ATHENICA ENVIRONMENTAL
ENGINEERING PLLC
Environmental Engineering Consultants

REMEDIAL INVESTIGATION WORK PLAN

500 Third Avenue
Brooklyn, New York 11215

Site Number C224426

Prepared for:

PAB 3rd Avenue Holdings, LLC.
135 13th Street
Brooklyn, New York 11215

Prepared By:

Athenica Environmental Engineering PLLC
31-33 31st Street, Second Floor
Astoria, New York 11106

August 18, 2025

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CERTIFICATION

I, Spiro Dongaris, P.E., certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10) and DER Green Remediation (DER-31).

STATE OF NEW YORK
SPIRO I DONGARIS
095954
LICENSED PROFESSIONAL ENGINEER

August 18, 2025

1.0 INTRODUCTION

PAB 3rd Avenue Holdings, LLC. entered into the New York State Brownfield Cleanup Program (BCP) via a Brownfield Cleanup Agreement (BCA) with the New York Department of Environmental Conservation (NYSDEC) on May 22, 2025, as a Volunteer to investigate and remediate the property located at 500 Third Avenue in Brooklyn, New York (Site). The Site property encompasses 8,400 square feet, with a legal description on the New York City Tax Map of Block 1020, Lot 35 (previously identified as Lots 34, 35, and 36, which have since been merged). Currently, the Site is vacant; the building previously occupying the Lot 34 portion of the Site was demolished circa 2017 and the building previously occupying Lots 35 and 36 portion of the Site was demolished in 2023. The location of the Site is shown on **Figure 1**.

Athenica Environmental Engineering PLLC (Athenica) has prepared this Remedial Investigation Work Plan (RIWP) to further assess the nature and extent of impacted media (soil, groundwater, and soil vapor) across the Site. The objectives of the Remedial Investigation (RI) include:

- Delineate the lateral and vertical extent of impacted soils throughout the Site,
- Assess the lateral and vertical extent of impacted groundwater throughout the Site, and
- Assess soil vapor quality across the Site.

Athenica will implement this RIWP on behalf of the Volunteer in in accordance with Title 6 New York Codes, Rules, and Regulations (NYCRR) Part 375, the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10, May 3, 2010), the NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006, with May 2017 updates), and all other applicable regulatory and procedural requirements.

1.1 Surrounding Use and Site History

The Site is located within a primarily mixed-use industrial/warehouse, commercial, and residential area of Brooklyn, New York. **Figure 1** shows the Site location. The 8,400 square foot Site is bordered by a 1-story auto repair shop and a 1-story manufacturing building across 11th Street to the northeast, a 3-story mixed-use commercial and residential building and a 3-story warehouse to the southwest, a 4-story mixed-use commercial and residential building and three 3-story residential buildings across Third Avenue to the southeast, and a 1-story warehouse to the northwest.

According to the May 1, 2024 Phase I Environmental Site Assessment (ESA), the historic Lot 35 portion of the Site was developed with a 3-story building from prior to 1886 until as recently as 2007 (with commercial use shown from 1886 until as recently as 1950, residential and commercial uses from at least 1969 until as recently as 1982, and unspecified manufacturing use from 1986 until as recently as 2007), a 1-story stable from prior to 1886 until as recently as 1915, and a 1-story garage from 1938 until as recently as 2007. The Lot 36 portion of the Site was developed with two 1-story commercial buildings from prior to 1886 until as recently as 2007 (one of these commercial buildings was depicted with office use from 1904 until as recently as 1950), a 1-story stable in 1886, a second 1-story stable from prior to 1886 until as recently as 1915, a 1-story carriage house from 1904 until as recently as 1915, and an additional 1-story building from 1938 until as recently as 2007 (shown as a garage with a gasoline storage tank in 1938, a ceramic laboratory and warehouse in 1950, and a mirror manufacturing facility from 1969 until as recently as 2007). Lots 35 and 36 were combined as Lot 35 in 2024. Lot 34 was merged with Lot 35 in 2025. The Lot 34 portion of the Site was first developed with a 2-story residential building from prior to 1886 until as recently as 2007. The building on the former Lot 34 was demolished circa 2017 and all buildings on the former Lots 35 and 36 were demolished in 2023.

1.2 Contemplated Use of Site

Upon completion of the investigation and remediation activities, the Volunteer plans to redevelop the Site with a new 6-story mixed-use (commercial and residential) building. Based on the recent building plans, the building will have a full cellar, commercial occupancy on the ground floor, and residential occupancy on the second through sixth floors, with a portion of the residential occupancy as affordable housing.

1.3 Summary of Previous Reports and Investigation

Prior to acceptance into the BCP, a Phase I ESA, Remedial Investigation, and Supplemental Sampling event were conducted at the Site. These are documented in the following reports (all of which are included in **Appendix A**):

- Phase I ESA prepared by Athenica Environmental Services, Inc. (AES), dated May 1, 2024.
- Remedial Investigation Report prepared by AES, dated August 2024.
- Supplemental Sampling Report prepared by AES, dated October 9, 2024.

1.3.1 May 2024 Phase I

A Phase I ESA was completed for the Site in May 2024 by AES. The scope of the Phase I ESA included a Site visit, historical research, and a review of regulatory database records. The Recognized Environmental Conditions (RECs) and Controlled RECs (CRECs) that were identified by AES are summarized below:

RECs:

- The Site property is listed on the "E" Designation database under City Environmental Quality Review (CEQR) #20DCP129K with "E" Designation E-617 for potential hazardous materials, air quality, and noise, dated December 9, 2021; shown on Sanborn maps with historic gasoline storage, ceramics laboratory, and unspecified manufacturing uses; and appears in the City Directory abstract from Environmental Data Resources, Inc. (EDR) and on the New York City Fire Department (FDNY) Bureau of Fire Prevention Building Information Profile indicating potential unregistered underground storage tanks (USTs). The "E" Designation database listing, the historic gasoline storage, ceramics laboratory, unspecified manufacturing uses, and the potential unregistered USTs are considered to be RECs, and the historic gasoline storage, unspecified manufacturing uses, and the potential unregistered USTs are also considered to be potential vapor encroachment conditions (pVECs).

- The property at 498 3rd Avenue is listed on the Leaking Storage Tank Incident Reports (LTANKS) database as Spill Number 8809911, reported on March 14, 1989 and closed by the NYSDEC on August 31, 2021, due to identified leaks in five gasoline USTs and documented groundwater contamination; is listed on the EDR Historical Auto Stations database as a gasoline station and an auto repair facility; is shown on Sanborn maps with historic gasoline station and auto repair uses; and appears in EDR's City Directory abstract with historic auto repair use. These LTANKS and EDR Historical Auto Stations database listings, and the historic gasoline station and auto repair uses of this adjacent property are considered to be RECs. The documented groundwater contamination, the historic gasoline storage, and the historic auto repair use are also considered to be pVECs.

CRECs:

- The property located at 521-539 4th Avenue is listed on the BROWNFIELDS database as BCP Site Numbers C224189 and C224189A, based on historic use of the property for auto repairs; use of the chlorinated solvent tetrachloroethene (PCE); documented metal and polycyclic aromatic hydrocarbon (PAH) contamination in soil; and documented PCE and trichloroethene (TCE) contamination in groundwater and soil vapor. Remediation activities conducted at the property included excavation and disposal of contaminated soil, removal of 13 USTs, in-situ enhanced bioremediation treatment of groundwater, and installation of a vapor barrier system and sub-membrane depressurization system (SMDS). Residual contamination is being managed under a NYSDEC-approved Site Management Plan with on-going groundwater monitoring events and operation of the SMDS. Due to on-going remediation with regulatory oversight, this property is considered to be a CREC and a pVEC.

1.3.2 August 2024 Remedial Investigation Report

AES conducted a Remedial Investigation (RI) at the Site in response to the RECs identified by the Phase I ESA and to satisfy the requirements for investigation and remediation of properties subject to oversight by the New York City Office of Environmental Remediation (OER). The following scope of work was completed to characterize subsurface conditions at the Site:

- Implemented a geophysical survey.
- Advanced one soil boring (designated SB-1) to a depth of 10 feet below ground surface (bgs) and advanced four soil borings (designated SB-2 through SB-5) to a depth of 15 feet bgs. collected a total of 10 soil samples for chemical analysis of Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi volatile organic compounds (SVOCs), TCL pesticides, TCL polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals to evaluate soil quality. Three soil samples (including a blind duplicate) were analyzed for 1,4-dioxane and PFOA/PFAS.
- Installed three temporary groundwater monitoring wells (designated TW-1 through TW-3) and collected three groundwater samples for chemical analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals (total and dissolved), 1,4-dioxane, and PFOA/PFAS to evaluate groundwater quality.
- Installed five temporary soil vapor probes (designated SV-1 through SV-5) and collected four vapor samples for chemical analysis of VOCs (soil vapor sample SV-2 could not be analyzed due to technical difficulties with the Summa canister). All soil vapor samples were collected in accordance with the New York State Department of Health (NYSDOH document *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006), as amended (NYSDOH Guidance Document).
- Surveyed the elevations of all temporary wells relative to a common random datum (benchmark).
- Measured depth to water utilizing appropriate field instrumentation and, with the survey data, determined the groundwater flow direction at the Site.

Soil samples collected during the RI were compared to 6NYCRR Part 375 Unrestricted Use and Restricted Residential Use Soil Cleanup Objectives (SCOs). SVOCs and metals were detected in two soil samples at concentrations exceeding Restricted Residential Use SCOs. SVOCs, metals and pesticides were detected in three soil samples at concentrations exceeding Unrestricted Use SCOs, but below Restricted Residential Use SCOs. There were no VOCs or PCBs detected in any of the soil samples at concentrations above Unrestricted Use SCOs. PFOA/PFAS were not detected at concentrations exceeding their guidance values. 1,4-dioxane was not detected in any of the soil samples.

Groundwater samples collected during the RI were compared to 6NYCRR Part 703.5 Class GA Groundwater Quality Standards (GQS). VOCs and metals were detected at concentrations exceeding GQS in all three groundwater samples. PFOA/PFAS were detected in three groundwater samples at concentrations exceeding their respective guidance values. The SVOC naphthalene and the pesticide dieldrin were each detected in one groundwater sample at a concentration exceeding GQS. PCBs and 1,4-dioxane were not detected in any of the groundwater samples.

Soil vapor samples collected during the RI contained the following petroleum-related VOCs: benzene, ethylbenzene, cyclohexane, 2,2,4-trimethylpentane (isooctane), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, o-xylene, p- and m-xylenes, n-heptane, n-hexane, and toluene. The following chlorinated VOCs were detected in soil vapor: TCE, carbon tetrachloride, PCE, and methylene chloride. Other VOCs detected in soil vapor included: 1,3-butadiene, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, acetone, acrylonitrile, carbon disulfide, chloroform, chloromethane, dichlorodifluoromethane, ethyl acetate, isopropanol, methyl methacrylate, p-ethyltoluene, propylene, and styrene.

The soil sample locations and SCO exceedances, groundwater sample locations and GQS exceedances, and soil vapor sample locations and detections are depicted on figures in Appendix A. Summary of compounds detected in soil, groundwater, and soil vapor are summarized in tables in Appendix A. Figures and tables summarizing the analytical results for samples collected during the RI are also included in the Previous Environmental Reports appendix (**Appendix A)**.

Other significant findings of the RI were as follows:

- A subsurface geophysical anomaly approximately six feet by seven feet in size was identified in the western portion of the Site. This anomaly was subsequently excavated by the property owner on June 3, 2024, which showed it to be three drainage pipes located approximately 1.5 feet bgs.
- Depth to groundwater at the Site ranged from 15.62 to 18.26 feet bgs.
- Groundwater flow beneath the Site was determined to be generally from northwest to southeast.
- Site stratigraphy consists of brown to dark brown fine sand, medium sand, and silt from ground surface to five feet bgs. Some evidence of historic fill (concrete, crushed brick fragments, and asphalt) was observed within the soil borings at depths up to five feet bgs, with the exception of SB-5 where crushed brick was observed from ground surface to 11 feet bgs. Stratigraphy of the Site consists of brown, fine to medium sand, silt, clay, and fine to medium gravel from five to fifteen feet bgs. Bedrock was not encountered during the investigation.

1.3.3 October 2024 Supplemental Sampling Report

AES conducted supplemental sampling at the Site at the request of the NYSDEC, as a result of the findings from the RI. The following scope of work was completed to confirm the findings of the previous sampling conducted at the Site:

- Advanced one soil boring (designated SB-6) to a depth of 15 feet bgs at the location of the geophysical anomaly, and collected two soil samples for chemical analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, and TAL metals to evaluate soil quality.
- Installed four temporary monitoring wells (designated TW-1 through TW-4) and collected four groundwater samples for chemical analysis of TCL VOCs. Groundwater sample TW-4 was also analyzed for TCL SVOCs, TCL pesticides, TCL PCBs, and TAL metals (total and dissolved).
- Installed one temporary soil vapor probe (designated SV-2) and collected one soil vapor sample for chemical analysis of VOCs. The soil vapor sample was collected in accordance with NYSDOH Guidance Document.
- Surveyed the elevations of all temporary wells relative to a common random datum (benchmark).
- Measured depth to water utilizing appropriate field instrumentation and, with the survey data, determined the groundwater flow direction at the Site.

SVOCs and metals were detected in the shallow soil sample (SB-6 (0'-2')) at concentrations exceeding Restricted Residential Use SCOs. No VOCs were detected at concentrations exceeding Unrestricted Use SCOs in either of the soil samples. No pesticides or PCBs were detected in either of the soil samples.

VOCs were detected in two of the groundwater samples at concentrations exceeding GQS. The SVOC naphthalene, total metals, and dissolved metals were detected in groundwater sample TW-4 at concentrations exceeding GQS. No pesticides or PCBs were detected in groundwater sample TW-4.

The following petroleum-related VOCs were detected in soil vapor sample SV-2, including 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2,2,4-trimethylpentane, benzene, ethyl benzene, n-heptane, n-hexane, o-xylene, p- and m-xylenes, and toluene. Chlorinated VOCs PCE and TCE were also detected in soil vapor sample SV-2., at concentrations of 94 micrograms per cubic meter (µg/m^3) and 4,900 µg/m^3, respectively. The detection of TCE, when compared to the sub-slab vapor concentration criteria of the NYSDOH Guidance Document Decision Matrix A, results in a recommendation of mitigation regardless of the potential indoor air concentration of TCE (which were not collected as the Site was a vacant lot). Please note that the May 2024 Phase I Environmental Site Assessment (ESA) prepared for the Site did not identify any historic occupants that would be expected to utilize chlorinated VOCs, so the detected TCE concentration appears to be from an off-Site source or sources. Other VOCs detected in soil vapor sample SV-2 included: 1,3-butadiene, 2-butanone, 4-methyl-2-pentanone, acetone, acrylonitrile, carbon disulfide, chloroform, isopropanol, p-ethyltoluene, propylene, and tetrahydrofuran.

Figures and tables summarizing the analytical results for samples collected during the supplemental sampling are included in **Appendix A** – Previous Environmental Reports.

Other significant findings of the supplemental sampling were as follows:

- Depth to groundwater at the Site measured in the temporary wells from the top of casing ranged from 16.57 to 18.40 feet bgs.
- Groundwater flow beneath the Site was determined to generally be from northwest to southeast.

1.4 Project Organization and Responsibility

Approval of this RIWP by the NYSDEC project manager will be obtained prior to the start of any field activities. Athenica will coordinate with the NYSDEC and provide at least a 10-business-day notification to NYSDEC before implementing this RIWP. The drilling subcontractor will be responsible for all drilling activities, including compliance with applicable Occupational Safety and Health Administration (OHSA) regulations, installation of soil borings, groundwater monitoring wells, and soil vapor implants. Athenica will be responsible for overall project management, oversight of the driller and any other subcontractor, determination of corrective measures when appropriate, perimeter air monitoring for protection of the surrounding community (CAMP monitoring), collection of samples for analysis, and completion of daily logs and appropriate field documentation.

The following are the key personnel or agencies involved with the RIWP activities at the Site:

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2.0 PURPOSE

A RI is planned to define the nature and extent of contamination on Site, identify contaminant source areas, and produce data o sufficient quantity and quality to complete an on-Site exposure assessment and a qualitative off-Site exposure assessment for purposes of designing the remedial action for the Site. Based on the past uses of the Site and documented characterization results from prior testing, a detailed scope of work has been developed to investigate surface and subsurface conditions at the Site, and is presented in Section 3 of this RIWP.

In accordance with in accordance with Title 6 New York Codes, Rules, and Regulations (NYCRR) Part 375, the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10, May 3, 2010), the NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006, with May 2017 updates), and all other applicable regulatory and procedures requirements, this RIWP is developed to achieve the following overall objectives:

- Delineation of the areal and vertical extent of the contamination at, and emanating from all media at the Site and the nature of that contamination;
- Characterization of the surface and subsurface characteristics of the Site, including topography, surface drainage, ecological resources, stratigraphy, depth to groundwater, and any aquifers that have been impacted or have the potential to be impacted;
- Identification of the sources of contamination, the migration pathways and actual or potential receptors of contaminants;
- Evaluation of actual and potential threats to public health and the environment; and
- Production of data of sufficient quantity and quality to support the necessity for, and the proposed extent of, remediation and to support the evaluation of proposed alternatives.

3.0 INVESTIGATION SCOPE OF WORK

The proposed scope of work for the RI is as follows, with details provided in the subsequent subsections:

- Advance 14 soil borings (designated SB-01 through SB-14) to groundwater, field screening of soil samples, and selection of at least two soil samples per boring for chemical analysis, pending subsurface observations;
- Install nine permanent groundwater monitoring wells (designated MW-01 through MW-09), and collection of 1 groundwater sample per well for chemical analysis;
- Install 14 temporary soil vapor probes (designated SV-01 through SV-14) to an average depth of 12 feet bgs (the proposed redevelopment depth), or above and below the previously observed clayey layer at the Site, and collection of 1 sample per probe for chemical analysis;
- A New York State–licensed surveyor will survey the horizontal and vertical locations of all soil borings, groundwater monitoring wells, and soil vapor points, to establish horizontal and vertical coordinates relative to a Site-specific datum; and
- Measured depth to water utilizing appropriate field instrumentation and, with the surveyed information, determined the groundwater flow direction at the Site.

For protection of on-Site personnel implementing this plan, field work will follow the health and safety protocols of a Site-specific Health and Safety Plan (HASP), which is included in **Appendix B.** For the protection of the public, a Community Air Monitoring Plan (CAMP) will be implemented during field activities with the potential of generating dust (see Section 3.7); a copy of this CAMP is included in **Appendix C.** The proposed RI sample locations are shown on **Figure 5**. **Table 4** provides a summary of the scope and rationale for sample collection and analyses for all media.

3.1 Pre-sampling Activities

Upon receipt of written notification that this RIWP has been approved by the NYSDEC, Athenica will direct the drilling subcontractor to contact the One Call Center and request that subsurface utilities in the Site vicinity be marked. Based on the estimated completion date for the One Call mark-out, the sampling work will be scheduled with the Volunteer and subcontractors (drilling, land surveying, and laboratory), and the NYSDEC will be notified of the start of the planned sampling.

3.2 General Requirements for Execution of Work Plan

Site work will comply with all applicable local rules and regulations with respect to noise and traffic. Site activities will commence no earlier than 7:00 a.m. and will cease for the evening no later than 5:00 p.m. on Monday through Friday of each week, unless otherwise authorized by the Volunteer. During working hours, the drilling subcontractor will implement measures to minimize potential community impacts, including, but not limited to, noise and traffic. Noise will be mitigated through the use of equipment fitted with mufflers and by limiting idling time of machinery. Traffic impacts will be reduced by staging equipment and vehicles within the designated work zone, using flagging or signage as needed, and coordinating deliveries to avoid peak traffic hours. All work will be conducted in a manner that limits disruption to surrounding residents and businesses.

Site work will be performed in accordance with applicable OSHA, state and industry safety standards. All on-Site personnel performing intrusive activities that have the potential to come in contact with impacted materials will have requisite 1910.120 OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training, as well as any other applicable training prior to intrusive activities. As described further in the site-specific Health and Safety Plan (HASP), all personnel performing field work at the Site will receive daily safety training that will include review of potentially hazardous conditions or activities and required personnel protective equipment (PPE). The manner for which representative soil and groundwater samples will be collected and analyzed are described in detail in the Quality Assurance Project Plan (QAPP) in **Appendix D**.

