, such as beakers or dippers, which may be attached to extension rods, should be used if sample containers have preservatives. Sampling by direct sample container immersion is not recommended.

2. The sampler, if wading, will remain downstream of the sample collection point. Downstream samples will be collected prior to upstream samples.
3. Care will be taken not to disturb bottom sediments. Allow the device to fill slowly and continuously. If disturbed, wait until the sediment settles.
4. Fill sample containers directly from the sampling device.
5. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
6. Once sample has been collected, submerge a water quality meter in the sample location and record the water parameters including temperature, pH, conductivity, ORP, DO, and turbidity or as specified in the work plan/QAPP.
7. Perform post-sampling activities (Section 5.3.3).

5.3.3. *Post Sampling Activities for Surface Water Sampling*

The following steps shall be completed once surface water sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.3.4. *Open Channel Flow Measurement*

The volume rate of flow of water in open channels can be determined using the flow velocity and cross-sectional area and computing the discharge therefrom. The following steps shall be completed once surface water sampling is complete. Test methods will follow ASTM D3858:

1. Using an outstretched measuring tape, the field team shall set up a horizontal profile across the length of the surface water body where the surface water sample was collected.
2. Using a velocity flow meter (e.g., OTT® electromagnetic current meter), stream flow will be measured at various distances along the horizontal profile and at various depths within the stream channel (as defined in ASTM D3858 or as calculated in real-time by the field instrument).
3. The Sampling Team Leader shall download stored data from the flow meter.
4. Alternatively, if the water depth is too shallow or velocities to slow, the float-area method can be used to determine stream discharge.

5.4. Sampling Methods for Wet Sediment

Wet sediment is defined as material of organic or mineral origin that is transported by, suspended in, or deposited from water. This SOP applies to the collection of sediment samples only in surface water bodies such as streams, rivers, ditches, ponds, lagoons, and wetlands. Sediment samples will only be collected as discrete samples.

Sediment samples may be collected using a variety of methods and equipment depending on the depth of water above the sediment and the type of sediment being collected. Sediments may range from very soft to dense. Hand corer method is best used for firm sediment, soft sediment can be collected using the PVC tube method, and very soft sediment can be collected using a stainless steel scoop or PVC/HDPE disposable trowel. For sediment being collected from a boat in deeper water (e.g. a lake or pond) PONAR or Van Veen type grab samplers can be used.

Most core and grab sampling devices are constructed of stainless steel. Some core samplers include an HDPE sleeve inserted in the core barrel to retain the sample.

If collecting paired surface water/wet sediment samples the surface water sample shall be collected before the wet sediment sample, unless otherwise specified in the work plan. Surface water/wet sediment samples shall also be collected beginning at the location furthest from the contamination source (e.g., downstream) and working to most likely contaminated location to prevent cross contamination of samples by sediments suspended during sample collection.

5.4.1. Preparation for Wet Sediment Sampling

The following steps shall be completed when preparing for collection of wet sediment samples:

1. The Sampling Team Leader shall review the applicable section(s) of the work plan to confirm the sample location, quantities, required sample containers, filters and other relevant information.
2. The Sampling Team Leader shall determine the optimal type of sampling equipment required to collect the sample, unless already specified in the work plan.
3. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
4. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
5. The Sampling Team shall don clean, powder free nitrile gloves before each sampling event.
6. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment utilized shall be decontaminated prior to use.
7. The Sampling Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.4.2. Collection of Wet Sediment Samples – Scoop/ Trowel Method

5.4.2.1. The scoop/trowel method is best suited for sample collection in shallower water with easy access to sediments. If wading to the sample location, care shall be taken to not stir up the sediment in the collection area. The preferred sampling tools for this method are stainless steel or disposable spoons, trowels, or scoops.

5.4.2.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect wet sediment samples using the scoop/trowel method:

1. If collecting the sample in a stream, stand downstream of the sample location. Insert the sampling tool 6-inches and gently scoop the sample out of the water.
2. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan/QAPP, the sample will be homogenized in a bowl prior to placement into sample containers.

3. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
4. Perform post-sampling activities (Section 5.4.6).

5.4.3. Collection of Wet Sediment Samples – Hand Corer Method

5.4.3.1. The hand corer method is best suited to the collection of firm sediment samples. The preferred sampling tool for this method is a stainless steel sediment corer. Using these in conjunction with disposable acetate sleeves is preferred because this facilitates removal of the sample from the corer, though this is not required.

5.4.3.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the hand corer method:

1. Gently push the corer into the sediment with a smooth continuous motion to a depth of approximately 6 inches (or as specified in the work plan/QAPP).
2. Twist the corer to detach the sample, and then withdraw the corer in a single smooth motion.
3. Remove the top of the corer and slowly decant excess water; however, take care to avoid the loss of collected fine sediment.
4. Remove the nosepiece and deposit the sample into a stainless-steel bowl.
5. Decant again if necessary, again taking care to avoid the loss of collected fine sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan/QAPP (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.4. Collection of Wet Sediment Samples – PVC Pipe Method

5.4.4.1. The PVC pipe method can be used for to collect samples of loose sediment where water is too deep for the scoop/trowel method to be used. The preferred sampling tool for this method is a 2-inch diameter PVC pipe with air-tight cap.

5.4.4.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the PVC pipe method:

1. Gently push the PVC tube into the sediment with a smooth continuous motion to a depth of approximately 6 inches (or as specified in the work plan/QAPP).
2. Tightly secure the cap on the end of the pipe extruding from the water. This forms an airtight seal that when the tube is gently pulled from the sediment, causes a vacuum to hold the sediment in place.
3. Once the tubing is out, tilt the bottom into an upright position. Slowly and carefully decant excess water; however, take care to avoid the loss of collected fine sediment.
4. Deposit the sample into a stainless-steel bowl.
5. Decant again if necessary, again taking care to avoid the loss of collected fine sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel trowel or scoop). If specified in the work plan (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.5. *Collection of Wet Sediment Samples – Grab Sampler Method*

5.4.5.1. Sediment grab samplers (e.g., Ponar and Van Veen - see **Exhibit 1**) can be used to collect wet sediment samples in deeper waters where other methods are unsuitable. These samples are collected by sampling teams in boats or from locations adjacent to the waterbody (e.g., jetties or other platforms). Grab samplers most commonly use a set of spring-loaded jaws that snap shut when lowered into the sediment. They are often equipped with mesh screens and rubber flats that cover the jaws, limiting the wash out and loss of fine sediments from the sample. Sediment grab samplers can be attached to a winch and lowered through the water to the sediment on steel cables or they can be manually lowered using ropes or cables.

5.4.5.2. Following the preparatory actions (Section 5.4.1), the Sampling Team shall complete the following steps to collect sediment samples using the grab sampler method:

1. Position the grab sampler above the sample location.
2. Make sure the sampler is in locked position (jaws open) and slowly lower down until the sampler triggers. Take care to keep the line tight to prevent an early trigger of the jaw caused by a slack line. (The device will be retrieved and reset if the jaw mechanism triggers early.)
3. Slowly retrieve the sampler by retracting the line by hand or using a hand winch. The grab sampler shall be retrieved at a steady rate to minimize the loss of fine sediments from the sample.
4. Once out of the water, rotate the grab sampler slowly over the deck of the boat and deposit the sample into a large stainless-steel or disposable bowl.
5. If necessary, decant surface water from the bowl; however, take care to avoid the loss of collected sediment.
6. Transfer the sample into sample containers using an approved sampling tool (e.g., stainless steel or disposable spoon, trowel, or scoop). If specified in the work plan (except for volatile analysis samples), the sample will be homogenized in a bowl prior to placement into sample containers.
7. When sample containers are filled, secure the caps tightly on the containers and place on ice as soon as possible (if required by sample preservation method).
8. Perform post-sampling activities (Section 5.5).

5.4.6. *Post Sampling Activities for Sediment Sampling*

The following steps shall be completed once wet sediment sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall record the sample location GPS coordinates.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.5 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.5. Sampling Equipment Decontamination

5.5.1. *PFAS-free Water*

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water, as appropriate;
6. Final rinse with deionized or distilled water;
7. All rinsate should be collected in a sealed pail for disposal.
8. For surface water sampling, the flow-through cell and any non-dedicated equipment (i.e., interface probe) that comes into contact with water should be decontaminated between uses.