As required by law, the initial field task will be to request a One Call (811) subsurface utility mark-out for the Site. Athenica will mobilize to the Site with our drilling subcontractor and will identify the sample locations for all media, based on the approved RIWP, as well as the results of the subsurface utility mark-out and other access considerations (overhead utilities, vehicles, etc.).

3.3 Subsurface Soil Sampling

A total of 14 soil borings (designated SB-01 through SB-14) will be advanced at the Site to identify and to delineate the nature and extent of contamination. Proposed boring locations are shown on **Figure 2**.

A track-mounted direct-push rig will be utilized for advancement of all borings. For each boring, soil cores will be obtained using a macro-core sampler with a new, dedicated internal acetate liner, thereby avoiding the need for field decontamination of soil sampling equipment. Retrieved soil samples will be screened for VOCs via headspace techniques. Representative portions of each sample will be placed in clean plastic bags, sealed, and allowed to equilibrate for approximately 15 minutes. Following equilibration, the headspace within the bags will be screened using a photoionization detector (PID). All samples will also be geologically described, including observations regarding potential contamination (e.g., odors, staining, discoloration, etc.).

Each boring will be advanced to an appropriate depth to ensure full vertical delineation of contamination, in accordance with 6 NYCRR Part 375-1.8(e). Borings will extend below the groundwater interface to assess the potential presence of CVOCs and other contaminants in the saturated zone. Soil will be continuously sampled to the planned termination depth of each boring. If evidence of contamination is observed—based on elevated PID readings, organoleptic observations (e.g., staining, odors), or soil characteristics (e.g., discoloration, grain size anomalies)—borings may be extended to greater depths to fully delineate vertical impacts. Additional borings and/or samples will be collected as needed to delineate the horizontal and vertical extent of all contaminant types potentially present.

Based on field screening results and subsurface observations, a minimum of two soil samples will be collected from each boring for laboratory analysis. Additional samples will be collected as necessary to ensure full vertical delineation of contamination and to prevent data gaps. Soil samples will be selected from intervals exhibiting evidence of contamination (e.g., elevated PID readings, staining, odors), as well as from distinct lithologic units (e.g., clay layers, coarse-grained zones). Final sample intervals will be determined in the field by the on-Site engineer or geologist. Soil to be analyzed will be placed directly into laboratory-supplied containers, using dedicated disposable equipment (wooden tongue depressors, plastic scoops, etc.), and filled containers will immediately be placed into an iced cooler. Samples submitted for analysis will be properly transported under chain-of-custody (COC) procedures to an environmental laboratory approved under the NYSDOH Environmental Laboratory Approval Program (ELAP). The soil samples collected under this program will be analyzed for:

- TCL VOCs by U. S. Environmental Protection Agency (USEPA) Method 8260;
- TCL SVOCs by USEPA Method 8270;
- TAL Metals by USEPA Method 6010;
- TCL Pesticides by USEPA Method 8081; and
- TCL PCBs by USEPA Method 8082.
- PFOA/PFAS (NYSDEC list of compounds) using USEPA Method 1633; and
- 1,4-dioxane using a USEPA Method 8270 SIM.

Samples to be analyzed for PFOA/PFAS will be collected using the NYSDEC procedures for these compounds, as documented in the QAPP.

All non-dedicated sampling equipment in contact with soil samples will be decontaminated between boring locations in accordance with standard industry practices using a solution of non-phosphate detergent (e.g., Alconox®) and potable water, followed by a clean potable water rinse. After completion of soil sampling, borings will be abandoned in accordance with NYSDEC protocols outlined in *DER-10 Technical Guidance for Site Investigation and*

Remediation. Borings will be backfilled with clean, inert materials (e.g., bentonite chips, grout) appropriate to the boring depth and subsurface conditions, and sealed at the surface as required.

3.4 Groundwater Monitoring Well Installation, Development, and Sampling

A total of nine permanent groundwater monitoring wells will be installed as part of this investigation to evaluate current groundwater conditions at the Site. For any wells installed at locations where soil borings have not already been advanced, soil logging will be conducted during well installation to characterize subsurface conditions and ensure that well construction (e.g., screen interval and depth) is appropriate for the site-specific geology. If elevated PID measurements or other field evidence of contamination (e.g., staining, odors, discoloration) are observed in drill cuttings during well installation, soil samples will be collected from the apparently impacted interval for laboratory analysis of the full suite of analyses. Where appropriate, additional soil samples may also be collected from intervals with no field evidence of contamination to confirm vertical delineation. The proposed monitoring well locations are presented on **Figure 2**.

3.4.1 Site Hydrogeologic Conditions

Based on information obtained during the 2024 RI and Supplemental Sampling event, groundwater is anticipated to be encountered at a depth between approximately 15.5 and 18.5 feet bgs, and the direction of groundwater flow is generally from northwest to southeast.

3.4.2 Monitoring Well Installation

A hollow-stem auger (HAS) drill rig will be used to install all permanent groundwater monitoring wells. Each well will be constructed of 2-inch (inside diameter) Schedule 40 PVC casing and a 10- to 15-foot length of 0.010-inch machine-slotted PVC screen. This screen length is based on groundwater levels observed during previous investigations at the Site, where static water levels were encountered between approximately 16 and 18 feet below ground surface (bgs). The final screen interval for each well will be determined in the field to ensure that the well screen straddles the water table interface, in accordance with NYSDEC guidance. Screen depths and lengths may be adjusted in the field based on observed groundwater conditions and lithology encountered during drilling.

For any monitoring wells installed at locations where soil borings have not already been completed, soil logging will be performed during well installation to characterize subsurface conditions and confirm that the screen interval is appropriate for site-specific geology and hydrogeology.

A clean, washed #1 or #2 silica sand filter pack will be placed around the well screen and will extend from the bottom of the boring to at least 1 foot above the top of the screen. A 2-foot-thick bentonite seal (e.g., bentonite chips or pellets) will be placed above the filter pack to inhibit vertical migration of groundwater. The remaining annular space will be filled to grade with a Portland cement–bentonite grout mixture (typically 5–10% bentonite by weight). Grout will be placed via tremie pipe to ensure proper sealing and avoid bridging. After installation, a minimum 24-hour cure time will be observed to allow the bentonite seal and grout to fully hydrate and set prior to any well development or sampling activities.

Each well will be completed with either a flush-mount road box or stick-up protective casing, depending on site conditions and surface use, and will include a locking cap to prevent unauthorized access. A concrete surface seal will be poured around each wellhead for added protection. All well construction details—including boring logs, screen depths, filter pack elevations, and sealing methods—will be documented in the field by the on-site geologist.

3.4.3 Monitoring Well Development and Surveying

As stated above, the newly installed groundwater monitoring wells will be developed no sooner than 24 hours after installation, and only after the grout and bentonite seals have fully cured. Well development will be performed using a submersible pump equipped with a variable frequency drive (VFD) or equivalent control mechanism to allow for precise adjustment of flow rates. Alternatively, dedicated bailers may be used. A minimum of three well casing volumes will be purged, and the water in the well will be surged as needed to loosen and remove fine-grained sediments from the well screen. While submersible pumps with impellers may be used for development, future quarterly groundwater sampling events will employ low-flow sampling techniques using a peristaltic pump, bladder pump, or similar low-disturbance equipment to minimize sample agitation and potential VOC loss.

All development water will be containerized in properly labeled 55-gallon drums (or equivalent) and securely stored on-site pending receipt of laboratory analytical results. These results will be used to determine appropriate management and disposal of the development fluids in accordance with applicable regulations and guidance.

Wells will be installed at the locations shown on Figure 2; however, final placement may be adjusted in the field based on site access limitations or the presence of subsurface utilities. Following development, each well will be allowed to equilibrate with the surrounding aquifer for a minimum of one week prior to sampling, unless hydraulic conductivity data are obtained to justify a shorter equilibration period while still ensuring collection of representative groundwater samples.

A New York State–licensed surveyor will survey the horizontal and vertical locations of all soil borings, groundwater monitoring wells, and soil vapor points, to establish horizontal and vertical coordinates. A fixed measuring point will be established at the top of each well casing, either by making a permanent mark (using paint, marker, etc.) or cutting a small notch in the well casing, which will be where the survey data and depth to groundwater measurements will be taken. The top-of-casing elevation values will be used in conjunction with depth to groundwater measurements to calculate the groundwater elevation at each monitoring well, and the groundwater elevations will be contoured to determine the Site-specific groundwater flow direction.

3.4.4 Groundwater Sample Collection

Groundwater sampling will be completed utilizing the USEPA low-flow (minimal drawdown) procedures with dedicated or decontaminated sampling equipment. Prior to collecting the groundwater samples, the depth to groundwater and total well depth will be measured at each groundwater monitoring well using an interface probe attached to a measuring tape accurate to 0.01 foot. Field parameters, including turbidity, pH, temperature, oxidation-reduction potential, and dissolved oxygen, will be measured during the groundwater sampling event.

A representative groundwater sample will be collected from each well, using the same low-flow equipment used for purging, directly into laboratory-supplied containers. The filled containers will be immediately placed into an iced cooler for delivery to the laboratory under COC protocols, and will be analyzed for:

- TCL VOCs using USEPA Method 8260;
- TCL SVOCs using USEPA Method 8270;
- TAL metals (total and dissolved) by USEPA Methods 6010/7471;
- TCL pesticides by USEPA Method 8081; and
- TCL PCBs by USEPA Method 8082.
- PFOA/PFAS (NYSDEC list of compounds) using USEPA Method 1633; and
- 1,4-dioxane using a USEPA Method 8270 SIM.

Samples to be analyzed for PFOA/PFAS will be collected using the NYSDEC procedures for these compounds, as documented in the QAPP. All non-dedicated sampling equipment will be decontaminated between wells in accordance with the procedures described in the QAPP and standard industry practices.

3.5 Soil Vapor

A total of 14 temporary soil vapor probes (SV-1 through SV-14) will be installed to target the planned excavation depth for the proposed redevelopment, approximately 12 feet bgs. However, final probe depths may be adjusted in the field based on lithologic observations to better assess soil vapor conditions relative to subsurface materials. In particular, consideration will be given to installing probes both above and below low-permeability units such as the clayey interval identified in previous borings (e.g., SB-2 through SB-5, 7 to 14 feet bgs), to evaluate vertical vapor migration and potential attenuation.

Soil vapor points will be installed in areas where subsurface conditions have been characterized through previous or concurrent soil boring activities, to ensure that probe placement is appropriate for the site-specific geology. Proposed sample locations are shown on **Figure 2** but may be revised based on field conditions. All samples will be collected in accordance with the NYSDOH Guidance Document.

A track-mounted direct-push drill rig will be used to advance a steel rod containing a soil vapor probe to the target sampling depth. Each soil vapor probe will consist of a prefabricated perforated stainless steel or Teflon screen attached to 3/8-inch diameter low-density polyethylene (LDPE) tubing. Once the target depth is reached, the steel rod will be withdrawn, leaving the vapor probe in place.

Clean, inert silica sand or glass beads will be emplaced to fully encapsulate the screened interval. Above the sand pack, a hydrated bentonite seal will be installed to fill the annular space from immediately above the sand pack to grade, ensuring an airtight seal between the probe and surrounding soil. This configuration will prevent ambient air from entering the probe and ensure that the soil vapor sample collected is representative of the target depth. Prior to sampling, and in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York, a tracer gas test will be conducted to verify that each soil vapor probe has been properly sealed to prevent infiltration of ambient outdoor air. Helium will be used as the tracer gas and will be introduced into an enclosure placed over the soil vapor probe tubing. A portable helium detector will be used to measure helium concentrations within the probe.

If the tracer test indicates that the helium concentration inside the probe exceeds 10 percent of the helium concentration introduced into the enclosure (i.e., the ambient concentration in the shroud), the probe seal will be considered compromised. In such cases, the seal will be removed and reinstalled, and the leak test will be repeated until acceptable results are achieved. At the conclusion of sampling, the tracer gas test will be repeated to confirm continued integrity of the probe seal.

Prior to sample collection, at least three tubing volumes will be purged from each soil vapor probe using a low-flow pump capable of maintaining a flow rate that does not exceed 0.2 liters per minute (L/min), in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion. A photoionization detector (PID) capable of detecting volatile organic compounds at parts-per-billion (ppb) concentrations—such as a ppbRAE or equivalent—will be used to screen purge vapors for evidence of contamination.

Following purging, soil vapor samples will be collected over a two-hour period into laboratory-supplied 6-liter Summa canisters that have been pre-cleaned and certified. Analytical samples will be submitted for laboratory analysis of VOCs using USEPA Method TO-15 with Select Ion Monitoring (SIM) to achieve reporting limits of 0.20 micrograms per cubic meter ($\mu g/m^3$) or less for key compounds of concern, including trichloroethene, cis-1,2-dichloroethene, 1,1-

dichloroethene, carbon tetrachloride, and vinyl chloride. These reporting limits will be incorporated into the QAPP for the investigation.

A detailed sampling log will be maintained for each probe, documenting sample identification numbers, dates and times of sample collection, sampling depths, sampler(s), methods and equipment used, purge volumes, total vapor volume extracted, canister vacuum readings before and after sample collection, and chain-of-custody procedures. One outdoor ambient air sample will be collected concurrently with the subsurface vapor samples to document background air quality. The ambient air sample will be collected upgradient of the soil vapor sampling locations based on the prevailing wind direction on the day of sampling.

3.6 Material Handling

All investigation-derived waste (IDW), including soil cuttings, purge water, and development water, will be managed in accordance with NYSDEC DER-10, Section 3.3(e). If grossly contaminated soil or free-phase product is encountered during drilling, the affected drill cuttings and/or purge/development fluids will be containerized in 55-gallon DOT/UN-approved drums. These materials will be labeled with the contents, date, and source location and stored in a secure, designated drum staging area onsite. The staging area will be selected during a preliminary Site visit, prior to the commencement of field activities. Drummed materials will be characterized through laboratory analysis and disposed of off-site at a permitted facility in accordance with applicable local, state, and federal regulations.

Soil cuttings that exhibit no visual or olfactory evidence of contamination and show no elevated PID readings may be returned to the borehole from which they were generated, provided the cuttings are returned to within 12 inches of the ground surface. If warranted, bentonite or similar low-permeability material may be added to reduce vertical migration potential. Any excess uncontaminated cuttings that cannot be returned to the borehole by the end of the workday will be containerized, labeled, and stored for proper characterization and disposal.

Development and purge water not exhibiting field indicators of contamination (e.g., sheens, odors, discoloration, elevated PID readings) will be containerized and stored on-site in properly labeled drums. Field observations and analytical results will be used to determine appropriate disposal methods. Discharge to the ground surface will only occur if approved in advance by the NYSDEC and supported by documentation showing the absence of significant contamination.

All waste handling activities will be documented in the field logs, including the volume of material generated, field observations, storage location, and final disposition.

3.7 Odor and Fugitive Dust Control

In accordance with NYSDEC and NYSDOH requirements, a CAMP will be implemented at the Site during any soil disturbance activities (i.e., drilling of soil borings and installation of monitoring wells and soil vapor probes). The objective of the CAMP will be to provide protection for the surrounding community from potential airborne contaminant releases as a result of intrusive RI activities. The CAMP will consist of two air monitoring stations (one upwind and one downwind of the area where intrusive work is occurring). Each monitoring station will be equipped with instruments to continuously measure and record levels of VOCs and particulates. In addition to the two fixed stations, VOCs will be monitored within the work zone using a hand-held PID. A copy of the CAMP is included in **Appendix C**.

In the event of a dust or odor complaint, and in the event of any exceedance related to the CAMP, the NYSDEC and NYSDOH project managers will be notified within 24 hours. Any CAMP exceedance will be reported to the NYSDEC and the NYSDOH on the same business day and as soon as possible. Notification of the exceedance will be sent via email along with the reason for the exceedance, the measure(s) taken to address the exceedance, and if the exceedance was resolved.

3.8 Site Restoration

The drilling subcontractor will restore all areas disturbed by the RIWP activities to preexisting conditions. Restoration actions will include removal of any temporary facilities, such as decontamination areas and unused materials, and repair or replacement of all asphalt or concrete surfaces damaged during the RI, as applicable.

4.0 QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

In accordance with DER-10 Section 3.3(c)(4) and Appendix 3B, a Qualitative Human Health Exposure Assessment (QHHEA) will be completed as part of the Remedial Investigation to identify and characterize how people may be currently or potentially exposed to site-related contaminants, under both existing and reasonably anticipated future use scenarios. The QHHEA will evaluate potential exposures to on-site and off-site receptors and help determine the need for further action, such as additional data collection, quantitative risk assessment, or development of remedial strategies.

The assessment will begin with development of a **Conceptual Site Model (CSM)**, which will identify:

- Known or suspected contaminant source areas;
- Environmental media that have been impacted or are likely to be impacted in the future;
- Potential release mechanisms and contaminant transport pathways;
- Points of potential exposure;
- Routes of exposure (e.g., inhalation, ingestion, dermal contact); and
- Potentially exposed human receptor populations.

The CSM will be based on current and anticipated future land use, both on-site and in surrounding areas.

Per DER-10 Section 3.3(c)(4)(i–vii), the QHHEA will qualitatively assess the following components:

1. **Identification of Contaminant Sources** – Description of known or suspected on-site sources of contamination.
2. **Contaminant Release and Transport Mechanisms** – Explanation of how contaminants are released to and move through environmental media (e.g., leaching, volatilization, runoff).
3. **Exposure Media and Migration Pathways** – Identification of soil, groundwater, soil vapor, or air as potential exposure media, and description of migration pathways.
4. **Exposure Points and Routes** – Evaluation of current and potential future exposure points and routes, including inhalation, ingestion, or dermal contact.
5. **Receptor Populations** – Identification and characterization of potentially exposed populations, such as on-site workers, nearby residents, or future site occupants.
6. **Exposure Scenarios** – Description of realistic and reasonable exposure scenarios based on land use, receptor behavior, and exposure assumptions.

7. **Uncertainty Analysis** – Identification of key uncertainties or data gaps in the exposure assessment.

Chemical concentrations in environmental media will be compared to applicable NYSDEC criteria and guidance values (e.g., Soil Cleanup Objectives, Ambient Water Quality Standards). Constituents detected at concentrations exceeding relevant standards will be identified as chemicals of potential concern (COPCs). These COPCs will be carried forward for pathway-specific qualitative evaluation.

The QHHEA will be documented in the Remedial Investigation Report and used to inform the need for remedial action or additional data collection.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality control (QA/QC) samples serve as checks on both the sampling and measurements systems and assist in determining the overall data quality with regard to representation, accuracy, and precision. Field duplicates and matrix spike samples are analyzed to assess the quality of the data resulting from the field sampling. Field duplicate samples are individual portions of the same field sample. These samples can be used to estimate the overall precision of the data collection activity. Sampling error can be estimated by the comparison of field sample result and duplicated sample result. During RI sampling, one field duplicate sample will be collected for each 20 samples collected per media. Matrix spikes and matrix spike duplicates are used to evaluate analytical accuracy and precision, respectively. Matrix spikes/matrix spike duplicates (MS/MSDs) will be analyzed by the laboratory at a frequency of one per preparation batch per media. The frequency of QA/QC sampling is detailed in the QAPP, which is included as **Appendix D**.

5.1 Laboratory and Data Preparation

All samples collected during the BCP RI will be analyzed using USEPA-approved analytical methods. The subcontracted laboratory will be certified under the NYSDOH ELAP. Laboratory data will be provided with Analytical Services Protocol (ASP) Category B deliverables and a third-party Data Usability Summary Report (DUSR) will be prepared.

All sample data generated for the RI will be logged in a database and organized to facilitate data review and evaluation and will be submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. The NYSDEC has implemented an Environmental Information Management System (EIMS). The EIMS uses the database software application EQuIS™ from EarthSoft® Inc. Complete data packages will be submitted with supporting tables, which highlight such data as sample location coordinates and proper electronic data deliverable groupings.

The electronic dataset will include the data flags provided in accordance with USEPA Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis and Inorganic Analyses, as well as additional comments of the data review for ASP/CLP analyses. The data flags include such items as: 1) concentration below required detection limit, 2) estimated concentration due to poor recovery below required detection limit, 3) estimated concentration due to poor spike recovery, and 4) concentration of chemical also found in laboratory blank.

5.2 Data Evaluation

The purpose of the data evaluation is to determine the extent of any identified soil, groundwater, and soil vapor impacts associated with the Site, and to assure that data obtained during the implementation of the RI are adequate in quantity and quality, and applicable to project objectives. To make this determination, the data will be reviewed for the quality of data coverage, and completeness, with respect to meeting project objectives.

The data package will be sent to a qualified, independent, data validation specialist for evaluation of the accuracy and precision of the analytical results. A DUSR will be prepared to describe the compliance of the analyses with the analytical method protocols detailed in the NYSDEC ASP. The DUSR will provide a determination of whether the data meets the project-specific criteria for data quality and data use. The validation effort will be completed in accordance with NYSDEC Division of Environmental Remediation DUSR guidelines.

6.0 REPORTING

Daily work reports will be submitted to the NYSDEC and NYSDOH project managers by the end of each day following the reporting period during all ground-intrusive and soil handling activities. These daily reports will include:

- An update of progress made during each day;
- Locations of work being performed;
- Photographs of work completed each day;
- A summary of work planned for the following day;
- The names and titles of staff performing on-site IRM activities;
- A timeline of daily work activities, including start and end times;
- A summary of any and all complaints with relevant details (names, phone numbers);
- A summary of CAMP findings, including exceedances;
- A summary of any data collected in association with IRM activities;
- An explanation of notable site conditions; and
- Any deviations from the approved work plan.

Daily reporting and CAMP monitoring will be conducted during ground-intrusive and soil handling activities. The NYSDEC and NYSDOH will be notified of any CAMP exceedances, including the duration and actions taken in response, as soon as possible and within a maximum of 24 hours of the exceedance event.

Daily reports are **not** intended as the primary means of communication for emergencies (e.g., accidents, spills) or time-critical information such as requests for modifications to the RIWP. Such notifications will be made directly to the NYSDEC PM and NYSDOH PM via personal communication but will also be documented in the daily reports.

Each daily report will include a description of daily activities keyed to a site map identifying work areas. Reports will summarize air sampling results, odors, dust issues, and any corrective actions taken. All public complaints will be reported to the NYSDEC PM and NYSDOH PM immediately upon receipt. The NYSDEC-assigned project number will appear on all reports.

The **Remedial Investigation Report (RIR)** will be prepared in accordance with **DER-10 Section 3.14** and will include a summary of all fieldwork performed, data collected, and supporting documentation. The report will include summary data tables, soil boring logs, well construction details, analytical results, photographs, and figures. If no additional site characterization is required (as anticipated), the RIR will include the Qualitative Human Health Exposure Assessment (QHHEA) described in this Work Plan. If further investigation is required, the QHHEA will be completed following receipt of validated data from the additional sampling.

The RIR will describe contaminant sources, characterize geologic and hydrogeologic conditions at the Site, and assess the quality of soil, soil vapor, and groundwater. Data will be presented in tabular and graphical formats, with figures such as spider diagrams to illustrate contaminant distribution.

Based on RIR findings, the need for remediation will be evaluated. If warranted, a draft Remedial Action Work Plan (RAWP) will be prepared under separate cover. The RAWP will identify and preliminarily screen remedial alternatives, perform detailed evaluation of feasible alternatives, and recommend a preferred remedial approach for review and approval by NYSDEC.

7.0 PROJECT SCHEDULE

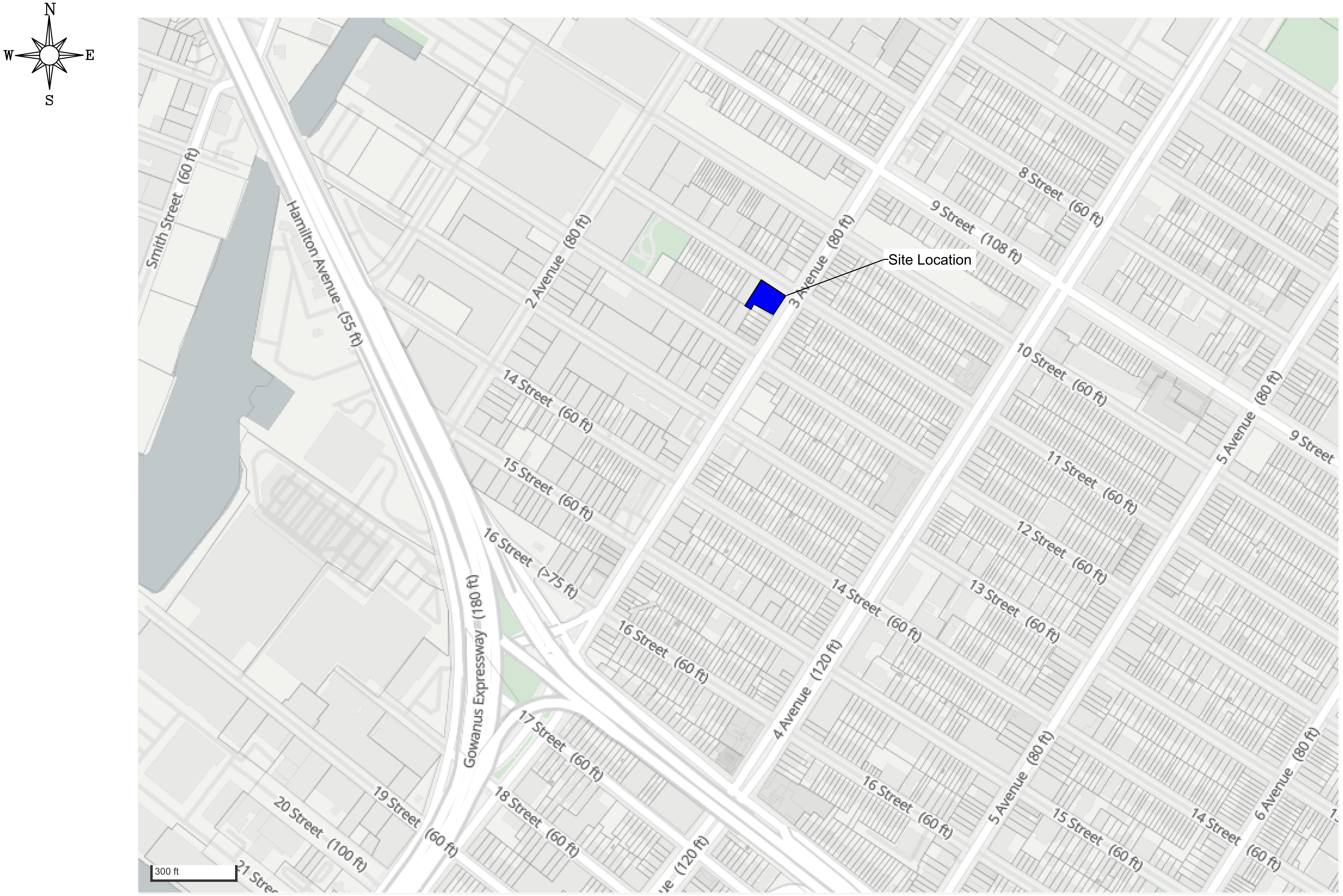
It is estimated that the soil sampling, permanent monitoring well installation and sampling, and soil vapor sampling portions of the scope of work presented in this RIWP can be completed within two weeks (approximately 9 business days). The laboratory results (with the ASP Category B data packages) will be provided with a two week turnaround time, and the data validation and DUSR preparation are expected to be completed within four weeks after receipt of the data. Based on these timeframes, it is expected that project activities will be completed within 14 weeks after RIWP approval by the NYSDEC. As a result, the following project schedule has been developed:

Task	Estimated Duration (business days)	Total Duration (business days)
RIWP approval by NYSDEC	0	0
Pre-sampling activities*	10	10
Soil, groundwater and soil vapor sampling	10	30
Laboratory analysis	10	40
Data validation and DUSR	20	70
Data review and reporting	10**	70

* Includes scheduling with Volunteer and subcontractors, 10-day notification to NYSDEC, and completion of utility mark-out through One Call Center.

** Portions of this task will be conducted concurrently with samples analysis and the data validation tasks – duration shown represents time for completion of the report after receipt of the DUSR.

Figures



LEGEND:

🟦 Site Boundary

ATHENICA ENVIRONMENTAL ENGINEERING PLLC
Environmental Engineering Consultants
31-33 31ST STREET, 2ND FLOOR
ASTORIA, NY 11106
TEL: (718) 784 - 7490
FAX: (718) 784 - 4085

NOTES:

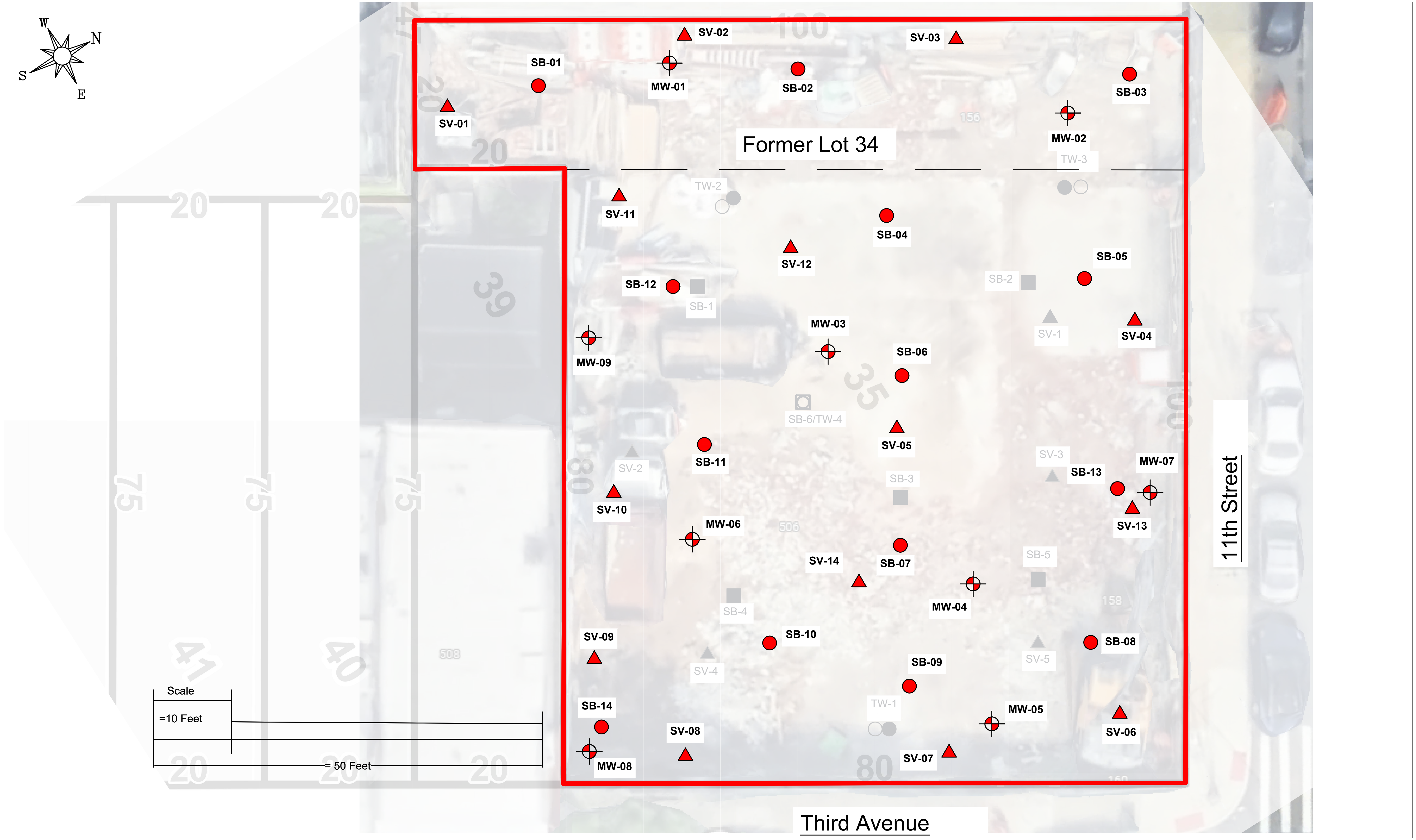
- Adapted from "NYC Zoning and Land Use Map" (ZOLA).

Date:	June 4, 2025
Drawn by:	Evan Greenberg, EIT
Checked by:	Jessica Collins, QEP
Drawing Scale:	As Drawn
Project No.:	25-134-0711

Site: 500 Third Avenue Site
500 Third Avenue, Brooklyn, New York 11215
BCP Remedial Investigation Workplan

Figure: 1

Title: Site Location Map



LEGEND:

🟥	Site Boundary	■	Soil Boring - June 2024 OER RI
		▨	Soil Boring - August 2024 Supplemental OER RI Sampling
●	Proposed Soil Boring	●	Temporary Groundwater Monitoring Wells - June 2024 OER RI
⊕	Proposed Groundwater Monitoring Well	○	Temporary Groundwater Monitoring Wells - August 2024 Supplemental OER RI Sampling
▲	Proposed Soil Vapor Probe	▲	Soil Vapor Probe - June 2024 OER RI/ August 2024 Supplemental OER RI Sampling

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NOTES:

- Basemap adapted from NYC Digital Tax Map and Imagery @2025 Google, Map Data @2025 Google

Date:	June 30, 2025
Drawn by:	Evan Greenberg, EIT
Checked by:	Jessica Collins, QEP
Drawing Scale:	As Drawn
Project No.:	25-134-0711

Site: 500 Third Avenue Site
500 Third Avenue, Brooklyn, New York 11215
BCP Remedial Investigation Workplan

Figure: 2

Title: Proposed Remedial Investigation Sample Locations

Table

Table 1
Proposed Sampling Rationale
500 Third Avenue, Brooklyn, New York

Proposed Testing Location	Sample Medium	Number of Samples	Sample Depth	Location	Laboratory Analysis	Purpose
Borings SB-01 through SB-03	Soil	≥2 per boring	To be determined based on field measurements	Former Lot 34 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals, PFAS and 1,4 Dioxane	Complete characterization of soil contamination at Site
Borings SB-05, SB-08 and SB-13	Soil	≥2 per boring	To be determined based on field measurements	Former Lot 35 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals, PFAS and 1,4 Dioxane	Complete characterization of soil contamination at Site
Borings SB-04, SB-06, SB-07, SB-09 through SB-12, SB-14	Soil	≥2 per boring	To be determined based on field measurements	Former Lot 36 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals, PFAS and 1,4 Dioxane	Complete characterization of soil contamination at Site
Permanent groundwater monitoring wells MW-01 and MW-02	Groundwater	1 per well	To be determined based on field measurements	Former Lot 34 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals (total and dissolved), PFAS and 1,4 Dioxane	Complete characterization of groundwater contamination at the Site
Permanent groundwater monitoring wells MW-04, MW-05, and MW-07	Groundwater	1 per well	To be determined based on field measurements	Former Lot 35 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals (total and dissolved), PFAS and 1,4 Dioxane	Complete characterization of groundwater contamination at the Site
Permanent groundwater monitoring wells MW-03, MW06, MW-08, and MW-09	Groundwater	1 per well	To be determined based on field measurements	Former Lot 36 portion of the Site	VOCs, SVOCs, Pesticides, PCBs, Metals (total and dissolved), PFAS and 1,4 Dioxane	Complete characterization of groundwater contamination at the Site
Soil vapor probe SV-01 through SV-03	Soil Vapor	1 per probe	12' bgs (development depth)	Former Lot 34 portion of the Site	VOCs	Complete characterization of soil vapor contamination at Site
Soil vapor probe SV-04 and SV-06	Soil Vapor	1 per probe	12' bgs (development depth)	Former Lot 35 portion of the Site	VOCs	Complete characterization of soil vapor contamination at Site
Soil vapor probe SV-05 and SV-07 through SV-14	Soil Vapor	1 per probe	12' bgs (development depth)	Former Lot 36 portion of the Site	VOCs	Complete characterization of soil vapor contamination at Site
Outdoor Air Sample OA-1	Outdoor Ambient Air	1 for the Site	Breathing height	To be field-determined	VOCs	Complete characterization of outdoor ambient air contamination at Site

Appendix A
Previous Environmental Reports
(included as a separate file)

Appendix B

Site-Specific Health and Safety Plan

SITE-SPECIFIC HEALTH & SAFETY PLAN

500 THIRD AVENUE
BROOKLYN, NEW YORK 11215

PREPARED FOR:

PAB 3RD AVENUE HOLDINGS, LLC.
135 13TH STREET
BROOKLYN, NEW YORK 11215

PREPARED BY:

ATHENICA ENVIRONMENTAL
SERVICES, INC.
Environmental Consultants

31-33 31st Street, 2nd Floor
Astoria, New York 11106

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FIGURES

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APPENDICES

1.0 *GLOSSARY OF TERMS*

AHA	Activity Hazard Analysis
BZ	Breathing Zone
C	Ceiling Limit
CNS	Central Nervous System
CTPV	Coal tar pitch volatiles
CRZ	Contamination Reduction Zone
CZ	Clean Zone
dBA	Decibels Adjusted
ERCP	Emergency Response and Contingency Plan
EZ	Exclusion Zone
FDNY	New York City Fire Department
GI	Gastrointestinal
HSO	Health & Safety Officer
IP	Ionization Potential
Mg/m^3	Micrograms per cubic meter
MPH	Miles per hour
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Health and Safety Administration
Owner	Street Five 116 LLC
PAHs	Poly aromatic hydrocarbons
PEL	Permissible Exposure Limit
PM	Project Manager
PPE	Personal Protective Equipment
PPM	Parts per Million
PSM	Project Safety Manager
SHASP	Site-Specific Health and Safety Plan
Site	500 Third Avenue, Brooklyn, New York
STEL	Short-term exposure limit (15 minutes)
SZ	Support Zone
TLV	Threshold Limit Value
TWA	Time-weighted average (8 hours)
USEPA	United States Environmental Protection Agency
VP	Vapor Pressure at approximately 68 F° in mm Hg

2.0 INTRODUCTION

The 500 Third Avenue Site is located in an urban area of Brooklyn (Kings County), and currently consists of a one tax parcel totaling 8,400 square feet in area, with an address of 500 Third Avenue (Block 1020, Lot 35), hereafter referenced as the "Site". Previously, the Site consisted of three separate parcels (Lots 34, 35, and 36) that were merged into the current single tax lot (Lot 35) in 2025. The Site is bordered to the northeast (across 11th Street) by a 1-story auto repair shop, to the southwest by a 3-story mixed-use commercial and residential building, to the southeast (across 3rd Avenue) by a 4-story mixed-use commercial and residential building and three 3-story residential buildings, and to the northwest by a 1-story warehouse. Currently, the Site is vacant and used for construction equipment storage, as the building previously occupying Lot 34 of the Site was demolished in approximately 2017 and the buildings previously occupying Lots 35 and 36 of the Site were demolished in 2023.

This Site-Specific Health and Safety Plan (Site-Specific HASP) has been developed by Athenica Environmental Engineering PLLC ("Athenica") for specific activities associated with the construction of a new commercial building at the Site.

This Site-Specific HASP documents the policies and procedures which will protect workers from potential chemical hazards associated with the soils and/or fill at this Site. Other plans and documentation will establish the policies and procedures that will protect workers from potential physical hazards associated with drilling activities at the Site. Forms that will be used to document

This plan assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise during the disturbance of soil/fill at the Site. This Site-Specific HASP was prepared by the general contractor's Environmental Consultant, Athenica. The general contractor and its subcontractors will be required to utilize this plan when working at the Site, and will certify such utilizing the form in Appendix A.

Although this plan focuses on the specific work activities planned for this Site, it must remain flexible because of the nature of this work. Conditions may change and unforeseen situations may arise that require modifications from the original plan. Therefore, Athenica only makes representations or warranties as to the adequacy of this Site-Specific HASP for currently anticipated activities and conditions. This flexibility allows modification by authorized personnel (e.g., Project Manager, Project Safety Manager). All changes to procedures in this plan will be documented in writing using the form provided in Appendix B.