5.5.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC’s Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

7. EXHIBITS

Exhibit 1

PONAR and Van Veen Grab Samplers


Ponar Sediment Sampler


Van Veen Sediment Sampler

Exhibit 2: Surface Water Sampling Form (attached)

Exhibit 3: Sediment Sampling Form (attached)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a

PARSONS
SURFACE WATER SAMPLING RECORD

SITE NAME: ______________________

PROJECT NUMBER: ______________________

SAMPLING DATE / TIME: ______________________

WEATHER: ______________________

SAMPLERS: __________ of __________

__________ of __________

SAMPLE ID: ______________________

SAMPLING METHOD: ______________________

DEPTH OF SAMPLE: ______________________

DESCRIPTION OF SAMPLING POINT

LOCATION: ______________________

PHYSICAL APPEARANCE: ______________________

DEPTH TO BOTTOM: ______________________

DRAINAGE DIRECTION: ______________________

UPSTREAM FROM: ______________________

DOWNSTREAM FROM: ______________________

SAMPLE DESCRIPTION

COLOR: ______________________

ODOR: ______________________

SUSPENDED MATTER: ______________________

OTHER: ______________________

FIELD TESTS

TEMPERATURE:	__________	REDOX:	__________
pH:	__________	DISSOLVED O2:	__________
CONDUCTIVITY:	__________	OTHER:	__________

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: ______________________

QA/QC SAMPLE ID: ______________________

ANALYZE QA/QC SAMPLES FOR: ______________________

DATE/TIME REFRIGERATED: ______________________

CHAIN OF CUSTODY NUMBER: ______________________

SHIPPED VIA: ______________________

LABORATORY: ______________________

COMMENTS / MISCELLANEOUS

____

____

____

PARSONS
SEDIMENT SAMPLING RECORD

SITE NAME: ______________________________

PROJECT NUMBER: ______________________________

SAMPLING DATE / TIME: ______________________________

WEATHER: ______________________________

SAMPLERS: ______________ of ______________

______________ of ______________

SAMPLE ID: ______________________________

SAMPLING METHOD: ______________________________

DEPTH OF SAMPLE: ______________________________

DESCRIPTION OF SAMPLING POINT

LOCATION: ______________________________

PHYSICAL APPEARANCE: ______________________________

DEPTH OF WATER: ______________________________

DRAINAGE DIRECTION: ______________________________

UPSTREAM FROM: ______________________________

DOWNSTREAM FROM: ______________________________

SAMPLE DESCRIPTION

TEXTURE: ______________________________

COLOR: ______________________________

ODOR: ______________________________

OTHER: ______________________________

FIELD TESTS

TEMPERATURE:	______________	REDOX:	______________
pH:	______________	DISSOLVED O2:	______________
CONDUCTIVITY:	______________	OTHER:	______________

SAMPLE ANALYSIS / QA/QC / CHAIN OF CUSTODY

ANALYZE FOR: ______________________________

QA/QC SAMPLE ID: ______________________________

ANALYZE QA/QC SAMPLES FOR: ______________________________

DATE/TIME REFRIGERATED: ______________________________

CHAIN OF CUSTODY NUMBER: ______________________________

SHIPPED VIA: ______________________________

LABORATORY: ______________________________

COMMENTS / MISCELLANEOUS ______________________________

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Procedure # **SOP ENV-05**	**Title:** **MONITORING WELL DEVELOPMENT**	**Revision #** **00**
Effective Date: 04/20/2022	**Approved By:** Todd Belanger	**Last Revised:** n/a

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when developing monitoring wells prior to groundwater sample collection. Proper development procedures are necessary to assure the quality and integrity of the samples. If the wells are to be sampled for PFAS or suspected to be sampled in the future for PFAS, the **SOP ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Site Manager	Responsible for ensuring that the work is performed in conformance with this procedure and that the field personnel understand and perform activities in accordance with this SOP.
Field Geologist or Environmental Scientist	Responsible for continuous monitoring of development activities, collecting water quality data and determining that the development is complete.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Development Tools	PFAS free submersible pump, HDPE tubing, and surge block/swabbing tool.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.
GPS Unit	To record well coordinates.
Water Quality Meter	To measure water quality parameters: temperature, pH, conductivity, turbidity, DO and ORP or as specified in the approved work plan/QAPP.
Water Level Indicator	To measure depth to static water level and total depth of well.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Field Geologist or designee shall complete the attached well development log (**Exhibit 1**) or project-specific form. Information to document includes:

1. Total depth of well and the static water level from top of the well casing, before and immediately after pumping/development.
2. Method used for well development including description (size, type, make, etc.) of all equipment used during development.
3. Time spent developing the wells by each method and typical pumping rate(s).
4. Volume and physical characteristics of the purged water including written descriptions of water clarity, color, particulates, and odor.
5. Readings of turbidity, pH, conductivity, and temperature taken before, during, and after well development.

5.2.1.2. The Field Geologist or designee shall record daily activities, instrument bump check and/or calibration activities, groundwater parameters, and any other notable details in the Field Sampling Form and/or project specific forms. The Field Geologist or designee shall also record the sample locations using a GPS unit (e.g., Trimble® GeoXT™ or similar) and document sample coordinates in the Field Sampling Form. The Field Geologist or designee shall record other information as specified in the approved work plan/QAPP.

5.3. Well Development

Monitoring wells are developed to remove or minimize the near-well-bore formation damage caused by drilling and the addition of well drilling fluids, and to remove fines from the filter pack. New wells shall not be developed before 48 hours after completion when a cement bentonite grout is used to seal the annular space, but shall be developed within seven days of well installation or as otherwise specified in the approved work plan/QAPP. Following development, the monitoring wells will be allowed to equilibrate for a minimum of 72 hours prior to groundwater sampling.

5.3.1. Preparation for Well Development

The following steps shall be completed when preparing for well development:

1. The Field Geologist shall review the applicable section(s) of the work plan to confirm the details of the activity to be conducted.
2. The Field Team shall don clean gloves before each sample.
3. The Field Team shall calibrate all necessary equipment and document the calibration(s) on an equipment calibration form.

4. The Field Team shall arrange the required sampling equipment for convenient use. If onsite decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the wellhead. All equipment entering the well will be decontaminated.

5.3.2. Well Development

The following steps shall be completed when during well development:

1. Open well and collect PID reading (if required in approved work plan/QAPP). Measure depth to static water level and total depth of the well using an electronic water level meter. Record these measurements into the project specific log or electronic form or application.
2. Calculate three well volumes of standing water in the well bore using the following:
   - (a) **4-inch diameter wells**: well bore water column height (ft.) x 0.65 x 3 (volumes) = gallons of water to be removed.
   - (b) **2-inch diameter wells**: well bore water column height (ft.) x 0.16 x 3 (volumes) = gallons of water to be removed.
   - (c) **Volume of water in the filter pack**: 3 volumes x well bore column water height from the top of sand pack to the bottom of screen (ft.) x (R1-R2) x 3.14 x 0.3, where R1 is the borehole radius and R2 is the well screen radius. This assumes 30 percent porosity.
   - (d) **If water was added during the drilling process**: 3 times the volume of water during drilling within the vertical interval that starts at the top of the sand pack and ends at the bottom of the screen should be removed from the well during development.
   - (e) **If the filter pack was installed as a slurry**: 3 times the amount of water used in the slurry should be removed from the well.
   - (f) All calculations shall be recorded on the well development log.
3. If light non-aqueous phase liquids (LNAPLs) are suspected, use a clear bailer to collect water from the surface of the well. If the well contains LNAPL, measure and record it using an oil-water interface meter. The monitoring well will not be developed if separate phase liquids are present.
4. Begin development by pumping/bailing and swabbing (using a loose fitting surge block) to surge the water to pull sediment into the well.
5. If excessive turbidity is expected, use a bottom-opening bailer to remove water and to reduce the turbidity level. Once turbidity level has been lowered to an appropriate level begin pumping using a submersible pump.
6. Start the pumping from the bottom of the well, but periodically move it up and down within the screened zone to ensure adequate development of the entire filter pack. Keep the pumping rate constant and record and collect drawdown measurements.
7. Record water quality parameters (temperature, pH, conductivity, and turbidity or as specified the work plan/QAPP) at the start of the development and after every borehole volume removed from the well.
8. Continue development until the water is clear (turbidity ≤50 NTUs) or three consecutive turbidity readings are within 10% and the other field parameters (temperature, pH, and conductivity) have stabilized (pH ±0.2 units, temperature± 1° Centigrade, and conductivity 10%).
   - (a) If the well goes dry during development, it will be allowed to recharge to 80% of initial water level and pumped or bailed again. The well will be considered developed after pumping the well dry three times.
9. If field parameters have not stabilized after five borehole volumes of water have been removed, the Field Geologist will contact the Site Manager to determine further action.