Refusal or failure to comply with this Site-Specific HASP or violation of any safety procedures by field personnel and/or subcontractors may result in immediate removal from the Site following consultation with the Project Safety Manager (PSM) and the Project Manager (PM).

It is expected that this Site-Specific HASP will be implemented at a multi-employer work Site. Information and references within this plan shall in no way imply or alleviate any other Site contractor from their responsibility to comply with any and all applicable State or Federal statutes or regulations regarding the completion of this project. It is the responsibility of each employer to communicate and coordinate work planning so as to prevent their work activities from becoming a potential hazard to other workers at the project Site. Failure to communicate will not alter an employer's responsibilities or obligations for any resulting injuries to their employees.

2.1 SITE HISTORY

According to the May 1, 2024 Phase I Environmental Site Assessment (ESA), the historic Lot 35 portion of the Site was developed with a 3-story building from prior to 1886 until as recently as 2007 (with commercial use shown from 1886 until as recently as 1950, residential and commercial uses from at least 1969 until as recently as 1982, and unspecified manufacturing use from 1986 until as recently as 2007), a 1-story stable from prior to 1886 until as recently as 1915, and a 1-story garage from 1938 until as recently as 2007. The Lot 36 portion of the Site was developed with two 1-story commercial buildings from prior to 1886 until as recently as 2007 (one of these commercial buildings was depicted with office use from 1904 until as recently as 1950), a 1-story stable in 1886, a second 1-story stable from prior to 1886 until as recently as 1915, a 1-story carriage house from 1904 until as recently as 1915, and an additional 1-story building from 1938 until as recently as 2007 (shown as a garage with a gasoline storage tank in 1938, a ceramic laboratory and warehouse in 1950, and a mirror manufacturing facility from 1969 until as recently as 2007). Lots 35 and 36 were combined as Lot 35 in 2024. Lot 34 was merged with Lot 35 in 2025. The Lot 34 portion of the Site was first developed with a 2-story residential building from prior to 1886 until as recently as 2007. The building on the former Lot 34 was demolished circa 2017 and all buildings on the former Lots 35 and 36 were demolished in 2023.

2.2 SCOPE OF WORK

The scope of work for the Remedial Investigation is meant to characterize the Site in support of planned redevelopment in accordance with the requirements of the Brownfields Cleanup Program. The proposed scope of work is as follows:

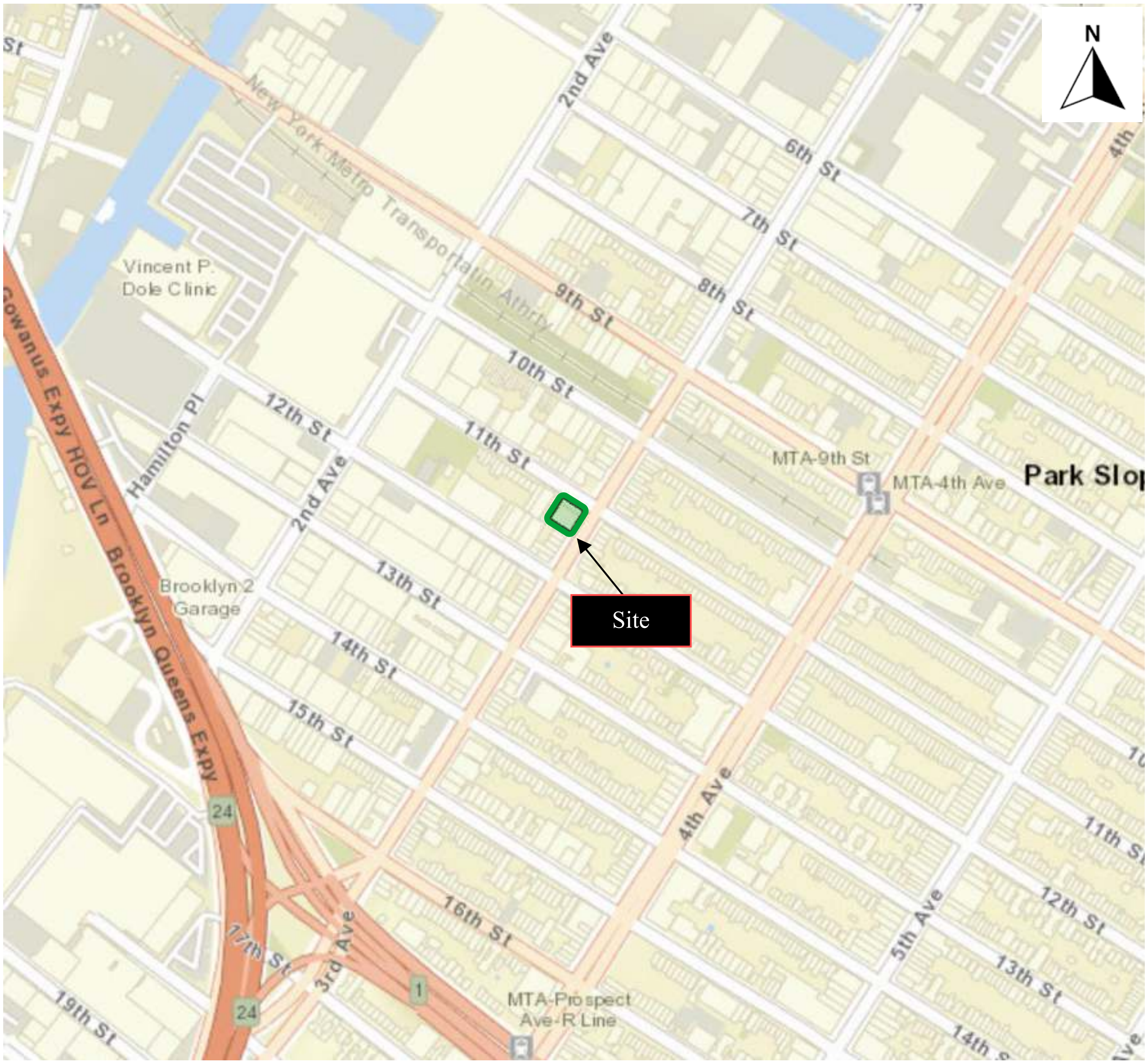
- Advance 12 soil borings (designated SB-01 through SB-12) to groundwater, field screening of soil samples, and selection of at least two soil samples per boring for chemical analysis;

- Install six permanent groundwater monitoring wells (designated MW-01 through MW-06), and collection of 1 groundwater sample per well for chemical analysis;
- Install 11 temporary soil vapor probes (designated SV-01 through SV-11) to a depth of 12 feet bgs (the proposed redevelopment depth), and collection of 1 sample per probe for chemical analysis;
- A New York State–licensed surveyor will survey the horizontal and vertical locations of all soil borings, groundwater monitoring wells, and soil vapor points, to establish horizontal and vertical coordinates relative to a Site-specific datum; and
- Measured depth to water utilizing appropriate field instrumentation and, with the surveyed information, determined the groundwater flow direction at the Site.

The planned redevelopment will consist a new 6-story mixed-use (commercial and residential) building. Based on the recent building plans, the building will have a full cellar, commercial occupancy on the ground floor, and residential occupancy on the second through sixth floors, with a portion of the residential occupancy as affordable housing. Only those activities associated with the disturbance and handling of fill/soil are addressed in this Site-Specific HASP.

This Site-Specific HASP has been prepared and approved for the above scope of work. In order to remain approved, any changes to the scope of work will require amendment of the plan. The Site Health and Safety Amendment Documentation form (Appendix B) will be used for all revisions/amendments to this plan

FIGURE 2-1
SITE LOCATION MAP



3.0 *KEY PERSONNEL*

The Project Manager (PM), Health & Safety Officer (HSO), and Project Safety Manager (PSM) all share responsibilities for formulating and enforcing health and safety requirements, and assuring that the Site-Specific HASP is implemented as intended. This section outlines the responsibilities for each of these positions. Responsibilities for Site employees and subcontractor personnel are also outlined in this section. The General Contractor and/or other authorized personnel may also be involved and identified in future Site-Specific HASP documents, as appropriate.

3.1 PROJECT MANAGER (PM)

The PM has the overall responsibility for the project and to assure that the requirements of the contract are attained in a manner consistent with the Site-Specific HASP requirements. The PM will coordinate with the HSO to assure that the work is completed in a manner consistent with the HASP. The PM will supervise the allocation of resources and staffing to implement specific aspects of the HASP and may delegate authority to expedite and facilitate any application of the program. This role will be filled by the General Contractor or Excavation Subcontractor. OER will be notified in the future who the PM will be for this project.

3.2 HEALTH AND SAFETY OFFICER (HSO)

The HSO is authorized to administer the HASP. The HSO's primary operational responsibilities include personal and environmental monitoring, selection and monitoring of personal protective equipment, assignment of protection levels, coordination/review of work permits and observation of work activities. The HSO is authorized to stop work when an imminent health or safety risk exists. The HSO will review the essential safety requirements with all on-Site personnel and will facilitate the daily safety meetings. OER will be notified in the future who the HSO will be for this project.

Specific responsibilities for HSO performance include:

- Monitoring workers for signs of stress, such as cold stress, heat stress, and fatigue. Reevaluating Site conditions on an on-going basis.
- Coordinating protective measures including engineering controls, work practices and personal protective equipment.
- Conducting and preparing reports of daily safety inspections of work processes, Site conditions, and equipment conditions.
- Initiating revisions of the Site-Specific HASP as necessary for new tasks or modifications of existing operations and submitting to the Project Safety Manager for approval (see Appendix B).

- Performing air monitoring as required by the Site-Specific HASP.
- Assisting the PM in incident investigations.
- Preparing permits for special operations, e.g., hot work, confined spaces, line breaking, etc.
- Maintaining Site safety records.
- Conducting inspections of all fire extinguishers, first-aid kits and eye washes on a regular basis.
- Informing subcontractors of the elements of the Site-Specific HASP.

3.3 PROJECT SAFETY MANAGER (PSM)

The Project Safety Manager (PSM) is responsible for developing/reviewing the Site-Specific HASP and ensuring that it is complete and accurate. The PSM provides technical and administrative support and will be available for consultation when required. If necessary, the PSM will direct modifications (Appendix B) to specific aspects of the HASP to adjust for on-Site changes that affect safety. The HSO will coordinate with the PSM on necessary modifications to the HASP. The PSM may make periodic visits to the project Site to review implementation of this HASP. This role is role will be filled by the General Contractor's representative.

3.4 EMPLOYEE SAFETY RESPONSIBILITIES

Each employee is responsible for personal safety as well as the safety of others in the work area and is expected to participate fully in the Site safety and health program. Employees will use all equipment provided in a safe and responsible manner. Employees shall report any hazardous conditions which might affect the health and safety of Site personnel to the HSO. To protect the health and safety of all personnel, Site employees that knowingly disregard safety policies/procedures will be subject to removal.

Specific requirements include:

- Reading the Site-Specific HASP and any amendments prior to the start of on-Site work.
- Providing documentation of any applicable medical surveillance and training to the HSO prior to the start of work.
- Attending the pre-entry briefing prior to beginning on-Site work as well as other scheduled safety meetings.
- Asking any questions or reporting concerns regarding the content of the Site-Specific HASP to the HSO prior to the start of work.
- Reporting all potentially dangerous situations, incidents, injuries, and illnesses, regardless of their severity, to the HSO.

- Complying with the requirements of this Site-Specific HASP and the requests of the HSO.

4.0 *ACTIVITY HAZARD ANALYSIS*

This section outlines the potential chemical and physical hazards which workers may be exposed to during work on this project. The assessment of chemical hazards in this section is based on the results of samples collected at the Site by Athenica as part of the Remedial Investigation, as documented in the Remedial Investigation Report. This is a representative list of contaminants that have been identified through extensive soil and groundwater testing at this Site.

4.1 CHEMICAL HAZARDS

Based on review of the Remedial Investigation Report and Supplemental Sampling Report, workers at this Site have the potential to be exposed to chemicals in soil including common polycyclic aromatic hydrocarbons (PAHs) associated with historic fill material, metals such as lead, barium, copper, zinc, and mercury, as well as pesticides such as 4,4'-DDD, 4,4'-DDT, and dieldrin. All listed compounds will be considered as potential contaminants of concern.

Potential exposure to the contaminants of concern may occur during ground intrusive soil activities or where direct contact with the contaminated soil takes place. PAHs, metals, and pesticides are primarily inhalation hazards and exposure can be minimized with simple dust control measures. A summary of hazard information is listed in Table 4-1.

The following general symptoms may indicate exposure to a hazardous material. Personnel will be removed from the work Site and provided immediate medical attention should any of the following symptoms occur:

- Dizziness or stupor
- Nausea, headaches, or cramps
- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns

TABLE 4-1
CHEMICAL DATA

COMPOUND	ACGIH TLV	OSHA PEL	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
PAHs	0.2 mg/m^3	0.2 mg/m^3	Inhalation Ingestion Skin contact	Headache, nausea, vomiting, and diaphoresis	Genitourinary system, hematopoietic system, GI tract, respiratory system, eyes, skin	Liquid, gas and solid, can be combustible
Lead	0.05 mg/m^3	0.05 mg/m^3	Inhalation Ingestion Skin contact	Weakness, lassitude, insomnia; facial pallor; eye irritation, anorexia, low-weight, malnutrition; constipation; abdominal pain; colic; hypertension, anemia; gingival lead line; tremors; paralysis of wrist, ankles; encephalopathy; neuropathy	GI tract, CNS, kidneys, blood, gingival tissue	Non-combustible solid
Barium	0.5 mg/m^3	0.5 mg/m^3	Inhalation Ingestion Skin contract	Irritation of eyes and skin; coughing; shortness of breath	Respiratory system, kidneys	Silver to white solid
Copper	1.0 mg/m^3 (as dust)	1.0 mg/m^3	Inhalation Ingestion Skin contact	Irritation of eyes, skin, and nose; metallic taste	Eyes, skin, respiratory system, kidneys, liver, brain	Reddish, odorless solid
Mercury	0.25 g/m^3	0.1 mg/m^3	Inhalation Ingestion Skin contact	Inflammation of eyes and skin; coughing; choking; shortness of breath; death	Blood, kidneys, liver, brain, peripheral nervous system, CNS	Non-combustible liquid
Zinc	Not established	Not established	Inhalation Ingestion Skin Contact	Irritation of eyes, skin, throat and nose	Blood, kidneys, pancreas, liver, brain, and respiratory system	Bluish-silver lustrous metal, odorless, non-combustible solid
4,4'-DDD	262 mg/m^3	260 mg/m^3	Inhalation Ingestion Skin Contact	Irritation of nose, throat, and eyes; dizziness, headaches, and vomiting	Nervous system, liver, and reproductive system,	Colorless, alcohol-like (odor) fluid; highly flammable liquid and vapor

4,4'-DDT	1,401 mg/m^3	2,350 mg/m^3	Inhalation Ingestion Skin Contact	Irritation/paresthesia of nose, throat, and eyes; anxiety, dizziness, headaches, and vomiting	Nervous system, liver, and reproductive system,	Colorless and nearly odorless liquid and vapor
Dieldrin	0.1 mg/m^3	0.25 mg/m^3	Inhalation Ingestion Skin Contact	Irritation of nose, throat, and eyes; headaches, dizziness, vomiting, and uncontrolled muscle movements	Nervous system, liver, and reproductive system,	Light-tan non-combustible solid

Abbreviations

ACGIH = American Conference of Governmental Industrial Hygienists
C = Ceiling Unit
CNS = Central Nervous System
CVS = Cardiovascular System
GI = Gastrointestinal
TLV = Threshold Level Value
mg/m^3= milligrams per cubic meter
OSHA = Occupational Safety and Health Administration
PNS = Peripheral Nervous System
ppm = parts per million
PEL = Permissible Exposure Level

4.2 PHYSICAL HAZARDS

To minimize physical hazards, standard safety protocols will be followed at all times. Failure to follow safety protocols may result in removal of the employee from the Site. All personnel shall be familiar with the physical hazards presented by each of the tasks they perform. Task specific hazard analyses are provided in Section 4.5. These hazard analyses shall be reviewed prior to beginning each task and periodically throughout the task. It must be noted that these activity hazard analyses are general in nature.

The HSO will observe the general work practices of each crew member and enforce safe procedures. Work areas will be inspected by the crew leaders, HSO. All hazards will be corrected in a timely manner. A variety of physical hazards may be encountered during work activities at this Site. Activity Hazard Analyses will be developed for each principal activity and will identify all major hazards to which employees may be exposed. Hard hats, safety glasses, and steel-toe safety boots are required in all work areas of the Site. Site-specific hazards and all necessary precautions will be discussed at the daily safety meetings. The General Contractor's Safety Manual will be maintained at the project Site as a reference document.

4.3 ENVIRONMENTAL HAZARDS

Environmental factors such as weather, wild animals, insects, and irritant plants may pose a hazard when performing outdoor tasks. The HSO will take necessary actions to alleviate these hazards should they arise.

4.3.1 *Heat Stress*

The combination of warm ambient temperature and protective clothing increases the potential for heat stress. Heat stress disorders include:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

This information will be reviewed during safety meetings. Workers are encouraged to increase consumption of water and electrolyte-containing beverages, e.g., Gatorade™. Heat stress can be prevented by assuring an adequate work/rest schedule. Guidelines are presented below.

The HSO will determine the specific work-rest schedule based on project specific conditions. In addition, workers are encouraged to take rests and report symptoms whenever they feel any adverse effects that may be heat-related. The frequency of breaks may need to be increased based on worker recommendation to the HSO. The HSO will determine the specific work-rest schedule based on project specific conditions. In addition, workers are encouraged to take rests and report symptoms whenever they feel any adverse effects that may be heat-related. The frequency of breaks may need to be increased based on worker recommendation to the HSO.

Heat stress can be prevented by assuring an adequate work/rest schedule and adequate fluid consumption. A guide for work-rest schedules for various protection levels (defined in Section 5.0) is given below. The number of hours before a work-rest period is based on experience with similar work. The time periods should be considered maximum. It must also be remembered that individual physical variability and differences in physical work activities may require revisions to Site plans. This table should be used as a guide. Professional judgment (evaluation of individual work load, ambient weather conditions, worker acclimatization and PPE levels) of the HSO is necessary to assure a fully protective plan to prevent heat stress disorders.

GUIDELINES FOR WORK-REST PERIODS
FOR VARIOUS PROTECTION LEVELS (A-D)
NUMBER OF HOURS BEFORE REST PERIOD

Temperature	Level D	Level C	Level B	Level A
90+ F*	2.0	1.5	1.0	0.5
87.5 F	2.5	2.0	1.5	1.0
82.5 F	3.0	2.5	2.0	1.5
77.5 F	3.5	3.0	2.5	1.5
72.5	4.0	3.5	2.5	1.5

**Work above 100 F will be reviewed with the Project Safety Manager to determine specific requirements.*

Alternately the work/rest schedule can be calculated based on heat stress monitoring results. Monitoring consists of taking the radial pulse of a worker for 30 seconds immediately after exiting the work area. The frequency of monitoring is described below.

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by 1/3 and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, increase the following rest period by 1/3. The initial rest period should be at least 5 minutes.

Body temperature, measured orally or through the ear canal, may also be monitored to assess heat stress. Workers should not be permitted to continue work when their body temperature exceeds 100.4 F (38C). Monitoring should be conducted at the beginning of each break period as noted above.

Monitoring for heat stress will begin when the ambient temperature reaches or exceeds 72.5 degrees Fahrenheit when wearing chemical protective clothing (Level C, B, A), or 80 degrees Fahrenheit for Site activities performed with no chemical protective clothing (Level D). Monitoring should include pulse rate, weight loss, oral/ or ear canal temperature, signs and symptoms of heat stress and fluid intake.

An additional measure that can be employed to minimize heat stress is through the utilization of Heat Stress Relief Stations. A Heat Stress Relief Station (HSRS) is a location inside the exclusion zone where workers can partially remove their personal protective equipment, rest and take in fluids. Since the HSRS is established inside the exclusion zone, it is imperative that its use be closely monitored and controlled to ensure that workers do not ingest contamination during use.