10. Record the final water level and note the drawdown rate and pumping rate used. If static water level not recovered to the initial water level, another static water level measurement should be collected in 24 hours.
11. Development water will be discharged to the ground surface unless contamination of the groundwater is known to be present, in which case alternate disposal methods will be considered. Well development water should be directed away from surface water bodies and allowed to infiltrate back into the ground unless other techniques are stipulated on a site-specific basis.

5.3.3. *Post Development Activities*

The following steps shall be completed once well development is complete:

1. The Field Team Leader or designee shall close and lock the well.
2. The Field Team Leader or designee shall properly store and label purge water, if necessary, and record the total volume removed from the well during development.
3. The Field Team Leader or designee shall decontaminate reusable equipment following procedures outlined in Section 5.4 or as specified in the approved work plan.

5.4. Sampling Equipment Decontamination

5.4.1. *PFAS-free Water*

5.4.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.4.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.4.2. *Decontamination Procedures*

5.4.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.4.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;

3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. For surface water sampling, the flow-through cell and any non-dedicated equipment (i.e. interface probe) that comes into contact with water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e. those that foam during shaking) will be cleaned as per above in triplicate.

5.4.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.

7. EXHIBITS

Exhibit 1: Well Development Log (attached)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	04/20/2022	Initial Release	n/a

WELL DEVELOPMENT LOG

Well ID:

Date ____________________ Field Personnel ____________________ Weather ____________________

Site Name ____________________ Contractor ____________________ Project No. ____________________

Site Location ____________________ Evacuation Method ____________________ ____________________

Well information:

Depth to Bottom (Initial) * ____________ ft. Date(s) Installed ____________________ Date(s) Developed ____________

Depth to Bottom (Final)* ____________ ft. Driller ____________________ Development Time Start: ____________

Depth to Water (Initial)* ____________ ft. Well Diameter ____________ in. Stop: ____________

Depth to Water (Final)* ____________ ft. Casing Volume ____________ gal. Total: ____________

* Measuring point ____________ Pump setting* (intake) ____________________

Well Volumes	Volume of Water Removed (Gallons)	Temperature ^{o}C	pH s.u	Conductivity mS/cm	Turbidity (NTU)	Approximate Flow Rate (gal/min)	Depth to Water (ft.)	Appearance of Water
Start								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Development Water Characteristics:

Total volume of Development water removed: ____________________

Physical appearance at start		Physical appearance at end	
Color	____________	Color	____________
Odor	____________	Odor	____________
Sheen/Free Product	____________	Sheen/Free Product	____________

NOTES: ____

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____

____

____

Geologist Signature: ____

Procedure # SOP ENV-06	Title: SOIL BORINGS AND MONITORING WELL INSTALLATION	Revision # 00
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: n/a

1. PURPOSE

This standard operating procedure (SOP) establishes guidelines and procedures for use by field personnel in advancing borings using direct push, hollow stem auger, and rotosonic drilling and for the activities performed during evaluation of the drilled soil (core). The SOP also defines the requirements and procedures for the installation of permanent groundwater monitoring wells that can provide representative groundwater samples. The procedures listed in this SOP can be followed after any borehole method (direct push, sonic, auger, etc.) as specified in the approved Work Plan or QAPP. Proper execution of these activities is necessary to ensure that each boring is adequately evaluated and to assure the quality and integrity of all samples. When installing borings or wells that will be used to sample PFAS compounds or there is the potential to sample PFAS compounds, SOP ENV-01 PFAS Sampling Guidance provides an in-depth discussion of prohibited and approved materials and should be reviewed and used in conjunction with this SOP.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Site Manager	Responsible for ensuring that the work is performed in conformance with this procedure and that the field personnel understand and perform activities in accordance with this SOP.
Field Geologist	Responsible for oversight of drilling activities and for logging soils encountered during advancement of the borehole. The Field Geologist is also responsible for continual inspection and documentation of well construction process including materials to be used, continuous construction activities (insure targeted annular material intervals and well screen locations are achieved), and oversight of the wells surface completion as per the work plan specifications.
Drilling Contractor	The drilling contractor is responsible for ensuring that field personnel are properly trained in drilling techniques and construction of groundwater wells.

3. RELEVANT DEFINITIONS

Term	Definition
Tagging	When the driller uses a weighted tape measure to continually measure the well materials (e.g., filter pack, bentonite, grout) as it is poured to ensure the correct amount of materials are used and to keep the materials from bridging during the construction.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Well Construction Materials	PVC riser and slotted screen, filter pack, sealing and grouting materials, surface pad construction material.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof fieldbooks.

Equipment	Brief Description of Function and Purpose
Logging Instruments	Borehole logging and well construction forms, hand lens, USCS classification card, Munsell color chart, digital camera, razor knife, tape measure, and HDPE plastic or cotton sheeting.
GPS Unit	To record coordinates of borehole.
Water Level Indicator	To measure depth to static water level and total depth of well.

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products to be used will follow the guidance provided in **SOP ENV-01 PFAS Sampling Guidance**.

5.2. General Requirements for all Boring Methods

5.2.1. Documentation

The Field Geologist or designee shall record the description of the cores in the Drilling Log Form (**Exhibit 1**) or equivalent electronic boring log per American Society for Testing and Materials (ASTM) standard D 2488 and will also include field screening values for VOCs (if required), drilling time and the footage for each core run, a graphic log, and drill rig specifications. Well construction details will be documented in the Well Construction Form (**Exhibit 2**) or equivalent electronic well construction log. The Field Geologist or designee shall record daily activities including equipment calibration, samples collected (if required per work plan), and any other notable details on the Field Sampling Forms and/or project specific forms.

5.3. Soil Boring Installation

5.3.1. Preparatory Steps for Soil Borings

The following steps shall be completed when preparing for collection of surface soil samples:

1. The Field Geologist shall review the applicable section(s) of the work plan to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Field Geologist shall confirm that the Drilling Contractor is complying with **SOP ENV 01 PFAS Sampling Guidance**, as applicable.
3. The Field Geologist will obtain any necessary excavation permits and, if necessary, contact a local underground utility locating service to perform a utility clearance for all subsurface sample locations.
4. The Field Geologist will navigate to the boring location, make initial observations, and complete the required documentation.
5. The Field Geologist or designee shall record the description of the cores per modified Burmister System or ASTM standards D2487 (USCS)/D2488 in the Drilling Log Form and will also include field screening values for VOCs (if required), drilling time and the footage for each core run, a graphic log, and drill rig specifications.

Well construction details will be documented in the Well Construction Form portion of the electronic log or equivalent paper form. The Field Geologist or designee shall record daily activities including equipment calibration, samples collected (if required per work plan), and any other notable details in the Drilling Log Form and/or project specific forms.

6. The Sample Team shall don clean, powderfree nitrile gloves as per the **SOP ENV 01 PFAS Sampling Guidance.**
7. The Sample Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. The team shall prepare an area for logging and related activities. HDPE plastic sheeting or a clean, washed cotton sheet shall be laid out to set the drill core on. The area should be large enough for the full length of the boring but should also not intrude on the drilling activities.
8. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the boring. All equipment entering the well will be decontaminated prior to advancement and will be free of any petroleum-based materials including fuels, oils, grease, or solvents. With the exception of Hole Products - Thread Armour Thread Joint Compound, no thread lubricants or drilling fluids are permitted without prior approval of the Contractor.
9. The Sample Team shall calibrate required equipment and document the calibration on an equipment calibration form.