The following is a detailed description of the Heat Stress Relief Station:

- Location- The HSRS should be located in an area of the exclusion zone where it will be predominantly upwind of Site activities. This can typically be adjacent to the contamination reduction zone.
- Delineation- The HSRS must be separated from the exclusion zone by temporary fencing and must be labeled as “Heat Stress Relief Station”.
- Elements- The HSRS contains several elements:
    - A tarp or tent for shade;
    - A bench or chairs for workers to sit on;
    - A wash station;
    - A table for fluids, cups and clean personal protective equipment (PPE); and
    - A trash can for contaminated PPE.
- Set-Up- Proper set up of the HSRS is imperative its successful use.
    - In the Support Zone, prepare the water cooler with ice and water or Gatorade.
    - The person bringing the items to the HSRS must don the appropriate PPE required for the Exclusion Zone.
    - Bring the following items to the HSRS:
        - Cooler;
        - Clean disposable cups;
        - Disinfectant wipes;
        - A clean trash bag;
        - Surgical gloves; and
        - Duct tape.

    - Ensure the wash station has clean water and paper towels for drying hands/face.
- Procedure for Use- In order for the HSRS to be effective, it must be properly used. It is imperative that workers decontaminate properly before drinking fluids so that ingestion of Site contaminants does not take place. The following are the steps to properly use the HSRS:
    - Upon entering the HSRS:
        - If wearing a Tyvek, remove duct tape on wrists and unzip and tie around waist;
        - Remove your outer gloves and surgical gloves; set outer gloves aside and throw surgical gloves into trash;
        - Wash hands and/or face at Wash Station;
        - Use disinfectant wipe on hands;
        - Get drink and/or rest on bench/chair.
    - Before re-entering the Exclusion Zone:
        - Dispose of cups in trash;
        - Put on a clean pair of surgical gloves;
        - If wearing a Tyvek, pull up and rezip;
        - Re-apply duct tape to wrists;
        - Put on outer gloves.
- Monitoring- The HSO are both responsible for monitoring the use of the Heat Stress Relief Station. The HSO should review the procedures for use of the HSRS with the workers before its use begins to ensure that everyone understands the parameters for proper use.

4.3.2 *Exposure to Cold*

With outdoor work in the winter months, the potential exists for hypothermia and frostbite. Several forms of cold stress as well as preventative measures are described in this section of the HASP.

4.3.2.1 *Cold Stress Conditions and Symptoms*

Typical cold stress conditions are included in the tables below, including symptoms and first aid precautions. If cold stress conditions develop, professional medical attention will be sought.

TABLE 4.3.2A
COLD WEATHER INJURIES

Cause	Symptoms	First Aid
Frostbite		
Freezing of tissue, normally due to exposure below 32°F	Numbness in affected area. Tingling, blistered, swollen or tender areas. Pale, yellowish waxy-looking skin.	Warm affected area with direct body heat. Consult with medical personnel ASAP. **Do not** thaw frozen area if treatment will be delayed. **Do not** massage or rub affected area. **Do not** wet area or rub with snow or ice.
Chilblain		
Repeated exposure of bare skin for prolonged periods to temperatures 20° to 60°F (for those not acclimated to cold weather).	Swollen, red skin. Tender, hot skin, usually accompanied by itching.	Warm affected area with direct body heat. **Do not** massage or rub. **Do not** wet area or rub with snow or ice. **Do not** expose affected area to open fire, stove or any other intense heat source.
Immersion Foot (Trench Foot)		
Prolonged exposure of the feet to wet conditions at temperatures between 32° to 50°F. Inactivity and damp socks (or tightly laced boots that impair circulation) speed onset and severity.	Cold numb feet may progress to hot with shooting pains. Swelling redness and bleeding.	Rewarm feet by exposing them to warm air. Evacuate victim to a medical facility. **Do not** massage, rub, moisten or expose affected area to extreme heat source.
Dehydration		
Depletion of body fluids.	Dizziness. Weakness.	Replace lost water. Water should be sipped not gulped. Get medical treatment.
Hypothermia		
Prolonged cold exposure and body heat loss. May occur at well above freezing, especially when a person is immersed in water.	Lack of shivering. Drowsiness, mental slowness, lack of coordination. Can progress to unconsciousness, irregular heartbeat and death.	Strip off clothing and wrap victim in blankets or a sleeping bag. Get victim to a heated location and medical treatment as soon as possible.

In cold weather, the potential for frostbite exists, especially in body extremities. Personnel will be instructed to pay particular attention to hands, feet, and any exposed skin when dressing. Personnel will be advised to obtain more clothing if they begin to experience loss of sensation due to cold exposure.

4.3.2.2 *Monitoring and Preventative Actions*

Typical cold stress monitoring procedures are included in the tables below, including temperatures to initiate monitoring, protective clothing uses and administrative practices to prevent or reduce the potential for cold stress related injury/illness. For weather conditions below -43 °C or -45 °F with no wind and/or similar conditions (see Work/Warm-up Table) all work will cease.

TABLE 4.3.2B
COLD STRESS PREVENTION*

	Temperature	**Preventative Action**
1	<61°F	Use thermometer to measure ambient temperature.
2	<40°F	Cold weather protective clothing available; check core body temperature at breaks using oral or ear canal thermometer. Maintain core body temperature above 96.8°F to avoid hypothermia.
3	<30°F	Record ambient temperature and wind speed every 4 hours; compare to wind chill chart when below 19.4°F.
4	<19°F	Provide and use heated warming shelters for work breaks and when cold stress symptoms appear.
5	<10°F	Constant observation of workers, i.e., "buddy system"; rest in heated shelters (see work-rest schedule); dry clothing available for change-out; acclimate new workers.
6	<0°F/ >5 mph winds	Obtain medical certification for workers subject to hypothermia risk.

** Based on "2009 ACGIH Threshold Limit Values... for Physical Agents."*
Note: refer to wind-chill and work-warmup charts in Table 4.3.2E

TABLE 4.3.2C
COLD WEATHER CLOTHING REQUIREMENTS

1	If wind chill is a factor at a work location, the cooling effect of the wind shall be reduced by shielding the work area or providing employees an outer windbreak layer garment.
2	Extremities, ears, toes, and nose shall be protected from extreme cold by protective clothing.
3	Employees performing light work whose clothing may become wet shall wear an outer layer of clothing which is impermeable to water.
4	Employees performing moderate to heavy work whose clothing may become wet shall wear an outer layer of clothing which is impermeable to water.
5	Outer garments must provide for ventilation to prevent wetting of inner clothing by sweat, or if not possible, a heated shelter for warming/drying clothing, or a change of clothing, shall be provided prior to returning to work in a cold environment.

Protective clothing greatly reduces the possibility of hypothermia in workers. However, personnel will be instructed to wear warm clothing and to stop work to obtain more clothing if they become too cold. Employees will also be advised to change into dry clothes if their clothing becomes wet from perspiration or from exposure to precipitation.

Employees will be instructed to use heated shelters on-Site, at regular intervals, depending upon the severity of ambient temperatures. Symptoms of cold stress, including heavy shivering, excessive fatigue, drowsiness, irritability, or euphoria necessitate immediate return to the shelter.

TABLE 4.3.2D
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE *(under calm conditions)**

	Actual Temperature Reading (F)											
Estimated Wind Speed (in MPH)	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind Speeds greater than 40 mph have little additional effect.)	***Little Danger*** In < hr with dry skin. Maximum danger of false sense of security				***Increasing Danger*** Danger of freezing of exposed flesh within one minute.				***Great Danger*** Flesh may freeze within 30 seconds.			
	Trench foot and immersion foot may occur at any point on this chart.											

**Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA. (Shaded area) Equivalent chill temperature requiring dry clothing to maintain core body temperature above 36 C (98.6 F) per cold stress TLV.*

TABLE 4.3.2E
TLV WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature – Sunny Sky		No Noticeable Wind		5 mph wind		10 mph wind		15 mph wind		20 mph wind	
C (appx.)	F (appx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26 to -28	-15 to -19	Normal	1	Normal	1	75 min	2	55 min	3	40 min	4
-29 to -31	-20 to -24	Normal	1	75 min	2	55 min	3	40 min	4	30 min	5
-32 to -34	-25 to -29	75 min	2	55 min	3	40 min	4	30 min	5	Non-Emergency work should cease	
-35 to -37	-30 to -34	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38 to -39	-35 to -39	40 min	4	30 min	5	Non-emergency work should cease					
-40 to -42	-40 to -44	30 min	5	Non-emergency work should cease							
< -43	< -45	Non-emergency work should cease									

* *Adapted from Occupational Health and Safety Division, Saskatchewan Department of Labor*

4.3.3 *Biological Hazards*

The contractor will be required to monitor and control insects, rodents, and other pests identified on-Site. Standing water will not be allowed on-Site, in an effort to control insects. Pest control procedures used by the contractor will include bait, trap, spray, or other means to abate pest problems that develop on-Site during disruption activities.

4.3.4 *Noise*

Hearing protection is required for workers operating or working near heavy equipment, where the noise level is greater than 85 dbA (Time Weighted Average). The HSO will determine the need and appropriate testing procedures, (i.e., sound level meter and/or dosimeter) for noise measurement. The provisions for noise protection for workers are presented in other safety-related documents for the Site.

4.4 VEHICLE AND HEAVY EQUIPMENT SAFETY

4.4.1 *Vehicle Safety*

Motor vehicle incidents are the number one cause of occupational fatalities, accounting for one in three deaths. The safety provisions for vehicle use at the Site are presented in other safety-related documents for the Site.

4.4.2 *Heavy Equipment Safety*

The use of drilling equipment and backhoes (if needed for any potential test pits) and other material handling equipment will present various physical hazards. The safety provisions for heavy equipment use at the Site are presented on other safety-related documents for the Site.

5.0 *WORK AND SUPPORT AREAS*

To prevent migration of contamination from personnel and equipment, work areas will be clearly specified as designated below prior to beginning operations. Each work area will be clearly identified using signs or physical barriers.

5.1 EXCLUSION ZONE (EZ)

The EZ is the area suspected of contamination and presents the greatest potential for worker exposure. Personnel entering the area must wear the mandated level of protection for that area. In certain instances, different levels of protection will be required depending on the tasks and monitoring performed within that zone. The EZ for this project will include the areas where ground intrusive activities are likely to occur.

5.2 CONTAMINATION - REDUCTION ZONE (CRZ)

The CRZ or transition zone will be established between the EZ and support zone (SZ). In this area, personnel will begin the sequential decontamination process required to exit the EZ. To prevent off-Site migration of contamination and for personnel accountability, all personnel will enter and exit the EZ through the CRZ. The CRZ for this project will be the access/egress routes to/from the EZ and the personnel and equipment decontamination stations.

5.3 SUPPORT ZONE (SZ)

The SZ serves as a clean, control area. Operational support facilities are located within the SZ. Normal work clothing and support equipment are appropriate in this zone. Contaminated equipment or clothing will not be allowed in the SZ. There will be a clearly marked controlled access point from the SZ into the CRZ and EZ that is monitored closely by the HSO to ensure proper safety protocols are followed. The SZ will be any office areas/trailers and the parking and visitor access ways to the project Site.

5.4 SITE CONTROL LOG

A log of all personnel visiting, entering or working on the Site shall be maintained in the main office location. The log will record the date, name, company or agency, and time entering or exiting the Site.

No visitor will be allowed in the EZ without showing proof of training and compliance with applicable medical monitoring requirements. Visitors will supply their own protective equipment, including hard hat, boots and respiratory equipment, if required. Visitors will attend a Site orientation given by the HSO and sign the HASP.

5.5 GENERAL

The following items are requirements to protect the health and safety of workers and will be discussed in the safety briefing prior to initiating work on the Site.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand to mouth transfer and ingestion of contamination is prohibited in the EZ and CRZs.
- Hands and face must be washed upon leaving the EZ and before eating, drinking, chewing gum or tobacco and smoking or other activities which may result in ingestion of contamination.
- During Site operations, each worker will consider himself as a safety backup to his/her partner. All personnel will be aware of dangerous situations that may develop.
- Visual contact will be maintained between workers on-Site when performing hazardous duties.
- No personnel will be admitted to the Site without the proper safety equipment, training, and medical surveillance certification.
- All personnel must comply with established safety procedures. Any Site personnel who do not comply with safety policy, as established by the HSO, will be dismissed from the Site.
- Proper decontamination procedures must be followed before leaving the Site.
- All Site workers are authorized to stop work if they observe unsafe actions of workers or other unsafe conditions on-Site which may cause an imminent danger.
- All workers and visitors must sign in and out of the Site.

6.0 *PROTECTIVE EQUIPMENT*

This section specifies the levels of personal protective equipment (PPE) which are or may be required for each principal activity performed at this Site. All Site personnel must be trained in the use of all PPE utilized.

6.1 ANTICIPATED PROTECTION LEVELS

The following protection levels have been established for the Site work activities based on-Site information concerning the levels of contaminants and the scope of work. Results of Site air monitoring and visual inspection of the work activities may indicate the need for changes in final PPE level(s). Changes in the initial PPE levels prescribed in the table below require completion of the HASP amendment form in Appendix B.

Task	Initial PPE Level	Upgrade/ Downgrade PPE Level	Skin Protection	Respiratory Protection	Other PPE
Drilling Activities	Level D	—	Generally, none	None	Hard-hat, steel-toe work boots, safety glasses, safety vests. Leather work gloves as needed. Hearing protection when >85 dBA.
Mobilization/ Demobilization	Level D	—	Generally, none	None	Hard-hat, steel-toe work boots, safety glasses, safety vests. Leather work gloves as needed. Hearing protection when >85 dBA.

6.2 PROTECTION LEVEL DESCRIPTIONS

This section lists the minimum requirements for each protection level. Modification to these requirements may have been noted in the table shown above.

6.2.1 *Level D*

Level D consists of the following:

- Safety glasses with side shields
- Hard hat
- Steel-toed work boots
- Work clothing as prescribed by weather
- Leather work gloves when material handling

7.0 *DECONTAMINATION PROCEDURES*

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination when they leave the work Site.

7.1 PERSONNEL DECONTAMINATION

Decontamination procedures will ensure that material which workers may have contacted in the EZ does not result in personal exposure and is not spread to clean areas of the Site. This sequence describes the general decontamination procedures for Level D. The specific stages will vary depending on the Site, the task, the protection level, etc. Dry decontamination may be used if there is insufficient space to support a full decontamination station as delineated with the steps below and approved by the HSO. The HSO will ensure that the decontamination procedures are adequate.

Level D Decontamination

1. Go to end of EZ
2. Cross into CRZ
3. Wash face and hands

7.1.1 *Suspected Contamination*

Any employee suspected of sustaining skin contact with chemical materials will first use the emergency shower. Following a thorough drenching, the worker will proceed to the decontamination area. Here the worker will remove clothing and don clean clothing. Medical attention will be provided as determined by the degree of injury.

7.1.2 *Personal Hygiene*

Personnel will wash hands, arms, neck and face, following decontamination and before any eating, smoking, or drinking.

7.2 EQUIPMENT DECONTAMINATION

Heavy equipment and other vehicles operated within the EZ will be decontaminated before being removed from the Site. Workers operating the equipment/vehicles will move the equipment to a gross decontamination location near the exit of the EZ. Following gross decontamination, the equipment/vehicle will be moved to the decontamination pad. Equipment decontamination will be performed on the pad until the equipment is visually clean. Following decontamination activities equipment will be inspected by the HSO prior to leaving the Site. Once the equipment is inspected it will be removed from the Site.

Heavy Equipment / Vehicle Decontamination

1. Equipment operator will move the heavy equipment / vehicle to a position near the EZ / CRZ interchange
2. Worker will use manual equipment (shovel, track spade) to remove gross contamination from tracks, bucket, dump box, and vehicle undercarriage (as required)
3. Following removal of gross decontamination equipment will be moved onto the decontamination pad and pressure washed / steam cleaned until equipment / vehicle is visually clean.
4. Equipment / vehicle decontaminated for removal from the Site will be moved to a clean area for the HSO inspection.
5. Once the equipment / vehicle is inspected and approved it will be removed from the Site. Vehicles that fail inspection will be returned to the decontamination pad for further cleaning and re-inspected.

All non-dedicated sampling equipment in contact with soil samples will be decontaminated between boring locations in accordance with standard industry practices using a solution of non-phosphate detergent (e.g., Alconox®) and potable water, followed by a clean potable water rinse. After completion of soil sampling, borings will be abandoned in accordance with NYSDEC protocols.

7.3 DISPOSAL OF WASTES

Wastes will be disposed according to applicable Local, State and Federal regulations.

7.4 DUST /EROSION CONTROL

The contractor will control dust and implement erosion control measures to be protective of nearby ecologically sensitive areas and sensitive receptors.

8.0 *AIR MONITORING*

Air monitoring will be conducted in order to characterize personnel exposures and fugitive emissions from Site contaminants. Principal contaminants of concern are listed in Section 4.0 of this HASP. The target compounds selected for air monitoring purposes for this Site include particulates. Results of air monitoring will be used to ensure the proper selection of protective clothing and equipment, including respiratory protection, to protect on-Site personnel and off-Site receptors from exposure to unacceptable levels of Site contaminants. Descriptions of air monitoring strategies, procedures and equipment are provided below. Modification of this plan, including additional monitoring, may be considered as judged necessary by the PSM, in conjunction with the HSO.

8.1 WORK AREA AIR MONITORING

Work area air monitoring will include direct reading methods and personal exposure monitoring. Air monitoring will be conducted during all ground intrusive activities at the Site.

8.1.1 *Direct Reading Air Monitoring*

During active sifting operations, direct reading air monitoring will be performed to determine the potential for worker exposure to airborne hazards. A summary of air monitoring information is provided in section 8.1.5. Real-time air samples will be taken at least four times each 8-hour worker shift in the workers breathing zone (BZ).

8.1.2 *Instrumentation*

The following is a description of the air monitoring equipment to be used:

- MIE PDR-1000 Personal DataRAM, Dust trak or equivalent unit for real-time measuring particulates.

8.1.3 *Use and Maintenance of Survey Equipment*

All personnel using field survey equipment must have training in its operation, limitations, and maintenance. Maintenance and internal or electronic calibration will be performed in accordance with manufacturer recommendations by individuals familiar with the devices before their use on-Site. Repairs, maintenance, and internal or electronic calibration of these devices will be recorded in an equipment maintenance logbook. The equipment maintenance logbook for each instrument will be kept in that instrument’s case. For rented monitoring equipment, repairs and maintenance will be conducted by the rental company. Daily calibration records will be documented on a log sheet found in Appendix D.

Air monitoring equipment will be calibrated before work begins. Only basic maintenance (such as changing batteries) will be performed by on-Site personnel. Any additional maintenance or repairs will be performed by a trained service technician.

8.1.4 *Air Monitoring Recordkeeping*

The HSO will ensure that all air-monitoring data is recorded on a data sheet found in Appendix D. The PSM may periodically review this data.

8.1.5 *Action Levels*

During all ground intrusive activities at the Site, direct reading air monitoring will be performed in the EZ to determine exposure to workers. A summary of air monitoring information is provided in the table below.

Monitoring Device	Monitoring Location/Personnel	Monitoring Frequency	Action Level	Action
pDr-1000, or equivalent (Dust)	Drilling, Soil excavation areas, technicians, equipment operators	Four times every 8-hour shift during soil disturbance activities	<5.0 mg/m^3 *	Level D
			≥ 5.0 mg/m^3 *	Stop work; notify PSM Implement dust suppression measures and resume work after dust levels are below action level

** Sustained levels in the breathing zone for 5 minutes*

As indicated by the below calculations, the action level for PAHs, pesticides and the metals of concern was selecting based on the OSHA PEL for respirable dust, which was found to be significantly lower than the calculated actions levels for PAHs and copper, lead, mercury, and zinc based on utilizing the highest concentrations of these contaminants found in soil.

- OSHA PEL for respirable dust: 5 mg/m^3.
- Maximum concentration of PAHs found in soil is 5.65 ppm or 0.000565%.
  - 5.0 mg/m^3 multiplied by 0.000565% = 0.002825 mg/m^3.
  - OSHA PEL for PAHs is 0.2 mg/m^3.
- Maximum concentration of lead found in soil is 1,690 ppm or 0.1690%.
  - 5.0 mg/m^3 multiplied by 0.1690% = 0.845000 mg/m^3.
  - OSHA PEL for lead is 0.05 mg/m^3.
- Maximum concentration of barium found in soil is 370 ppm or 0.0370%.