5.3.2. Soil Boring Operations

Following the preparatory actions (see above), the Field Team and driller shall complete the following steps:

1. As the driller advances the borehole, soil cores will be collected continuously from the ground surface to the bottom of the boring using the selected drilling method (as specified in the work plan/QAPP) operated by an appropriately licensed well driller.
2. Cores will be collected in 2-foot splits spoons (HSA), 5- or 10-foot runs (e.g., sonic, to ensure cores are more representative of the actual formation) or as specified in the approved work plan/QAPP.
3. Water and other drilling fluids should not be used while drilling. If fluids must be introduced into the borehole (e.g., rock coring) their use must be approved by the Site Manager. Water must be from a site approved water source and the amount used on each location will be recorded for well development purposes later.
4. When a core is completed, the drill crew will label the depths on the bottom end of each core section.
5. Each core section will be screened by the field geologist using a PID and recorded on the borehole log (if required per the approved work plan/QAPP).
6. The Field Geologist will perform geologic logging of the core as per modified Burmister System or ASTM standards D2487 (USCS)/D2488.
7. The Field Geologist will also document additional details as described in Section 5.2.1.
8. If samples are required, they will be collected and handled in accordance with **SOP ENV-02, Soil Sampling**, or as otherwise specified in the approved work plan/QAPP.

5.3.3. *Bedrock Operations*

Bedrock descriptions are dependent on the classification of the rock types present (igneous, sedimentary, or metamorphic). The rock materials retrieved during coring operations will be described on the Bedrock Core Form (Exhibit 3), as applicable, using the following parameters:

1. Color – The overall color of the rock, not a particular mineral;
2. Grain Size – The size of crystals or clasts making up the rock;
3. Texture – This applies only to igneous and some metamorphic rocks, and pertains to whether the rock is crystalline or glassy, equigranular, or porphyritic in nature;
4. Major Minerals – Applies to the identifiable minerals present as necessary as modifiers to the rock type, i.e., mica Schist, feldspathic Granite, quartz-mica Gneiss;
5. Rock Type – Granite, Gneiss, Amphibolite, Argillite, Sandstone, Limestone, Greywacke, etc;
6. Bedding and/or Foliation – Describes lineations within the rock. i.e. massive, poorly foliated, well bedded, cross-bedded, etc. The description in the log will include at least an approximate angle of any foliation or bedding, if present;
7. Continuity – Describes joints and fractures, or the lack of, in the rock, it may also describe cross-cutting veins of materials different from the primary rock type. Fracture, vein and joint angles will be referenced to the foliation. Approximations will be made based on core recovery, weathering, fracture density, etc., regarding the openness of any fracture or joint;
8. Competence – Describes the weathering features of the rock. Weathering features, combined with rock type and continuity, will give the overall hardness of the rock; and
9. Other – Describes secondary minerals, folding features, etc.

Both the overall core length as well as individual pieces of core (greater than 4 inches in length) will be measured. This data is used for the calculation of Rock Quality Designation (RQD) factors and for the interpretation of fracture spacing (per ASTM D6032). Core recovery will be recorded in two manners: as the ratio of core recovered to length of core run; and, as a percentage recovery. (i.e., 3.5 feet of 5.0 feet cored, 70%). The RQD will be calculated by: 1) summing the length of all the pieces greater than or equal to 4 inches in length recovered in the core barrel; and then, 2) by dividing this sum by the cored interval length. The resulting value is expressed as a percent and is recorded on the Bedrock Core Form (Exhibit 3).

Every reasonable attempt will be made to recover the correct orientation of the core samples. Each core will be measured for recovery, and an attempt to identify any missing sections will be made with the driller. Where the core is broken and fragmented, an attempt to reposition the correct orientation of the segments will be made before marking the core. While still in the core barrel, the core sample will be marked with a pair of differently colored (red and black) ceramic marking pencils in a fashion that results in a continuous parallel line down the length of the core. The red marking will be on the right side of the parallel lines when viewing the core from top to bottom. The coloration scheme will allow any piece of core to be correctly oriented in the vertical plane (red on right side). Marked rock cores will be stored in standard core boxes, and missing sections of the core replaced with spacers. Both the core box base and core top will be appropriately labeled with the well identification, core depth, date, and geologic formation origin. Additionally, the core box base will be sufficiently labeled so the top and bottom of the core are clearly evident. Depths for each 2-foot broken interval should be written on the core box base in a relative position that corresponds with the dividers. Spacers will be labeled with the missing interval or sampling information and appropriately positioned within the retrieved core.

5.3.4. *Post Drilling Activities*

The following steps shall be completed once the boring and any associated soil sample collection is complete:

1. The Sample Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.

2. The Sample Team Leader or designee shall record the sample location GPS coordinates.
3. If a well is to be installed, the Field Team shall follow the procedures described in Section 5.4. If the boring is to be abandoned the following procedures shall be completed:
    - (a) The casing will be filled with grout or bentonite grout slurry (as specified in the work plan/QAPP). The grout will extend from the bottom of the borehole (total depth) to ground surface.
    - (b) The grout will be a bentonite grout slurry mixed according to the specifications of the manufacturer (typically 14 gallons of water to a 50 pound bag of bentonite powder will produce 2.2 cubic feet of 30% solids grout slurry) or as specified in the work plan/QAPP.
    - (c) The grout slurry will be pumped through a tremie pipe to the bottom of the open annulus until undiluted grout is returned to the surface to ensure the seal is complete; and
    - (d) Additional slurry or chips will be added to the annulus the following day (to surface) should the grout column settle overnight.
4. The Sample Team will decontaminate reusable sampling equipment as described in Section 5.5 or as otherwise specified in the approved work plan/QAPP.
5. The Sample Team Leader or designee shall complete the CoC and other required documentation and prepare the sample for shipment following procedures outlined in SOP ENV-02, Soil Sampling.

5.4. Well Installation

5.4.1.1. Groundwater monitoring wells should be constructed with materials that will not interfere with sample quality either by contributing contaminants or by sorbing contaminants already present. Further, construction materials must be compatible with (i.e., not degraded by) contaminants present in soil or groundwater (i.e., PFAS). Materials should follow the PFAS guidance provided in **SOP ENV-01, PFAS Sampling Guidance**.

5.4.1.2. Groundwater monitoring wells may serve as preferential pathways for contaminant migration between aquifers or from the surface to the subsurface if they are not constructed properly. Construction procedures and standards must ensure that neither passive nor active introduction of contaminants can occur. Properly installed hydraulic seals and locking well covers (or site security) reduce the potential for introduction of contaminants to monitoring wells. All monitoring wells will be constructed to meet: State requirements; USACE requirements; the United States Environmental Protection Agency (USEPA) RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD); and Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. General procedures of ASTM D5092 are provided below.

5.4.1.3. Well depths and screen placements will depend on the site-specific geologic conditions. These specifications will be provided in the site-specific work plan.

5.4.2. Preparatory Steps for Well Installation

The following general steps shall be completed when preparing for well installation:

1. The Field Geologist shall review the applicable section(s) of the work plan/QAPP and **SOP ENV-01 PFAS Sampling Guidance** to confirm the sample location, quantities, required sample containers, and other relevant information.
2. The Field Team shall don clean, powderless nitrile gloves before each sampling event.
3. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the boring. All equipment entering the well will be decontaminated prior to

advancement and will be PFAS-free and free of any petroleum-based materials including fuels, oils, grease, or solvents.

4. The Field Team shall calibrate required equipment and document the calibration on an equipment calibration form.
5. The Field Team shall verify the correct quantity and type of well construction materials are onsite including:

    (a) New threaded flush-jointed riser pipe and slotted screen of an approved material (at a minimum schedule 40 polyvinyl chloride [PVC] or as specified in the work plan/QAPP, 4-inch or 2-inch diameter) in 5- and 10-foot lengths. (Note: no Teflon tape, solvents, glues or lubricants are permitted.) Wells with total depths greater than 100 feet below ground surface will need to be evaluated to determine what schedule of PVC is appropriate based on-site conditions.
    (b) Stainless steel or PVC well centralizers, as necessary (typically every 20-30 feet).
    (c) Filter pack material (quartz sand) larger than the slot size of the screen (0.010-inch or 0.020-inch as determined by the work plan/QAPP). The filter pack shall be certified free of contaminants by the vendor or contractor.
    (d) Pre-packed well screens are recommended if installing wells with direct push.
    (e) If the slot size is not specified in the work plan or known from previous work at the site, 0.010-inch slot will be used to be conservative.
    (f) Well seal materials (bentonite pellets, chips)
    (g) Well grouting materials (bentonite or cement slurry) and tremie pipe
    (h) Well surface pad materials (Portland cement [ASTM Types II or V])
    (i) Steel protective casing with locking cap (stand up or flush mount as specified in the work plan/QAPP).
    (j) All PVC will conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System)

5.4.3. Single Well Installation Operations (Permanent, Overburden Monitoring Well)

Following the preparatory actions (see above), the Field Team and driller shall complete the following steps:

1. The drill crew will cap the bottom of a new 10-foot section of PVC screen with a flush, threaded PVC cap. The screen will then be installed cap first with the full length below the water table. If LNAPL is anticipated the screen will be installed with approximately 3 feet of the screen above the static water level and the remaining seven feet below the water table (or as specified in the work plan/QAPP). The well screen will be a 0.010-inch or 0.020-inch slotted depending on the soil formation.
2. The screen will be lowered using threaded flush-jointed riser attached to the top of the screen. The riser will extend from the top of the screen to ground surface or as specified in the work plan.
3. A loose-fitting PVC cap will be used to cover the top of the well riser and will allow equilibration of the groundwater with atmospheric pressure.
4. For wells deeper than 20ft, at least one centralizer will be installed just above the well screen to keep it centered during well construction.
5. Once the screen, riser and centralizer are in place, the drill crew will tremie pour filter pack material using a decontaminated, flush threaded, 1-in. [25-mm] minimum internal diameter tremie pipe. Alternatively, the filter pack may be added directly between the riser pipe and the auger or drive/temporary casing and the top of the filter pack located using a tamper or a weighted line. The borehole should be at least 2 inches greater than the OD of the well casing and a calculated volume of the filter pack annular space and volume of the emplaces sand shall be recorded.
6. The primary filter pack will extend from a minimum of 6-inches below the screen to 20% of the screen length or 2 feet above the above the top of the screen, unless conditions warrant less.

   (a) The filter pack will not cross two water-bearing units.
   (b) The volume of filter pack required to fill the annular space will be calculated and compared to the volume installed. This information will be recorded in the electronic boring log.
   (c) Pre-packed well screens are recommended if installing wells with direct push.

7. A finer grained “choke” sand (100% passing a No. 30 sieve and less than 2% passing the No. 200 sieve) approximately 1-2 feet thick (as conditions warrant) will be installed between the top of the sand pack and the bentonite seal described below.
8. The drill crew will continuously tag the filter pack as it is being installed; any bridging will be broken prior to proceeding. The filter pack will then be surged prior to placing the seal. If the difference of volume of filter pack calculated and filter pack used is significant the Site Manager will be notified.
9. Once the filter pack is complete a bentonite seal will be installed.
10. The bentonite seal will be a minimum thickness of 3 feet placed above the filter pack between the filter pack and the grout slurry.

   (a) If the seal is above the water table, the bentonite will be pre-hydrated and installed in 6-inch lifts; if it is below the water table, sealed bentonite chips will be used. The driller will also continuously tag the bentonite as it is being installed to prevent bridging.
   (b) In wells designed to monitor possible contamination in firm bedrock, the bottom of the bentonite seal should be located at least 3 feet below the top of firm bedrock, as determined by drilling.
   (c) The remaining annulus will be back filled with bentonite grout slurry from the top of the bentonite seal to 3 feet bgs using a tremie pipe.
   (d) Additional chips or slurry will be added the next day if the grout column settles overnight prior to installation of the surface pad. The grout will be allowed to set before wells are developed.

11. The drill crew will complete the well by installing a stick-up or flush mount protective casing into a thick concrete surface pad.

   (a) For above grade completions, the well heads will extend approximately 3-foot above grade and will be fitted with a protective casing with a lockable lid. An approximate 2-foot diameter concrete well pad will be installed around the protective casing. The well pad will be sloped away from the protective casing to shed surface water away from the well head. The well identification will be clearly visible on the inside and outside of the lid of the protective casing. A drain hole will be installed at the base of the protective casing and vent hole will also be located at the top of the protective casing. The annulus of the protective casing will be filled with gravel and a locking well cap installed at the top of the protective casing.
   (b) Well heads in parking lots, roadways, or other areas accessed by vehicular traffic will be completed flush with grade. Flush-mount curb boxes will be fitted over the well head and will be flush to the surrounding grade. The curb box will be set in an approximate 2-foot diameter concrete pad. A locking J-plug will be installed on top of the well.

12. Protective bollards can be installed at each corner of the pad for protection and easier locating of the well if specified in the work plan/QAPP.
13. The top of the well casing and ground surface will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum. The measuring point on all wells will be on the innermost PVC casing.

5.4.4. *Single Well Installation Operations (Permanent, Bedrock Monitoring Well)*

5.4.4.1. Bedrock monitoring wells will be installed using a combination of hollow stem auger and rock coring, sonic, air rotary, or fluid rotary drilling methods as specified in the work plan/QAPP. Initially, borings will be advanced following the procedures in Sections 5.3.1 and 5.3.2.

5.4.4.2. Once bedrock is encountered, a 6-inch “rock socket” will be installed into the competent rock. If rock cores are to be collected, the bedrock will be cored using NX or HQ core barrels. Information to be recorded during the collection of core samples are indicated on the Core Log provided in **Exhibit 3** or equivalent electronic boring log form.

5.4.4.3. Well installation will follow the procedures outlined in Sections 5.4.2 and 5.4.3.

5.4.5. Nested Well Construction

5.4.5.1. Nested wells are multilevel monitoring wells in which multiple tubes or casings are installed at different depths within the same borehole (**Exhibit 4**). The screens are set at different depths and are separated by seals.

5.4.5.2. The preparatory steps outlined in Section 5.4.2 will be followed along with the following steps if installing nested monitoring wells:

1. In order to measure depth-discrete hydraulic heads and collect depth-discrete groundwater samples, each well screen in the nested well should be no more than 2 or 3 feet in length.
2. The primary filter pack surrounding the lower screened interval should extend a minimum of 6 inches below the bottom of the screen and 20% of the screen length or 2 feet above the top of the screen, whichever is greater.
3. A finer grained “choke” sand (100% passing a No. 30 sieve and less than 2% passing the No. 200 sieve) approximately 1-2 feet thick (as conditions warrant) will be installed between the primary filter pack and the bentonite seal.
4. A bentonite chip seal will be placed above the “choke” sand to a foot below the bottom of the upper screened interval. Sealed bentonite chips will be used for the seal that is below the water table.
5. As described in Section 5.4.3, a filter pack and choke sand will be installed around the screened interval. This process will be repeated if there is more than two screened intervals else the bentonite seal and completions described in Section 5.4.3, Items 10-13 will be followed.

5.4.6. Well Clusters

A well cluster or multiple set is a group of single wells, each installed at different levels in separate boreholes (**Exhibit 4**). If dictated by the project requirements, the screened interval of each well in the cluster will be no more than 2 or 3 feet long so that the head measurements and groundwater samples from each well will be depth discrete and not composited over a larger part of the aquifer. Otherwise the screen interval will be as dictated in the work plan/QAPP. Construction of wells in clusters will be as above in Sections 5.4.2 and 5.4.3.

5.4.7. Post Well Installation Activities

The following steps shall be performed once well installation is complete:

1. The Field Geologist or designee will confirm activities were completed as specified in the approved work plan/QAPP.
2. The Field Geologist or designee shall record the well location with GPS coordinates.
3. The Field Geologist shall complete the Well Construction Form (Exhibit 2) for the well and/or forms specified in the approved work plan.
4. The Field Geologist or designee shall measure and record a final static water level and depth to bottom.
5. The Field Geologist or designee will decontaminate reusable sampling equipment as described in Section 5.5 or as otherwise specified in the approved work plan/QAPP.