  - 5.0 mg/m^3 multiplied by 0.0370% = 0.185000 mg/m^3.
  - OSHA PEL for barium is 0.5 mg/m^3.
- Maximum concentration of copper found in soil is 72.6 ppm or 0.00726%.
  - 5.0 mg/m^3 multiplied by 0.00726% = 0.036300 mg/m^3.
  - OSHA PEL for copper is 1.0 mg/m^3.
- Maximum concentration of mercury found in soil is 1.25 ppm or 0.000125%.
  - 5.0 mg/m^3 multiplied by 0.000125% = 0.000625 mg/m^3.
  - OSHA PEL for mercury is 0.1 mg/m^3
- Maximum concentration of 4,4'-DDD found in soil is 0.00446 ppm or 0.000000446%.
  - 5.0 mg/m^3 multiplied by 0.000000446% = 0.000002 mg/m^3.
  - OSHA PEL for lead is 260 mg/m^3.
- Maximum concentration of 4,4'-DDT found in soil is 0.0725 ppm or 0.00000725%.
  - 5.0 mg/m^3 multiplied by 0.00000725% = 0.000036 mg/m^3.
  - OSHA PEL for lead is 2,350 mg/m^3.
- Maximum concentration of dieldrin found in soil is 0.00587 ppm or 0.000000587%.
  - 5.0 mg/m^3 multiplied by 0.000000587% = 0.000003 mg/m^3.
  - OSHA PEL for lead is 0.25 mg/m^3.

9.0 *EMERGENCY RESPONSE AND CONTINGENCY PLAN (ERCP)*

9.1 PRE-EMERGENCY PLANNING

Prior to engaging in remedial investigation activities at the Site, the HSO will plan for possible emergency situations and have adequate supplies and manpower to respond. In addition, Site personnel will be briefed on proper emergency response procedures during the Site orientation.

The following situations would warrant implementation of the emergency plan:

Fire/Explosion	• The potential for human injury exists. • Toxic fumes or vapors are released. • The fire could spread on-Site or off Site and possibly ignite other flammable materials or cause heat-induced explosions. • The use of water and/or chemical fire suppressants could result in contaminated run-off. • An imminent danger of explosion exists.
Spill or Release of Hazardous Materials	• The spill could result in the release of flammable liquids or vapors, thus causing a fire or gas explosion hazard. • The spill could cause the release of toxic liquids or fumes in sufficient quantities or in a manner that is hazardous to or could endanger human health.
Natural Disaster	• A rain storm exceeds the flash flood level. • The facility is in a projected tornado path or a tornado has damaged facility property. • Severe wind gusts are forecasted or have occurred and have caused damage to the facility.
Medical Emergency	• Overexposure to hazardous materials. • Trauma injuries (broken bones, severe lacerations/ bleeding, burns). • Eye/skin contact with hazardous materials. • Medical Conditions e.g., loss of consciousness, heat stress (heat stroke), heart attack, respiratory failure, allergic reaction.

The following measures will be taken to assure the availability of adequate equipment and manpower resources:

- Sufficient equipment and materials will be kept on-Site and dedicated for emergencies only. The inventory will be replenished after each use.

- It will be the responsibility of the HSO to brief on-Site personnel on anticipated hazards at the Site. The HSO shall also be responsible for anticipating and requesting equipment that will be needed for response activities.

Communications will be established prior to commencement of any activities at the remediation-Site. Communication will be established so that all responders on-Site have availability to all pertinent information to allow them to conduct their activities in a safe and healthful manner. A telephone will be available to summon assistance in an emergency.

Primary communication with local responders in the event of an emergency will be accomplished using commercial telephone lines.

9.2 EMERGENCY RECOGNITION AND PREVENTION

Because unrecognized hazards may result in emergency incidents, it will be the responsibility of the Health & Safety Officer (HSO), through daily Site inspections and employee feedback to recognize and identify hazards that are found at the Site. These may include:

Chemical Hazards	• Materials at the Site • Materials brought to the Site	
Physical Hazards	• Fire/explosion • Slip/trip/fall • Electrocution	• Confined space • IDLH atmospheres • Excessive noise
Mechanical Hazards	• Heavy equipment • Stored energy system • Pinch points	• Electrical equipment • Vehicle traffic
Environmental Hazards	• Electrical Storms • High winds • Heavy Rain/Snow	• Heat Stress • Vehicle traffic

9.3 EMERGENCY TELEPHONE NUMBERS

Emergency telephone numbers can be found in Table 9-1. The emergency numbers will be posted in all Site trailers.

Figure 9-1 is the Hospital Route Map with directions to the nearest hospital. Only in a non-emergency situation are personnel to be transported to the hospital by Site representatives.

TABLE 9-1
EMERGENCY TELEPHONE NUMBERS

Emergency Medical Service…………………………………………...	911
Police: New York City Police Department (NYPD)	911
Hospital: New York-Presbyterian Brooklyn Methodist Hospital	(718) 780-3000
Fire: New York City Fire Department (FDNY)	911
New York City Office of Emergency Management	911
National Response Center	(800) 424-8802
Poison Control Center	(800) 222-1222
Chemtrec	(800) 262-8200
Center for Disease Control	(800) 311-3435
USEPA (Region II)	(212) 637-5000
NYSDEC Spill Hotline	(800) 457-7362

FIGURE 9-1
DIRECTIONS AND HOSPITAL ROUTE MAP

Site Location: 500 Third Avenue, Brooklyn, New York 11215
Hospital Name: New York-Presbyterian Brooklyn Methodist Hospital
Hospital Location: 506 6th Street, Brooklyn, New York 11215
Main Telephone: (718) 780-3000

Direction	Distance
Head northeast on 3rd Ave. toward 11th St.	299 feet
Turn right at 2nd Cross Steet onto 10th St.	--- mile
Continue on 10th St.	0.7 miles
Turn left onto 8th Ave.	--- mile
Continue on 8th Ave.	0.2 miles
Turn left onto 6th St.	--- mile
Continue on 6th St.	0.1 miles
Destination is on the left side of the road	--- mile

Google Maps 500 3rd Ave, Brooklyn, NY 11215 to NewYork-Presbyterian Brooklyn Methodist Hospital, 506 6th St, Brooklyn, NY 11215 Drive 1.1 miles, 8 min

Once a hazard has been recognized, the HSO will take immediate action to prevent the hazard from becoming an emergency. This may be accomplished by the following:

- Daily safety meeting
- Task-specific training prior to commencement of activity
- Personal Protective Equipment (PPE) selection/use
- Written and approved permits for hot work, confined space
- Trenching/shoring procedure
- Air monitoring
- Following all standard operating procedures

9.4 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATIONS

This section of the ERCP describes the various roles, responsibilities, and communication procedures that will be followed by personnel involved in emergency responses.

The primary emergency coordinator for this Site is the HSO. In the event an emergency occurs and the emergency coordinator is not on-Site, the PSM will serve as the emergency coordinator until the HSO arrives. The emergency coordinator will determine the nature of the emergency and take appropriate action as defined by this ERCP.

The emergency coordinator will implement the ERCP immediately as required. The decision to implement the plan will depend upon whether the actual incident threatens human health or the environment.

Immediately after being notified of an emergency incident, the emergency coordinator or designee will evaluate the situation to determine the appropriate action.

9.4.1 *Responsibilities and Duties*

This section describes the responsibilities and duties assigned to the emergency coordinator.

It is recognized that the structure of the "Incident Command System" will change as additional response organizations are added. Personnel will follow procedures as directed by the fire department, LEPC, State and Federal Agencies as required.

9.4.2 *On-Site Emergency Coordinator Duties*

The on-Site emergency coordinator is responsible for implementing and directing the emergency procedures. All emergency personnel and their communications will be coordinated through the emergency coordinator. Specific duties are as follows:

- Identify the source and character of the incident, type and quantity of any release. Assess possible hazards to human health or the environment that may result directly from the problem or its control.
- Discontinue operations in the vicinity of the incident if necessary to ensure that fires, explosions, or spills do not recur or spread to other parts of the Site. While operations are dormant, monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment, where safe and appropriate.
- Notify the Client Representative and local Emergency Response Teams if their help is necessary to control the incident. Table 9-1 provides telephone numbers for emergency assistance.
- Direct on-Site personnel to control the incident until, if necessary, outside help arrives. Specifically: Ensure that the building or area where the incident occurred and the surrounding area are evacuated and shut off possible ignition sources, if safe and appropriate. The Emergency Response Coordinator is responsible for directing Site personnel such that they avoid the area of the incident and leave emergency control procedures unobstructed.
- If fire or explosion is involved, notify local Fire Department.
- Have protected personnel, in appropriate PPE, on standby for rescue.

If the incident may threaten human health or the environment outside of the Site, the emergency coordinator should immediately determine whether evacuation of area outside of the Site may be necessary and, if so, notify the Police Department and the Office of Emergency Management.

When required, notify the National Response Center. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of facility
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside of the facility.

The emergency telephone number for the National Response Center is 800-424-8802.

If hazardous waste has been released or produced through control of the incident, ensure that:

- Waste is collected and contained.
- Containers of waste are removed or isolated from the immediate Site of the emergency.
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided.
- Ensure that no waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed.
- Ensure that all emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.
- Notify the USEPA Regional Administrator that cleanup procedures have been completed and that all emergency equipment is fit for its intended use before resuming operations in the affected area of the facility. The USEPA Regional Administrator's telephone number is included in the Emergency Contacts.
- Record date, time, details of the incident, and submit a written report to the USEPA Regional Administrator. The report is due to the USEPA within 15 days of the incident.

9.5 SAFE DISTANCES AND PLACES OF REFUGE

The emergency coordinator for all activities will be the HSO. No single recommendation can be made for evacuation or safe distances because of the wide variety of emergencies which could occur. Safe distances can only be determined at the time of an emergency based on a combination of Site and incident-specific criteria. However, the following measures are established to serve as general guidelines.

In the event of minor hazardous materials releases (small spills of low toxicity), workers in the affected area will report initially to the contamination reduction zone. Small spills or leaks (generally less than 55 gallons) will require initial evacuation of at least 50 feet in all directions to allow for cleanup and to prevent exposure. After initial assessment of the extent of the release and potential hazards, the emergency coordinator or designee will determine the specific boundaries for evacuation. Appropriate steps such as caution tape, rope, traffic cones, barricades, or personal monitors will be used to secure the boundaries.

If a major incident may threaten the health or safety of the surrounding community, the public will be informed and, if necessary, evacuated from the area. The emergency coordinator, or designee will inform the proper agencies in the event that this is necessary. Telephone numbers are listed in Table 9-1.

Places of refuge will be established prior to the commencement of activities. These areas must be identified for the following incidents:

- Chemical release.
- Fire/explosion.
- Power loss.
- Medical emergency.
- Hazardous weather.

In general, evacuation will be made to the Site entrance, unless the emergency coordinator determines otherwise. It is the responsibility of the emergency coordinator to determine when it is necessary to evacuate personnel to off-Site locations.

In the event of an emergency evacuation, all the employees will gather at the entrance to the Site until a head count establishes that all are present and accounted for. No one is to leave the Site without notifying the emergency coordinator.

9.6 EVACUATION ROUTES AND PROCEDURES

All emergencies require prompt and deliberate action. In the event of an emergency, it will be necessary to follow an established set of procedures. Such established procedures will be followed as closely as possible. However, in specific emergency situations, the emergency coordinator may deviate from the procedures to provide a more effective plan for bringing the situation under control. The emergency coordinator is responsible for determining which situations require Site evacuation.

9.6.1 *Evacuation Signals and Routes*

Two-way radio communication or equivalent will be used to notify employees of the necessity to evacuate an area or building involved in a release/spill of a hazardous material. As necessary, each crew supervisor will have a two-way radio. Total Site evacuation will be initiated only by the emergency coordinator, however, in his/her absence, decision to preserve the health and safety of employees will take precedence.

9.6.2 *Evacuation Procedures*

In the event evacuation is necessary the following actions will be taken:

- The emergency signal will be activated.
- No further entry of visitors, contractors, or trucks will be permitted. Vehicle traffic within the Site will cease in order to allow safe exit of personnel and movement of emergency equipment.
- Shut off all machinery if safe to do so.

- ALL on-Site personnel, visitors, and contractors in the support zone will assemble at the entrance to the Site for a head count and await further instruction from the emergency coordinator.
- ALL persons in the exclusion zone and contamination reduction zone will be accounted for by their immediate crew leaders. Leaders will determine the safest exits for employees and will also choose an alternate exit if the first choice is inaccessible.
- During exit, the crew leader should try to keep the group together. Immediately upon exit, the crew leader will account for all employees in crew.
- Upon completion of the head count, the crew leader will provide the information to the emergency coordinator.
- Contract personnel and visitors will also be accounted for.
- The names of emergency response team members involved will be reported to the emergency coordinator.
- A final tally of persons will be made by the emergency coordinator or designee. No attempt to find persons not accounted for will involve endangering lives of Site personnel by re-entry into emergency areas.
- In all questions of accountability, immediate crew leaders will be held responsible for those persons reporting to them. Visitors will be the responsibility of those employees they are seeing. Contractors and truck drivers are the responsibility of the Construction Superintendent.
- Personnel will be assigned by the emergency coordinator to be available at the main gate to direct and brief emergency responders.
- Re-entry into the Site will be made only after clearance is given by the emergency coordinator. At his/her direction, a signal or other notification will be given for re-entry into the facility.

9.7 EMERGENCY SPILL RESPONSE PROCEDURES AND EQUIPMENT

In the event of an emergency involving a hazardous material spill or release, the following general procedures will be used for rapid and safe response and control of the situation. Emergency contacts found in Table 9-1 provide a quick reference guide to follow in the event of a major spill.

9.7.1 *Notification Procedures*

If an employee discovers a chemical spill or process upset resulting in a vapor or material release, he or she will immediately notify the on-Site emergency coordinator.

On-Site Emergency Coordinator will obtain information pertaining to the following:

- The material spilled or released.

- Location of the release or spillage of hazardous material.
- An estimate of quantity released and the rate at which it is being released.
- The direction in which the spill, vapor or smoke release is heading.
- Any injuries involved.
- Fire and/or explosion or possibility of these events.
- The area and materials involved and the intensity of the fire or explosion.

This information will help the on-Site emergency coordinator to assess the magnitude and potential seriousness of the spill or release.

9.7.2 *Procedure for Containing/Collecting Spills*

The initial response to any spill or discharge will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If for some reason a chemical spill is not contained within a dike or sump area, an area of isolation will be established around the spill. The size of the area will generally depend on the size of the spill and the materials involved. If the spill is large (greater than 55 gallons) and involves a tank or a pipeline rupture, an initial isolation of at least 100 ft. in all directions will be used. Small spills (less than or equal to 55 gallons) or leaks from a tank or pipe will require evacuation of at least 50 ft. in all directions to allow cleanup and repair and to prevent exposure. When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. If possible, the area will be roped or otherwise blocked off.

If the spill results in the formation of a toxic vapor cloud (by reaction with surrounding materials or by outbreak of fire) and its release (due to high vapor pressures under ambient conditions), further evacuation will be necessary. In general, an area at least 500 feet wide and 1,000 feet long will be evacuated downwind if volatile materials are spilled. Consult the DOT Emergency Response Guide for isolation distances for listed hazardous materials.

If an incident may threaten the health or safety of the surrounding community, the public will be informed and possibly evacuated from the area. The on-Site emergency coordinator will inform the proper agencies in the event this is necessary (refer to Table 9-1).

As called for in regulations developed under the Comprehensive Environmental Response Compensation Liability Act of 1980 (Superfund), a spill of a pound or more of any hazardous material for which a reportable quantity has not been established and which is listed under the Solid Waste Disposal Act, Clean Air Act, Clean Water Act, or TSCA shall be reported.

Clean up personnel will take the following measures:

- Make sure all unnecessary persons are removed from the hazard area.
- Put on protective clothing and equipment.
- If a flammable material is involved, remove all ignition sources, and use spark and explosion proof equipment for recovery of material.
- Remove all surrounding materials that could be especially reactive with materials in the waste. Determine the major components in the waste at the time of the spill.
- If wastes reach a storm sewer, try to dam the outfall by using sand, earth, sandbags, etc. If this is done, pump this material out into a temporary holding tank or drums as soon as possible.
- Place all small quantities of recovered liquid wastes (55 gallons or less) and contaminated soil into drums for incineration or removal to an approved disposal Site.
- Spray the spill area with foam, if available, if volatile emissions may occur.
- Apply appropriate spill control media (e.g., clay, sand, lime, etc.) to absorb discharged liquids.

For large spills, establish diking around leading edge of spill using booms, sand, clay or other appropriate material. If possible, use diaphragm pump to transfer discharged liquid to drums or holding tank.

9.7.3 *Emergency Response Equipment*

The following equipment will be staged in the support zone and throughout the Site, as needed, to provide for safety and first aid during emergency responses.

- ABC-type fire extinguisher.
- First-aid kit, industrial size.
- Portable eyewash.

9.7.4 *Emergency Spill Response Clean-Up Materials and Equipment*

A sufficient supply of appropriate emergency response clean-up and personal protective equipment will be available as needed.

The materials listed below may be kept on-Site for spill control, depending on the types of hazardous materials present on-Site. The majority of this material will be located in the support zone, in a supply trailer or storage area. Small amounts, as necessary, will be placed on pallets and located in the active work areas.

- Sand or clay to solidify/absorb liquid spills.
- Sorbent pads or booms to contain and absorb liquid spills.

All contaminated soils, absorbent materials, solvents, and other materials resulting from the clean-up of spilled or discharged substances shall be properly stored, labeled, and characterized for off-Site disposal.

9.8 EMERGENCY CONTINGENCY PLAN

This section of the ERCP details the contingency measures the Site Contractor will take to prepare for and respond to fires, explosions, spills and releases of hazardous materials, hazardous weather, and medical emergencies.

9.9 MEDICAL EMERGENCY CONTINGENCY MEASURES

The procedures listed below will be used to respond to medical emergencies. A minimum of one First-Aid/CPR trained personnel should be available on-Site.

9.9.1 *Response*

The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident. The work crew supervisor will be summoned.

The work crew supervisor will immediately make radio contact with the on-Site emergency coordinator to alert him of a medical emergency situation. The supervisor will advise the following information:

- Location of the victim at the work Site
- Nature of the emergency
- Whether the victim is conscious
- Specific conditions contributing to the emergency, if known

The Emergency Coordinator will notify the Health & Safety Officer. The following actions will then be taken depending on the severity of the incident:

- *Life-Threatening Incident* – If an apparent life-threatening condition exists, the crew supervisor will inform the emergency coordinator by radio, and the local Emergency Response Services (EMS) will be immediately called. An on-Site person will be appointed who will meet the EMS and have him/her quickly taken to the victim. Any injury within the EZ will be evacuated by personnel to a clean area for treatment by EMS personnel. No one will be able to enter the EZ without showing proof of training, medical surveillance and Site orientation.

- *Non Life-Threatening Incident* – If it is determined that no threat to life is present, the Health & Safety Officer will direct the injured person through decontamination procedures (see below) appropriate to the nature of the illness or accident. Appropriate first aid or medical attention will then be administered.

* **Note: The area surrounding an accident Site must not be disturbed until the scene has been cleared by the Health & Safety Officer.**

Any personnel requiring emergency medical attention will be evacuated from exclusion and contamination reduction zones if doing so would not endanger the life of the injured person or otherwise aggravate the injury. Personnel will not enter the area to attempt a rescue if their own lives would be threatened. The decision whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate the injury or delay life-saving first aid. Decontamination will be performed if it does not interfere with essential treatment.

If decontamination can be performed, observe the following procedures:

- Wash external clothing and cut it away.

If decontamination cannot be performed, observe the following procedures:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.
- Alert emergency and off-Site medical personnel to potential contamination, instruct them about specific decontamination procedures.
- Send Site personnel familiar with the incident and chemical safety information, e.g., MSDS, with the affected person.

All injuries, no matter how small, will be reported to the HSO. An accident/injury/illness report will be completely and properly filled out and submitted to the Corporate Health and Safety Manager.

A list of emergency telephone numbers is provided in Table 9.1.

9.9.2 *Notification*

The following personnel/agencies will be notified in the event of a medical emergency:

- Local Fire Department or EMS.
- On-Site Emergency Coordinator.