5.5. Sampling Equipment Decontamination

5.5.1. PFAS-free Water

5.5.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2017). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.5.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.5.2. Decontamination Procedures

5.5.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including oil/water interface meters, water level indicators, non-disposable bailers, and other nondedicated equipment used at each sample location, requires cleaning between uses. The SDSs of detergents or soaps used in decontamination procedures should be reviewed to ensure fluoro-surfactants are not listed as ingredients. Use laboratory-verified PFAS-free water for the final rinse during decontamination of sampling equipment. Decontaminate larger equipment (for example, drill rigs and large downhole drilling and sampling equipment) with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment coming in direct contact with samples with PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, rinse equipment with PFAS-free water immediately before use.

5.5.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable water;
4. Second rinse in a bucket of clean potable water;
5. Final rinse with laboratory-provided, "PFAS-free" water;
6. All rinsate should be collected in a sealed pail for disposal.
7. Any non-dedicated equipment (i.e., interface probe) that comes into contact with well water should be decontaminated between uses.
8. Field equipment used at locations that are suspected of containing AFFF (i.e. those that foam during shaking) will be cleaned as per above in triplicate.

5.5.2.3. Decontamination of drilling equipment

1. Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be sampled, containerized and appropriately disposed.
2. Equipment will then be sprayed with potable water using a high-pressure washer.
3. Washed equipment will then be rinsed with PFAS-free water.
4. Decontaminated downhole equipment (for example, drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting (PFAS-free) to prevent contact with contaminated soil and

allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination.

5.5.2.4. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ASTM D2487-17, 2017. Standard Practice for Classification of Soils for Engineering Purposed (Unified Soil Classification System), ASTM International.	The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.
ASTM D2488-17, 2017. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM International.	The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties. The descriptions are based on visual-manual procedures conducted in the field.
ASTM D5092/D5092M – 16, 2016 Standard Practice for Design and Installation of Groundwater Monitoring Wells	This practice describes a methodology for designing and installing conventional (screened and filter-packed) groundwater monitoring wells.
ASTM D6032/D6032M – 17; Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core	This test method covers the determination of the rock quality designation (RQD) as a standard parameter in drill core logging of a core sample in addition to the commonly obtained core recovery value
ITRC, 2018. PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
United States Environmental Protection Agency (USEPA), 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD).	EPA Guidance for proper installation of groundwater wells while safeguarding confined and unconfined aquifers integrity.
USEPA, 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.	The Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells is intended to assist personnel involved with the design, construction, and installation of ground-water monitoring wells.
USACE, 1998. Monitoring Well Design, Installation and Documentation at Hazardous, Toxic and Radioactive Waste Sites. Engineer Manual (EM) 1110-1-4000.	This Engineer Manual (EM) provides the minimum elements for consideration in the design, installation, and documentation of monitoring well placement (and other geotechnical activities) at projects known or suspected to contain chemically hazardous, toxic, and/or radioactive waste.

7. EXHIBITS

Exhibit 1:	Drilling Log Form (Attached)
Exhibit 2:	Well Construction Form (Attached)

Exhibit 3:	Coring Log Form (Attached)
Exhibit 4:	Nested and Cluster Monitoring Wells (shown below)

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	02/25/2020	Initial Release	n/a

OVERBURDEN BORING REPORT

PARSONS	**CLIENT:**	**BORING NO.:**

PROJECT :
SWMU # (AREA) :
SOP NO.:

START DATE:
FINISH DATE:
CONTRACTOR:
DRILLER:
INSPECTOR:
CHECKED BY:
CHECK DATE:
BORING CONVERTED TO MW? Y N

DRILLING SUMMARY

DRILLING METHOD	HOLE DIA.(ft)	DEPTH INTERVAL (ft)	SAMPLER		HAMMER	
			SIZE	TYPE	TYPE	WT/FALL

DRILLING ACRONYMS

HSA	HOLLOW-STEM AUGERS	HMR	HAMMER	SS	SPLIT SPOON
DW	DRIVE-AND-WASH	SHR	SAFETY HAMMER	CS	CONTINUOUS SAMPLING
MRSLC	MUD-ROTARY SOIL-CORING	HHR	HYDRAULIC HAMMER	5I	5 FT INTERVAL SAMPLING
CA	CASING ADVANCER	DHR	DOWN-HOLE HAMMER	NS	NO SAMPLING
SPC	SPIN CASING	WL	WIRE-LINE	ST	SHELBY TUBE
				3S	3 INCH SPLIT SPOON

MONITORING EQUPMENT SUMMARY

INSTRUMENT TYPE	DETECTOR TYPE/ENERGY	RANGE	BACKGROUND			CALIBRATION		WEATHER (TEMP., WIND, ETC.)
			READING	TIME	DATE	TIME	DATE	

MONITORING ACRONYMS

PID	PHOTO - IONIZATION DETECTOR	BGD	BACKGROUND	DGRT	DRAEGER TUBES
FID	FLAME - IONIZATION DETECTOR	CPM	COUNTS PER MINUTE	PPB	PARTS PER BILLION
GMD	GEIGER MUELLER DETECTOR	PPM	PARTS PER MILLION	MDL	METHOD DETECTION LIMIT
SCT	SCINTILLATION DETECTOR	RAD	RADIATION METER		

INVESTIGATION DERIVED WASTE

DATE			
SOIL AMOUNT : (fraction of drum)			
DRUM #, LOCATION:			

COMMENTS:

SAMPLES TAKEN:

SAMPLES
DUPLICATES
MS/MSD
MRD

PAGE OF

OVERBURDEN BORING REPORT

PARSONS

CLIENT:

BORING NO.:

COMMENTS:

DRILLER:

INSPECTOR:

DATE:

DEPTH (FT)	SAMPLING			SAMPLE				SAMPLE DESCRIPTION (As per Burmeister: color, grain size, MAJOR COMPONENT, Minor Components with amount modifiers and grain-size, density, stratification, wetness, etc.)	USCS CLASS	STRATUM CLASS
	BLOWS PER 6 INCHES	PENETRATION RANGE (FEET)	RECOVERY RANGE (FEET)	DEPTH INT (FEET)	NO.	VOC	RAD SCRN			

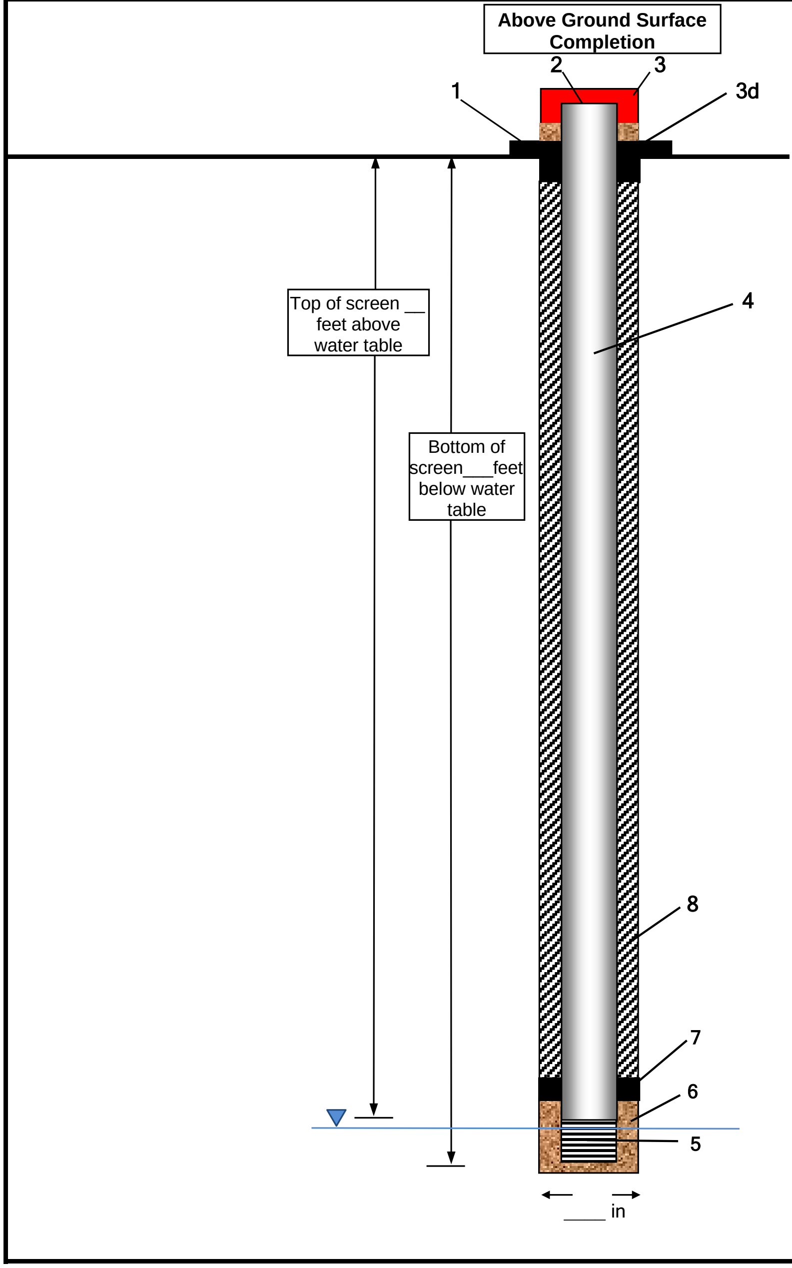
CONTRACTOR	WELL NUMBER	FIGURE
PARSONS		1