- Workers in the affected areas.
- Client Representative.

9.10 FIRE CONTINGENCY MEASURES

Because flammable/combustible materials are present at this Site, fire is an ever-present hazard. Safety personnel are not trained professional firefighters. Therefore, if there is any doubt that a fire can be quickly contained and extinguished, personnel will notify the emergency coordinator by radio and vacate the structure or area. The emergency coordinator will immediately notify the local Fire Department.

The following procedures will be used to prevent the possibility of fires and resulting injuries:

- Sources of ignition will be kept away from where flammable materials are handled or stored.
- The air will be monitored for explosivity before and during hot work and periodically where flammable materials are present. Hot work permits will be required for all such work.
- "No smoking" signs will be conspicuously posted in areas where flammable materials are present.
- Fire extinguishers will be placed in all areas where a fire hazard may exist.
- Before workers begin operations in an area the foreman will give instruction on egress procedures and assembly points. Egress routes will be posted in work areas and exit points clearly marked.

9.10.1 *Response*

The following procedures will be used in the event of a fire:

- Anyone who sees a fire will notify their supervisor who will then contact the Emergency Coordinator by radio. The emergency coordinator will activate the emergency air horns and contact the local Fire Department.
- When the emergency siren sounds, workers will disconnect electrical equipment in use (if possible) and proceed to the nearest fire exit.
- Work crews will be comprised of pairs of workers (buddy system) who join each other immediately after hearing the fire alarm and remain together throughout the emergency. Workers will assemble at a predetermined rally point for a head count.
- When a small fire has been extinguished by a worker, the emergency coordinator will be notified.

9.11 HAZARDOUS WEATHER CONTINGENCY MEASURES

Operations outside will not be started or continued when the following hazardous weather conditions are present:

- Lightning.
- Heavy Rains/Snow.
- High Winds.

9.11.1 *Response*

- Potential soil stock piles will be covered with plastic liner.
- All equipment will be shut down and secured to prevent damage.
- Personnel will be moved to safe refuge. The emergency coordinator will determine when it is necessary to evacuate personnel to off-Site locations and will coordinate efforts with fire, police and other agencies.

9.11.2 *Notification*

The emergency coordinator will be responsible for assessing hazardous weather conditions and notifying personnel of specific contingency measures. Notifications will include:

- Site workers and subcontractors
- Client Representative
- Local Emergency Management Agency

9.12 SPILL/RELEASE CONTINGENCY MEASURES

In the event of release or spill of a hazardous material the following measures will be taken:

9.12.1 *Response*

Any person observing a spill or release will act to remove and/or protect injured/contaminated persons from any life-threatening situation. First aid and/or decontamination procedures will be implemented as appropriate.

First aid will be administered to injured/contaminated personnel. All personnel will act to prevent any unsuspecting persons from coming in contact with spilled materials by alerting other nearby persons. Attempt to stop the spill at the source, if possible. Without taking unnecessary risks, personnel will attempt to stop the spill at the source. This may involve activities such as uprighting a drum, closing a valve or temporarily sealing a hole with a plug.

The emergency coordinator will be notified of the spill/release, including information on material spilled, quantity, personnel injuries and immediate life threatening hazards. Air monitoring will be implemented by the emergency coordinator and HSO to determine the potential impact on the surrounding community. Notification procedures will be followed to inform on-Site personnel and off-Site agencies. The emergency coordinator will make a rapid assessment of the spill/release and direct confinement, containment and control measures. Depending upon the nature of the spill, measures may include:

- Construction of a temporary containment berm utilizing on-Site clay absorbent earth
- Digging a sump, installing a polyethylene liner and
- Diverting the spill material into the sump placing drums under the leak to collect the spilling material before it flows over the ground
- Transferring the material from its original container to another container

The emergency coordinator will notify the Client Representative of the spill and steps taken to institute clean-up. Emergency response personnel will clean-up all spills following the spill clean-up plan developed by the emergency coordinator. Supplies necessary to clean up a spill may include, but are not limited to:

- Shovel, rake.
- Clay or sand absorbent.
- Polyethylene liner.
- Personal safety equipment.
- Steel drums.
- Pumps and miscellaneous hand tools.

The emergency coordinator will inspect the spill Site to determine that the spill has been cleaned up to the satisfaction of the Client Representative. If necessary, soil, water or air samples may be taken and analyzed to demonstrate the effectiveness of the spill clean-up effort. The emergency coordinator will determine the cause of the spill and determine remedial steps to ensure that recurrence is prevented. The emergency coordinator will review the cause with the Client Representative and obtain his/her concurrence with the remedial action plan.

10.0 *TRAINING REQUIREMENTS*

All personnel entering the exclusion zone will be trained in the provisions of this Site safety plan and be required to sign the Site-Specific HASP Acknowledgment form in Appendix A.

10.1 SITE-SPECIFIC TRAINING ORIENTATION

Outlines of the orientation for Site workers, subcontractor personnel and visitors are presented below:

CONTRACTOR WORKERS	VISITORS
• HASP sign off • Sign in/out procedures • Site background/characterization • Chain of command • Rules and regulations • Hours of work • Absences • Personal Protective Equipment/respirator fit test (if applicable) • Emergency Information Emergency signal Gathering point Responsibilities/roles Emergency phone numbers • Site Control/Work Zones • Hazards/AHAs • Air Monitoring Program • Forms, Site-specific • Incident Reporting • Lead Awareness (Appendix C)	• Sign in/out procedures • Site Background/ Characterization • Review of Site map • Work Zones in progress • Emergency plan/signals • Training/medical requirements • Zones/areas open to visitors

10.2 DAILY SAFETY MEETINGS

A safety meeting will be conducted by the HSO before each shift begins. Topics to be discussed include task hazards and protective measures (physical, chemical, environmental); emergency procedures; PPE levels and other relevant safety topics. Meetings will be documented in a log book or specific form.

APPENDIX A

- *HEALTH AND SAFETY PLAN CERTIFICATION*
- *GENERAL/SUB-CONTRACTOR HEALTH & SAFETY PLAN ACKNOWLEDGEMENT*
- *NOTICE OF SAFETY VIOLATION*
- *PRE-JOB SAFETY CHECKLIST*

HEALTH AND SAFETY PLAN CERTIFICATION

By signing this document, I am stating that I have read and understand the Site health and safety plan for ________________________ (Contractor) personnel, subcontractors and visitors entering the Site.

COMPANY NAME	NAME (PRINT)	SIGNATURE	DATE

NOTICE OF SAFETY VIOLATION

TO: ________________________(Name of Contractor/Subcontractor Supervisor)
FROM: ________________________(Name of Owner/Contractor's Project Manager)
DATE: ________________________
SUBJECT: ***Notice of Safety Violations***

The following Safety Violations were observed at the Name of Site/Project on Date.

1. ____________________________________
2. ____________________________________
3. ____________________________________
4. ____________________________________
5. ____________________________________

You are requested to take the necessary corrective action to alleviate these safety violations by ________________________ (Date).

Please notify ________________________(Name of Contractor/Subcontractor's Project Manager) when you have completed this corrective action.

Thank you in advance for your cooperation in this effort.

CONTRACTOR/SUBCONTRACTOR
PRE-JOB SAFETY CHECKLIST

JOB: SUBCONTRACTOR:

LOCATION: PROJECT NO.:

		Yes	**No**
1.	Standard emergency signals fully understood?	☐	☐
2.	Subcontractor responsibility in time of emergency understood?	☐	☐
3.	Fire and ambulance telephone numbers known?	☐	☐
4.	Areas for possible evacuation designated?	☐	☐
5.	Special safety rules for the plant or area known?	☐	☐
6.	Nature of Chemical or special hazards for area reviewed with safety officer?	☐	☐
7.	Special safety equipment for the area of job known?	☐	☐
8.	Safety shower and eye wash locations known?	☐	☐
9.	Smoking area designated?	☐	☐
10.	Have you been advised of potential hazards, protective Measures and availability of hazard information? e.g., Health & Safety Plan	☐	☐
11.	Do you understand you are required to provide your employees with the information in (10) above?	☐	☐
12.	Have you provided MSDSs to Athenica for any hazardous material you intend to bring on-Site?	☐	☐
13.	Have you submitted training/medical certification records?	☐	☐
14.	Are your subcontractors aware of the above rules?	☐	☐

Remarks: (Explain all No Answers)

____

____

____

____

______________________ ______________________

Subcontractor's Supervisor Date

______________________ ______________________

Contractor's Project Manager Date

______________________ ______________________

Contractor's Project Supervisor Date

______________________ ______________________

Health & Safety Officer Date

APPENDIX B

HEALTH AND SAFETY PLAN AMENDMENTS AND DOCUMENTATION FORM

SITE-SPECIFIC HEALTH AND SAFETY PLAN
AMENDMENT DOCUMENTATION

Project Name: ____________________ **Project No.:** ____________________________

Amendment No.: _________________________ **Date:** ____________________________

Amendment Page(s): **Revises:** _______________ **Section(s):** __________________________

Task(s) Amendment Affects:* ____

____

**(Attach new/revised Job Safety Analyses)*

Reason For Amendment:

____

____

____

Amendment: *(Attach separate sheet(s) as necessary)*

____

____

____

____

____

____

Completed by: _________________________ **Approved by:** _________________________

APPENDIX C

DAILY SAFETY REPORT FORM

AIR MONITORING RECORD FORM

EQUIPMENT CALIBRATION RECORD FORM

DAILY SAFETY REPORT

Date:	**Site Name:**	**Site Location:**

Time	Temp.	Wind Dir	Wind Spd	Conditions

Activity	PPE Worn

Time	Observations/Actions

Notes Taken By: ___________________________________

AIR MONITORING RECORD

Site Name:

Site Location:

Date:

Time	Respirable Particulates (mg/m^3)	Location	Activity	Initials

EQUIPMENT CALIBRATION RECORD

Site Name:

Site Location:

Date	Instrument	S/N	Battery	Zero	Init. Rdg.	Adjustments	Initials
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			
	pDR-1500, Dusttrack or equivalent			Filter			
	Mini-RAE 3000 PID, or equivelant			100 ppm isobutylene			

Calibration gases: 1. 100 ppm isobutylene, 2. 50% LEL methane, 3. 50 ppm CO, 4. 25 ppm H_2

APPENDIX D

TAILGATE SAFETY MEETING FORM

Daily Safety Meeting Report

Project Name:
Location:
Date:

Today's Tasks/Activities:

Potential Chemical/Physical Hazards:

Personal Protective Equipment:

Attendees:

HSO: ______________________ Const. Supt: ______________________

(Signature) **(Signature)**

Appendix C
Community Air Monitoring Plan

Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein are based on NYSDEC guidance, and exceedances thereof will necessitate appropriate response actions, such as increased monitoring, corrective actions to abate emissions, and/or work shut-down. Additionally, the CAMP helps to confirm that work activities did not spread contamination to off-Site receptors through the air.

Implementation of this CAMP will not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around all intrusive work areas.

Community Air Monitoring Plan

Real-time air monitoring for VOCs and particulate levels at locations upwind and downwind of the work area will be conducted during all intrusive sampling activities, as follows:.

> **Continuous monitoring** will be conducted for all ground intrusive activities. Ground intrusive activities include, but are not limited to, advancing of soil borings, potential soil excavation and handling, potential test pitting or trenching, installation of monitoring wells, and installation of soil vapor probes.
>
> **Periodic monitoring** for VOCs will be conducted during non-intrusive activities, such as collection of soil vapor/ambient air samples or sampling of existing monitoring wells. Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during such sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the upwind and downwind perimeter of the immediate work area on a continuous basis. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present (i.e., photoionization detector (PID)). The instruments will be calibrated at least daily in accordance with manufacturers' instructions. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the VOC level is above 25 ppm at the perimeter of the work area, activities will be halted.

4. All 15-minute readings will be recorded and will be available for review upon request. Instantaneous readings, if any, used for decision purposes will also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations, using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 $\mu g/m^3$ above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 $\mu g/m^3$ above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.

3. All readings will be recorded and will be available for review upon request.

Appendix D

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

500 Third Avenue
Brooklyn, New York 11215

Site Number C224426

Prepared for:

PAB 3rd Avenue Holdings, LLC.
135 13th Street
Brooklyn, New York 11215

Prepared By:

Athenica Environmental Engineering PLLC
31-33 31st Street, Second Floor
Astoria, New York 11106

June 11, 2025

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1.0 INTRODUCTION

1.1 Purpose

This Quality Assurance Project Plan (QAPP) has been prepared by Athenica Environmental Engineering, PLLC (Athenica) to establish the data quality objectives and data collection and analytical procedures for the site characterization activities at the property located at 500 Third Avenue, Brooklyn, New York (Site), which has been designated by the NYSDEC as Site Number C224426. Investigation and remediation (if warranted) at the Site will be conducted under the New York State Brownfield Cleanup Program (BCP).

1.2 Site Description

As described in the Remedial Investigation Work Plan (RIWP), the Site is currently vacant but is used for construction equipment storage. The building previously occupying Lot 34 of the Site was demolished in approximately 2017 and the buildings previously occupying Lots 35 and 36 of the Site were demolished in 2023.

1.3 Project Scope of Work

The overall purpose of the Remedial Investigation (RI) is to further characterize subsurface conditions at Site and support planned development of the Site in accordance with the requirements of the NYSDEC Brownfield Cleanup Program (BCP). The proposed scope of work for the Site characterization program is described in detail in Section 3.0 of the RI Work Plan (RIWP) and will include collection and laboratory analysis of at least 24 subsurface soil samples, six groundwater samples, 11 soil vapor samples, and 1 outdoor ambient air sample. Additional samples will be collected as warranted. Proposed sample locations are shown on Figure 1.

1.4 Project Organization

Athenica's Principal-in-Charge and Principal Engineer for this project will be Spiro Dongaris, a New York State-licensed Professional Engineer with more than 37 years of technical and management experience in the environmental engineering and consulting field. Mr. Dongaris has worked extensively with state and local agencies on numerous Site investigation and remediation projects throughout New York City and the surrounding area, including Brownfield Sites. He has extensive knowledge and experience in environmental engineering, Site assessments and construction management, in cost estimating and negotiating of bids, and oversees all aspects of the firm's work in these areas. As Principal of Athenica, he is responsible for the firm's overall commitment of resources to a project and its successful completion. In addition, he also oversees work in industrial hygiene, public safety and occupational health, and engineering design.

Mr. Dongaris will provide overall project administration and will be responsible for all top management decisions and overall oversight. In addition, as a New York State-licensed Professional Engineer, he will also serve as the Professional Engineer for this contract, actively participating in designing remediation systems and preparing design documents/drawings. As Professional Engineer, Mr. Dongaris will sign and seal design documents, as required by law.

Kenneth Wenz, Jr., Senior Project Manager at Athenica, will serve as the Project Director for this project. Mr. Wenz has more than 38 years of experience in the environmental field, including both consulting and regulatory positions, and is a Licensed Professional Geologist in New York, a Registered Professional Geologist in Pennsylvania, a Licensed Environmental Professional in Connecticut, and a Certified Professional Geologist. He has managed and implemented numerous investigation and remediation projects in New York City, New York State, New Jersey, Connecticut, Pennsylvania, Illinois, and Vermont, which have included Brownfield projects, federal and state Superfund investigation and remediation programs, state and local programs (e.g., NJ ISRA, CT RSR, NYCOER, etc.), petroleum spills, and property transfers (Phase I/II/III ESAs), as well as soil, soil vapor, sediment, and water assessment and remediation programs for numerous commercial, industrial, and government clients. His experience includes scoping, conducting, managing, and providing data assessment and technical review of deliverables for hundreds of Phase I ESAs, Phase II ESAs, and remediation projects. As such, he has substantial experience with all phases of environmental investigation/remediation, and with implementing such programs in compliance with all applicable environmental regulations.

Jessica Collins, Project Manager/Hydrogeologist at Athenica, will serve as the Project Manager. Ms. Collins has over 18 years of experience in the environmental consulting field, specializing in the investigation and remediation of sites enrolled in the New York State Brownfield Cleanup Program (BCP), as well as sites regulated under the NYC Office of Environmental Remediation (OER), NYSDEC Spills Program, and other state and local regulatory frameworks. She holds degrees in Geology and Environmental Science and has managed complex environmental projects throughout the five boroughs of New York City. Ms. Collins has authored and implemented Remedial Investigation Work Plans (RIWPs), Remedial Action Work Plans (RAWPs), Site Management Plans (SMPs), and Quality Assurance Project Plans (QAPPs) for a wide range of BCP sites. Her technical expertise includes Phase I and Phase II Environmental Site Assessments, subsurface investigations, soil vapor intrusion assessments, and groundwater monitoring programs. Ms. Collins has extensive experience navigating regulatory interactions with NYSDEC and OER, ensuring that project documentation and field activities are completed in accordance with DER-10, applicable TAGMs, and site-specific requirements under the BCP. She also provides mentorship to junior staff and oversees field implementation to maintain consistency with project goals and applicable guidance.

As Project Manager, she will be responsible for the overall technical performance, budget management, and schedule execution for the program, and will serve as liaison on behalf of the Volunteer with regulatory personnel and stakeholders, as needed. Ms. Collins will also provide project evaluation, technical input, and review of project deliverables, to ensure that all work meets all applicable project requirements as well as our exacting quality standards, and will oversee all project staff and validate scopes of work to ensure that all project deliverables are provided on time.

William Silveri will serve as the Quality Control Officer for this contract. Mr. Silveri has over 35 years of experience in the environmental consulting field, and is a Licensed Professional Geologist in New York and a Certified Hazardous Materials Manager. He has managed and conducted numerous environmental investigation and remediation projects in the New York City area, which has included substantial experience in report preparation, data review and assessment, and technical review of project deliverables (reports, specifications, etc.) prepared by others. As Quality Control Officer, he will be responsible for detailed technical review and evaluation of laboratory data, as well as providing quality control review of project deliverables, to ensure that all work plans, reports, specifications, etc. meet the quality and technical standards of Athenica

In addition, Athenica will utilize subcontractors for drilling, laboratory services, and data validation, as described in Section 3.0 of the RIWP. Once determined, the names of the selected subcontractors will be provided to the NYSDEC.

Resumes for the above referenced team members is found in Appendix C.

2.0 GENERAL QAPP PROCEDURES

Athenica will follow the sampling, sample handling and storage, and sample equipment decontamination procedures specified by the RIWP: Sampling procedures, field equipment functionality, chain-of-custody, and other relevant information will be recorded in the field. Data validation activities will include the manual check of laboratory data tables and reduced data summary tables. Conclusions and/or recommendations will be reviewed by one or more qualified peers of the professional who developed them to verify their accuracy on the basis of acquired data and conducted analyses.

A detailed description of the procedures to be used during this program for collection of the soil, groundwater and soil vapor samples is provided in RIWP. As noted, all samples will be collected using new, dedicated sampling equipment. Split spoon samplers and/or augers will be used if needed; therefore, field decontamination of equipment may as part of this Site characterization.

The data quality objectives for analysis of soil/historic fill, groundwater, and soil vapor are summarized in Tables 1 through 3.

3.0 SAMPLE HANDLING

The following subsections describe the manner in which representative samples will be collected at the Site.

3.1 Soil Sample Collection

Representative soil samples will be collected directly from the acetate sleeve of the direct-push boring. For VOC analysis, a discrete soil sample will be collected from the desired sampling depth utilizing a dedicated Terra Core sampling kit that includes a dedicate sample plunger. For non-VOC analysis, representative sample aliquots of soil sample will be collected from the required sampling depth, and will then be homogenized into a single sample for analysis. The homogenization of the sample will occur in a new, dedicated, disposable container (aluminum pan, plastic zip-top bag, etc.) or in a decontaminated stainless-steel container, utilizing dedicated sampling equipment (wooden tongue depressor, plastic spoon, etc.).

3.2 Groundwater Sample Collection

Representative groundwater samples will be collected from temporary groundwater monitoring wells after well development, as described in the RIWP, utilizing dedicated sampling equipment. The groundwater sampling will follow USEPA’s low-flow (minimal draw down) procedures that are summarized below and described in more detail in Appendix A.

The low-flow sampling procedure was designed to facilitate collection of groundwater samples that reflect total mobile organic and inorganic contaminant levels in the groundwater, with minimal physical and chemical alterations caused by the sampling event.