Project Name

Location Groundwater Monitoring Well

WELL INSTALLATION DATA RECORD

PROJECT : LOCATION :
DRILLING SUBCONTRACTOR : DRILLER:
DRILLING METHOD / EQUIPMENT: HELPERS:
WATER LEVEL: START: END: GEOLOGIST:



DRAWING NOT TO SCALE

1- Ground elevation at well :

2- Measuring point elevation :

3- Surface completion casing :
a) type / diameter
b) height above ground
c) length below ground
d) type of sealant
e) protective bollards

4- Well casing :
a) type / diameter
b) height above ground
c) length below ground
d) type / quantity of sealant
e) well centralizers

5- Well screen :
a) type / diameter
b) slot size
c) length

6- Well screen filter pack :
a) type
b) length

7- Bentonite seal :
a) method of placement
b) type
c) length

8- Grout :
a) type
b) grout mix
c) method of placement
d) depth (feet bgs)

OVERBURDEN MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS | CLIENT: | WELL #:

PROJECT: ______
LOCATION: ______
PROJECT NO: ______
INSPECTOR: ______
CHECKED BY: ______

DRILLING CONTRACTOR: ______
DRILLER: ______
DRILLING COMPLETED: ______
BORING DEPTH: ______
DRILLING METHOD(S): ______
BORING DIAMETER(S): ______
ASSOCIATED SWMU/AOC: ______
POW DEPTH: ______
INSTALLATION STARTED: ______
INSTALLATION COMPLETED: ______
SURFACE COMPLETION DATE: ______
COMPLETION CONTRACTOR/CREW: ______
BEDROCK CONFIRMED (Y/N?) ______
ESTIMATED GROUND ELEVATION: ______

PROTECTIVE SURFACE CASING:
DIAMETER: ______ LENGTH: ______ TOR: ______

RISER:
TOC: ______ TYPE: ______ DIAMETER: ______ LENGTH: ______

SCREEN:
TSC: ______ TYPE: ______ DIAMETER: ______ LENGTH: ______ SLOT SIZE: ______

POINT OF WELL: (SILT SUMP)
YPE: ______ BSC: ______ POW: ______

GROUT:
TG: ______ TYPE: ______ LENGTH: ______

SEAL: TBS: ______ TYPE: ______ LENGTH: ______

SAND PACK: TSP: ______ TYPE: ______ LENGTH: ______

SURFACE COLLAR:
TYPE: ______ RADIUS: ______ THICKNESS CENTER: ______ THICKNESS EDGE: ______

CENTRALIZER DEPTHS
DEPTH 1: ______ DEPTH 2: ______ DEPTH 3: ______ DEPTH 4: ______

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

SEE PAGE 2 FOR SCHEMATIC

CORE BORING REPORT

PARSONS	**CLIENT:**	**BORING #:**

PROJECT: ____________________

SWMU # (AREA) : ____________________

SOP NO.:

DATE CORING STARTED: ________

DATE CORING COMPLETED: ________

CONTRACTOR: ________

DRILLER: ________

INSPECTOR: ________

GEOLOGIST: ________

CHECKED BY: ________

DATE CHECKED: ________

TOTAL FOOTAGE CORED: ________

OVERBURDEN THICKNESS: ________

GALLONS OF WATER USED

MONITORING

INTRUMENT	INTERVAL	BACKGROUND	TIME

COMMENTS:

CORE EQUIPMENT BARREL LENGTH (ft):

TYPE	SERIES	RANGE	O.D.	I.D.

DEPTH FEET	RUN # RANGE FEET	CORE RECOVERY FEET	MON. DATA	RQD %	SCHEMATIC STRATA/ FRACTURES	ANGLES DIP/STRIKE (BD,FL,JNT,FC)	BEDROCK/ CORE DESCRIPTIONS AND REMARKS (color, major modifiers, rock type, minor components, bedding or foliation, strike of joints/fractures relative to foliation, weathering on fractures, etc.)

INVESTIGATION DERIVED WASTE :

DATE			
SOIL AMOUNT (fraction of drum)			
DRUM #, LOCATION			

BEDROCK MONITORING WELL
COMPLETION REPORT & INSTALLATION DETAIL
PROTECTIVE RISER COMPLETION

PARSONS	**CLIENT: USACOE**	**WELL #: MW**

PROJECT:		PROJECT NO:	
SWMU # (AREA):		INSPECTOR:	
SOP NO.:		CHECKED BY:	

DRILLING CONTRACTOR:		POW DEPTH (ft) :	
DRILLER:		INSTALLATION STARTED:	
DRILLING COMPLETED:		INSTALLATION COMPLETED:	
BORING DEPTH:		SURFACE COMPLETION DATE:	
DRILLING METHOD(S):		COMPLETION CONTRACTOR/CREW:	
BORING DIAMETER(S):		BEDROCK CONFIRMED (Y/N?)	

PROTECTIVE SURFACE CASING

DIAMETER (ft):		LENGTH (ft):	

RISER

TYPE:		TR (ft):	
DIAMETER(in):		LENGTH (ft):	

SURFACE COLLAR

TYPE:		RADIUS (ft):	
THICKNESS OF CENTER (ft):		THICKNESS OF EDGE (in):	

SCREEN

TYPE:				TSC (ft):	
DIAMETER (in):		SLOT SIZE:		LENGTH (ft):	

OUTER CASING

TYPE:				TC (ft):	
DIAMETER (in):		POC (ft):		LENGTH (ft):	

POINT OF WELL (SILT SUMP)

TYPE:		BSC (ft):		POW(ft):	

GROUT

TYPE:		TG (ft):		LENGTH (ft):	

SEAL

TYPE:		TBS (ft):		LENGTH (ft):	

SAND PACK

FINE SAND TYPE:		TSP (ft):		LENGTH (ft):	
COARSE SAND TYPE:		TSP (ft):		LENGTH (ft):	

ACRONYMS

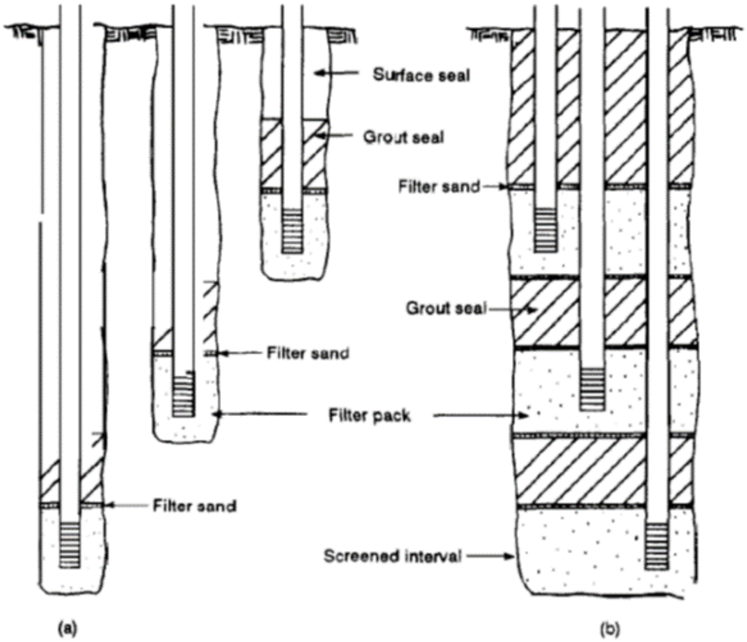
TR	Top of Riser	BSC	Bottom of Screen	TG	Top of Grout
TSC	Top of Screen	POW	Point of Well	TBS	Top of Bentonite Seal
BGD	Background	TSP	Top of Sand Pack		

COMMENTS:

* ALL DEPTH MEASUREMENTS REFERENCED TO GROUND SURFACE

Procedure # **SOP ENV-06**	**Title:** **SOIL BORINGS AND MONITORING WELL INSTALLATION**	**Revision #** **00**
Effective Date: 04/20/2022	Approved By: Todd Belanger	Last Revised: n/a

EXHIBIT 4 NESTED AND CLUSTER MONITORING WELLS



Wells installed as (a) clusters or, (b) nested. From EPA (1991)

Procedure # MEC-03	Title: MEC AVOIDANCE AND ESCORT	Revision # 00
Effective Date: 02/18/15	**Approved By:** Mike Coon	**Last Reviewed/Revised:** 02/18/15

1. PURPOSE

The purpose of this SOP is to provide the minimum procedures applicable to the performance of munitions and explosives of concern (MEC) escort and MEC avoidance operations at sites where surface and subsurface explosive hazards are present. The SOP also describes the procedures for down-hole magnetometry (i.e., anomaly avoidance used while advancing soil borings or groundwater wells).

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
UXOSO	Determines in which site areas MEC escorts are required and which personnel require escort.
MEC Escort	Conducts MEC escort and anomaly avoidance activities for non-UXO qualified personnel during intrusive activities in potential MEC hazard areas, or during other operations where non-UXO qualified personnel might be exposed to MEC hazards. Must be a qualified UXO Technician II or higher.
Site Geologist	Identifies undisturbed soil during augering/drilling operations.

3. RELEVANT DEFINITIONS

Term	Definition
None	Not applicable.

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Metal Detector	Instrument used to detect surface and/or subsurface anomalies indicating potential MEC. Typically instruments used are analog (e.g., Schonstedt magnetic locator, White's metal detector), but may also use digital instruments (e.g., EM61-MK2). Similar instruments attached to cables will be used for down-hole anomaly avoidance (e.g., Schonstedt MG 230/235 Borehole Gradiometer).
GPS Unit	Used to record the location of any MEC or MPPEH found during MEC escort or avoidance

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The UXOSO or designated representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP.

5.2. Confirm Instrument Function

5.2.1. Perform Function Test

Prior to conducting MEC escort or avoidance activities, the MEC Escort (i.e., instrument operator) will complete an instrument function test to confirm the metals detector being used can detect surface and/or subsurface metallic items. The requirements for the function test, including the required measurement performance criteria (MPCs) are described in the work plan.

5.2.2. Document Test Results

Following completion of the function test, the instrument operator will record the results in accordance with the work plan. If the instrument or operator does not pass the function test, corrective actions will be performed as described in the work plan.

5.3. Provide Preparatory Safety Briefing

Prior to any MEC escort or anomaly avoidance activities, the MEC Escort and non-UXO trained personnel performing the planned activity will review the anticipated work location, the ingress/egress routes, and the planned activities. This review will involve a discussion of the overall operation, possible hazards, and potential areas of concern.

5.4. Conduct MEC Escort and Anomaly Avoidance

5.4.1. MEC Escort

When working in areas where non-UXO trained personnel may be exposed to surface explosive hazards (e.g., performing geophysical surveys), the MEC Escort will accompany those personnel, performing metal detector-assisted visual surveys/surface sweeps to check for and avoid possible surface MEC. The swept area(s) shall be at least three feet wide and, if vehicles are involved, as wide as the widest vehicle that will use that route. The MEC Escort will instruct the non-UXO trained personnel to avoid areas where potential hazards are detected. Confirmed MEC items observed will be reported to the UXOSO.

5.4.2. Anomaly Avoidance

Prior to non-UXO trained personnel conducting intrusive activities (e.g., placing survey stakes, burying seed items, collecting soil samples, etc.) in areas with potential subsurface explosive hazards the MEC Escort will conduct MEC avoidance. Prior to conducting the intrusive activity, the MEC Escort will use a metal detector to check the planned intrusive location for surface hazards and subsurface anomalies that might indicate buried MEC. If surface hazards or subsurface anomalies are detected, the MEC Escort will advise the non-UXO trained personnel of the hazards and instruct them to select an offset or alternate location for the intrusive activity. This modified location will be checked by the MEC Escort for surface hazards and subsurface anomalies, and the process will be repeated until an anomaly-free area is located for the intrusive activity. Confirmed MEC items observed will be reported to the UXOSO.

5.5. Conduct Down-Hole Anomaly Avoidance

5.5.1. Initial Anomaly Avoidance

The MEC Escort will conduct down-hole magnetometry for MEC avoidance when augering or drilling (e.g., collecting soil borings, installing groundwater wells, etc.) in areas with potential subsurface explosive hazards. When the proposed augering or drilling location is identified, the MEC Escort will

Procedure # **MEC-03**	**Title:** **MEC AVOIDANCE AND ESCORT**	**Revision #** **00**
Effective Date: 02/18/15	**Approved By:** Mike Coon	**Last Reviewed/Revised:** 02/18/15

conduct anomaly avoidance as described in Section 5.4.2 before intrusive activity is conducted. If the MEC Escort determines the proposed location is free of surface and subsurface magnetic anomalies to a depth of two (2) feet, the auger or drill will be advanced. If the location is not anomaly free, the MEC Escort will advise the auger/drilling team of the hazards and instruct them to select an offset or alternate location for the intrusive activity and repeat the anomaly avoidance process as described in Section 5.4.2.

5.5.2. Down-Hole Anomaly Avoidance

5.5.2.1. During augering/drilling, the MEC Escort will check the hole every two (2) feet using a down-hole magnetometer. This will be achieved by lowering a down-hole magnetometer (Schonstedt MG 230 or equivalent) to the borehole bottom and monitoring the instruments audible signal and panel reading for intensity signatures. This process will be repeated every two (2) feet until borehole depth is reached or undisturbed soil is encountered as identified by the Site Geologist.

5.5.2.2. To avoid potential magnetic interference, the probe rods or corebarrel will be withdrawn from the boring prior to conducting down-hole magnetometry. If the drill rig or other equipment/vehicles are creating interference, the interfering item(s) shall be relocated outside the interference range of the downhole magnetometer during the drill hole inspections.

5.5.2.3. If subsurface magnetic anomalies indicating the potential presence of MEC are encountered and the drill hole cannot be completed, the drill hole will be terminated and backfilled with the removed sediment cuttings. An alternative location will be selected and the process will be repeated starting from Section 5.5.1.

5.5.2.4. If the soils are loose and collapsing into the hole, a polyvinyl pipe (PVC) pipe with a diameter that will allow passage of the downhole probe will be inserted inside the steel casing prior to its removal to maintain an open boring. Once an anomaly-free pilot hole has been advanced to the undisturbed native soil contact as determined by the Site Geologist, the hole will be stopped and the location will be marked with a wooden stake for later advancement. The actual borehole will only be advanced in the same location as the cleared pilot hole. If the cleared boring is not intended as a pilot hole to be returned to later, the boring may continue to its intended target depth without MEC avoidance procedures. If desired, multiple locations may be “pre-cleared” ahead of the actual boring installation (i.e., “pilot holes”).

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
None	Not applicable.

7. EXHIBITS

None.

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
0	02/18/15	Initial Release	n/a

Appendix B - Analytical SOPs and Certifications

The Katahdin and SGS SOPs and certifications are attached to the PDF. Click the lab headers below to open Appendix B or use the paperclip icon in Adobe (left side, under bookmarks) or by selecting view, Show/Hide, Navigation Panes, Attachments. There are two separate attachments for the SGS and Katahdin SOPs.

APPENDIX B – KATAHDIN CERTIFICATIONS AND SOPS

APPENDIX B – SGS ORLANDO CERTIFICATIONS AND SOPS