The low-flow groundwater sampling procedure will include the following general steps:

1. An appropriate, dedicated sampling pump and non-PFAS sampling tubing will be selected for use at the Site;
2. The pump intake will be placed at least 2 feet above the bottom of the well screen;
3. Prior to purging, the depth to groundwater will be measured utilizing a groundwater interface meter and recorded on a well purging purge form;
4. Groundwater will be purged at a flow rate that causes the groundwater level to be lowered (i.e., drawdown) by no more than 0.3 feet;
5. During purging, depth to groundwater will be periodically measured to allow adjustment of the groundwater flow rate to minimize any drawdown;
6. After the water level in the monitoring well has stabilized, purged water will be conveyed to a flow-through cell to allow for monitoring of the following indicator field parameters, including turbidity, temperature, specific conductance, pH, Oxidation/Reduction Potential (ORP), and dissolved oxygen (DO);
7. During the well purging, the above indicator parameters will be measured at least every 5 minutes;

8. Purging will cease after stabilization of these indicator parameters. Stabilization is considered to be achieved when three consecutive readings are within the following limits:
    - Turbidity = less than 5 NTUs or 10 percent for values greater than 5 NTUs.
    - DO = less than 0.5 mg/L or 10 percent for values greater than 0.5 mg/L.
    - Specific Conductance = 3 percent of prior reading.
    - Temperature = 3 percent of prior reading.
    - ORP = plus or minus 10 millivolts of prior reading.
9. After stabilization of indicator parameters, the tubing from the pump will be disconnected from the flow-through-cell, and representative groundwater samples will be collected directly from the pump's tubing;
10. After completion of purging, samples will be collected using the same equipment (i.e., pump and tubing) that were utilized for purging. Samples for PFAS and 1,4-dioxane analysis will be collected first (where applicable), followed by the VOC samples, the SVOC samples, the metals samples, and lastly the pesticides/PCBs samples.

3.3 Sample Identification/Labeling

Immediately upon collection, each sample will be labeled with an adhesive label. This sample label contains the authoritative information for the sample, including the Site name, date and time of sampling, sampler's initials, tests to be performed, preservative (if applicable), and a unique sample identifier. The unique identifier for each sample will include, at a minimum, the sample location and (where applicable) sample horizon (e.g., S-1 12-14', WC-3S, SV-2). This information will also be included on the chain of custody forms that will accompany the samples to the laboratory.

3.4 Sample Containers and Preservation

The analytical laboratory will supply appropriate sample containers for the media that will be sampled during this program. The containers will be pre-preserved, where appropriate. Table 3 provides a summary of the sample preservation and containerization requirements.

Soil samples submitted for VOC analysis will be collected by utilizing Terra Core samplers or (field-preserved using methanol). Soil samples to be analyzed for non-VOC parameters will be collected in unpreserved 4-ounce and/or 8-ounce glass jars. Groundwater samples submitted for VOC analysis will be preserved to a pH of ≤ 2 with hydrochloric acid (HCl), and groundwater samples to be analyzed for SVOCs, pesticides, and PCBs will be collected into unpreserved, 1-liter amber glass bottles. Groundwater samples to be analyzed for dissolved metals will be collected into unpreserved plastic containers, while groundwater samples to be analyzed for total metals will be collected into plastic containers preserved with nitric acid. The soil and groundwater samples to be analyzed for PFOA/PFAS will be collected into high-density polyethylene (HDPE) containers, which will be kept separated from the containers for other analyses (i.e., provided and maintained in a separate cooler), and will be handled in accordance with NYSDEC guidance (as discussed below in Section 3.8). The laboratory will provide all required Terra Core sampling kits, -preserved 40-mL VOC vials, amber glass containers, and HDPE bottles for the respective analyses. All soil and groundwater samples will also be preserved by cooling to 4^{o} C.

Soil vapor and ambient air samples will be collected into evacuated 6-liter Summa canisters. The canisters will be provided by the laboratory and will be batch-certified as clean by the laboratory.

3.5 Equipment Decontamination

Non-dedicated sampling equipment will be decontaminated between each use in the following manner:

- Wash and scrub with non-phosphate detergent (e.g., Alconox) and potable water solution, and
- Rinse with potable water.

3.6 Field Documentation

Field team members will maintain bound logbooks to document all field activities. Field logbooks will provide the means for recording field observations and data collection activities conducted during the investigation. Logbooks will be supported by (but not replaced by) standardized forms, including, but not limited to, boring logs, groundwater sampling logs, and vapor probe construction diagrams.

3.7 Chain-of-Custody and Shipping

Chain-of-Custody forms will be utilized to document the path of sample containers from the Site to the laboratory. Sample/bottle tracking sheets or the Chain-of-Custody will be used to document the custody of the samples within the laboratory from sample receipt though completion of analysis. The project manager will notify the laboratory of upcoming field sampling events and the subsequent transfer of samples. This notification will include information concerning the number and type of samples and the anticipated date of arrival. Sample shipping containers (e.g., coolers) will be provided by the laboratory for shipping samples. All sample containers within each shipping will be individually labeled with an adhesive identification label provided by the laboratory.

In the event that collected samples require shipping (as opposed to sample pick-up by the laboratory or delivery to the laboratory by Athenica personnel), each sample shipping container will be sealed with two adhesive custody seals. The custody seals will be initialed by a member of the field sampling team.

3.8 Additional Sample Handling Requirement for Emerging Contaminant Analysis

Collection of samples for analysis for Per- and Polyfluoroalkyl Substances (PFAS) will follow NYSDEC protocol established in the document titled *Sampling, Analysis, and Assessment of Per- And Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs*, dated January 2021. A copy of this document is included in Appendix B of this QAPP.

General sample handling requirements for PFAS will include the following:

- Sampling methods are intended to be consistent with analysis of samples by USEPA method 1633;
- Preferred material for sample containers is high density polyethylene (HDPE);
- Acceptable materials for sampling equipment include stainless steel, HDPE, PVC, silicone, acetate and polypropylene;
- No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™);
- Personnel performing sampling or drilling should wear nitrate gloves while conducting field work or handling sample containers;
- Personal protection equipment (PPE) will avoid any water or stain resistant materials that potential PFAS containing material (including Gore-Tex®); and
- Use of any potential PFAS containing clothing or personal care product will be allowed only if there is no other suitable alternative and approved by the NYSEC.

As an additional precaution to minimize laboratory artifacts arising from sample collection, Athenica will utilize only sample containers certified by the laboratory to be free of PFAS. Additionally, Athenica will collect PFAS and 1,4-dioxane samples prior to collection of samples for other analysis.

4.0 DATA QUALITY REQUIREMENTS

The following subsections describe the manner in which representative samples will be analyzed at the Site.

4.1 Analytical Methods

This program includes, at a minimum, collection and laboratory analysis of at least 28 soil samples, nine groundwater samples, 14 soil vapor samples, and one outdoor ambient air sample. Soil samples will be analyzed for Target Compound List (TCL) VOCs by USEPA Method 8260, TCL SVOCs by USEPA Method 8270, Target Analyte List (TAL) metals by USEPA Method 6010, TCL pesticides by USEPA Method 8081, and TCL PCBs by USEPA Method 8082. Groundwater samples will be analyzed for TCL VOCs by USEPA Method 8260, TCL SVOCs by USEPA Method 8270, TAL metals (total and dissolved) by USEPA Method 6010 and 7471, TCL pesticides by USEPA Method 8081, and TCL PCBs by USEPA Method 8082. Soil vapor and ambient air samples will be analyzed for VOCs by USEPA Method TO-15 SIM. In addition, soil and groundwater samples will be analyzed for PFAS by modified USEPA Method 1633 and analyzed for 1,4-dioxane by modified USEPA Method 8270 SIM.

All analyses will be conducted by a laboratory approved under the NYSDOH Environmental Laboratory Approval Program (ELAP). The data quality objectives for the required analysis are summarized in Tables 1 through 3.

4.2 Data Quality Assurance Objectives

Data quality objectives (DQOs) for measurement data in terms of sensitivity precision, accuracy, representativeness, comparability, and completeness are established so that the data collected are sufficient and of adequate quality for their intended use. Data collected and analyzed in conformance with the DQO process described in this QAPP will be used in assessing the uncertainty associated with decisions related to this Site.

4.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is easier to control and quantify than sampling precision; there are more historical data related to individual method performance and the “universe” is not limited to the samples received in the laboratory. In contrast, sampling precision is unique to each Site or project. Overall system (sampling plus analytical) precision will be determined by analysis of field duplicate samples. Analytical results from laboratory duplicate samples will provide data on measurement (analytical) precision. The laboratory objective for precision is to equal or exceed the precision demonstrated for the applied analytical methods on similar samples. Precision is evaluated by the analyses of laboratory and field duplicates. Field duplicates will be collected at a frequency of one per 20 environmental samples of each type.

Relative Percent Difference (RPD) criteria are used to evaluate precision between duplicates, using the equation below:

> $RPD = 100 \times [2(X1 - X2) / (X1 + X2)]$
> where:
> $X1$ and $X2$ are reported concentrations for each duplicate sample and subtracted differences represent absolute values.

Criteria for evaluation of laboratory duplicates are specified in the applicable methods. The objective for field duplicate precision is < 50% RPD for all matrices. Precision is not calculable where the analyte is not detected in one or both of the sample and duplicate. The absolute difference between the results ($X1 - X2$) may be a more appropriate measure of analytical precision where the reported concentrations are low (i.e., less than five times the RL).

4.2.2 Accuracy

The laboratory objective for accuracy is equal to or exceed the accuracy demonstrated for the applied analytical method on similar samples. Percent Recovery Criteria, published by the NYSDEC as part of the ASP, and those determined from laboratory performance data are used to evaluate accuracy in matrix (sample) spike and blank spike quality control samples. A matrix spike and blank spike will be performed once for every sample delivery group (SDG) as specified in the ASP-CLP. Other method-specific laboratory QC samples (such as laboratory control samples and continuing calibration standards) may also be used in the assessment of analytical accuracy. Sample (matrix) spike recovery is calculated as:

> $\%R = (SSR-SR)/SA \times 100$,
> where:
> SSR = Spiked Sample Result
> SR = Sample Result, and
> SA = Spike Added

4.2.3 Representativeness

The representativeness of data is only as good as the representativeness of the samples collected. Sampling and handling procedures, and laboratory practices are designed to provide a standard set of performance-driven criteria to provide data of the same quality as other analyses of similar matrices using the same methods under similar conditions.

Representativeness is assessed qualitatively (there are no equations or numerical criteria for this data quality indicator).

4.2.4 Comparability

Comparability of analytical data among laboratories becomes more accurate and reliable when all labs follow the same procedure and share information for program enhancement. Some of these procedures include:

- Instrument standards traceable to National Institute of Standards and Technology (NIST), USEPA, or the New York State Department of Health or Environmental Conservation;
- Using standard methodologies;
- Reporting results for similar matrices in consistent units;
- Applying appropriate levels of quality control within the context of the laboratory quality assurance program; and,
- Participation in inter-laboratory studies to document laboratory performance.

By using traceable standards and standard methods, the analytical results can be compared to other labs operating similarly. The QA Program documents internal performance. Periodic laboratory proficiency studies are instituted as a means of monitoring intra-laboratory performance. Comparability is assessed qualitatively (there are no equations or numerical criteria for this data quality indicator).

4.2.5 Completeness

The goal of completeness is to generate the maximum amount possible of valid data. The highest degree of completeness would be to find all deliverables flawless, valid, and acceptable. The lowest level of completeness is excessive failure to meet established acceptance criteria and consequent rejection of data. The completeness goal is 95 percent useable data. However, it is acknowledged that this goal may not be fully achievable; for example, individual analytes may be rejected within an otherwise acceptable analysis; or some sampling locations may not be accessible. The impact of rejected or unusable data will be determined on a case-by-case basis. If the study can be completed without the missing datum or data, no further action would be necessary. However, loss of critical data may require re-sampling or reanalysis.

4.2.6 Sensitivity

Sensitivity criteria are established so that reporting limits are adequate to verify the absence of a non-detected analyte at the applicable threshold concentration (e.g., regulatory limits or guidance values). Laboratory reporting limits will be reviewed prior to sample collection to verify that limits are appropriate for the specific analytes and matrices. Laboratory reporting limits for PFAS analysis is included in Table 5. Additionally, the laboratory standard operating procedure (SOP) for PFAS analysis is included as Appendix D.

4.3 Field Quality Assurance

Field quality assurance/quality control samples associated with the generation of environmental data typically include field (equipment rinsate) blanks; field duplicates; and trip blanks. The sampling frequency of these field-related QA/QC samples are discussed below and summarized in Table 5.

4.3.1 Equipment (Rinsate) Blanks

The purpose of an equipment blank is to determine if contaminants have been introduced through contact with sampling equipment. As dedicated sampling equipment will be utilized, no use of equipment blanks is anticipated other than for sample collect for PFAS and 1,4-Dioxane. Equipment blanks will be utilized for every day when samples are collected for PFAS and 1,4-Dioxane analysis and will consist of pouring PFAS-free water provided by the laboratory over the field sampling equipment into an appropriate container.

4.3.2 Field Duplicate Samples

The purpose of duplicates is to evaluate precision. Duplicates will be collected at a frequency of 1 per 20 samples of soil, groundwater, or soil vapor and will be analyzed for the same parameters as the environmental sample. A field duplicate sample is a co-located sample or a sample that is divided into two from the same sampling location and depth. Homogenizing solid samples, such as soil, is appropriate only for non-VOC analysis.

4.3.3 Trip Blanks

The purpose of a trip blank is to identify any VOC-related contamination that occurred during transportation of the samples. The trip blank travels along with empty glassware from the lab to the Site and returns from the Site with the collected sampled. A trip blank will be analyzed for every day that groundwater sampling for VOCs occurs, and will be analyzed for VOCs.

4.4 Laboratory Quality Assurance

Method-required laboratory quality assurance includes an instrument performance check; calibration check; and method blank analysis for each group of 20 or fewer samples. In addition, internal standards are added to every sample (environmental samples and laboratory QA/QC samples). Laboratories typically perform additional QC, such as spikes, laboratory duplicates, and laboratory control samples. The frequency of these analyses is specified in the laboratory's analytical SOP for the method, and is discussed below and summarized in Table 5.

4.4.1 Instrument Performance Check

The instrument performance check verifies the operation of the gas chromatography/mass spectroscopy and verifies that it meets tuning and mass spectral abundance criteria prior to sample data acquisitions.

4.4.2 Calibration Checks

An initial five-point calibration check must be performed after the instrument performance check but prior to the analysis of blanks and samples. Concentrations of the calibration standards should be selected to span the concentration range of interest. One of the concentrations of the initial calibration must be the same as the daily calibration check.

On a daily basis, a single-point calibration check must be analyzed (with each group of 20 or fewer samples). The percent difference (%D) for each compound in the daily calibration check should be within ±30 percent of the response determined in the initial calibration in order to proceed with sample analysis. If the %D criteria are not met, a new five-point calibration should be performed.

4.4.3 Method Blanks

Method blanks are used to assess the background variability of the method and to assess the introduction of contamination to the samples by the method, technique, or instrument as the sample is prepared and analyzed in the laboratory.

The method blank should not contain any target analytic at a concentration greater than its quantitation level (reporting limit; typically, three times the MDL) or its action level, whichever is more stringent. Method blanks are analyzed at a frequency of one for every 20 samples analyzed, or every analytical batch, whichever is more frequent.

4.4.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Site-specific MS/MSD samples will be submitted at a rate of one per 20 samples, for soil and groundwater samples collected during this sampling program.

4.4.5 Internal Standards

Internal standards (IS) are added to every sample analyzed for VOCs (in any matrix) and SVOCs. Sample-specific IS recovery should be 40 percent or less of the mean response in the most recent valid calibration.

5.0 QUALITY MANAGEMENT

Mr. William Silveri will serve as the Quality Assurance and Quality Control Officer (QA/QC) for the project. This individual will not have direct project responsibility but will independently monitor the implementation of the RIWP. The primary duties of the QA/QC officer will be:

- Monitor the project in accordance with the requirement of this QAPP and the RIWP;
- Review the project to ensure that the overall data quality objectives are attained;
- Record any deviations and inform the Project Manager (PM) of any such deviations;
- Meet with the PM, as needed, to discuss compliance with the QAPP;
- Advise the PM of findings and recommend changes on methods to improve quality; and
- Verify that outside services meet the data objectives of the QAPP.

6.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data validation activities will include the manual check of laboratory data tables and reduced data summary tables. A cycle of markup, revision, and trace checking shall be performed and a check by the PM will ensure data quality.

Conclusions and/or recommendations will be reviewed by one or more qualified peers of the professional who developed them to ensure their accuracy on the basis of acquired data and conducted analyses.

The guidance followed to perform quality data validation, and the methods and procedures outlined herein and elsewhere in the field sampling plan and remedial investigation work plan, pertain to initiating and performing data validation, as well as reviewing data validation performed by others (if applicable). An outline of the data validation process is presented here, followed by a description of data validation review summaries.

6.1 Laboratory Data Reporting and Reduction

The laboratory will meet the applicable documentation, data reduction, and reporting protocols as specified in the NYSDEC ASP Category B deliverable requirements.

In addition to the hard copy of the data report, the Electronic Data Deliverable (EDD) will be provided to NYSDEC in format pursuant to DER-10 requirements. The EDD will be generated, to the extent possible, directly from the laboratory's electronic files or information management system, to minimize possible transcription errors resulting from the manual transcription of data.

6.2 Data Validation

A subcontractor to Athenica will review and validate the groundwater, soil, and soil vapor/ambient air data. The data validator will be independent of the laboratory and independent of Athenica. Data validation will be performed by following guidelines established in the specific USEPA Region 2 SOPs.

Where necessary and appropriate, supplemental validation criteria may be derived from the USEPA Functional Guidelines (USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, USEPA 540/R-99/008; October 1999, and National Functional Guidelines for Inorganic Data Review, USEPA 540/R-04-004; October 2004), as appropriate.

Validation reports will consist of text results of the review and marked up copies of Form I (results with qualifiers applied by the validator). Validation will consist of target and non-target compounds with corresponding method blank data, spike and surrogate recoveries, sample data, and a final note of validation decision or qualification, along with any pertinent footnote references. Qualifiers applied to the data will be documented in the report text. The results of the data validation will be presented in a data Usability Summary Report (DUSR) prepared by the validation subcontractor.

6.3 Data Usability

Subsequent to review of the items evaluated in the subcontractor's DUSRs, Athenica will then prepare a brief summary of the data usability. This summary, which will be provided as part of the RIR, encompassed both quantitative and qualitative aspects of the data usability.

The quantitative aspect is a summary of the data quality as expressed by qualifiers applied to the data; the percent rejected, qualified (i.e., estimated), missing, and fully acceptable data are reported. As appropriate, this quantitative summary is broken down by matrix, laboratory, or analytical fraction or method.

The qualitative element of the data usability summary is the QA officer's translation and summary of the validation reports into a discussion useful to data users. The qualitative aspect will discuss the significance of the qualifications applied to the data, especially in terms of those most relevant to the intended use of the data. The usability report will also indicate whether there is a suspected bias (high or low) in qualified data and will also provide a subjective overall assessment of the data quality.

6.4 Field Data

Field data collected during the field activity will be presented in tabular form with any necessary supporting text. Unless activities resulted in significant unexpected results, field data comments can be added as footnotes to the tables.

7.0 DOCUMENT CONTROL

Project documents will be maintained in a secure area of Athenica's office at 31-33 31st Street in Astoria, Queens, New York. Access to these files will be limited to the PM, the Principal-in-Charge and those designated by the PM.

A system is established to ensure that only the latest authorized documents are employed to execute the work. This includes marking all previous versions "void" or "superseded" and/or sending communication to team members indicating the document is no longer valid and the new document should be used. The Quality Assurance Officer (QAO) or designee will periodically conduct review the document retention practices to ensure the new documents are being used.

The Principal-in-Charge, Project Manager, and/or QAO will be responsible for reviewing all documents for conformance.

Records of project activities will be maintained at Athenica's Office will be available for review, upon request.

8.0 QUALITY RECORDS AND DOCUMENTATION

Project Quality Records, which provide evidence of conformance to the requirements of this document, will be kept in Athenica’s corporate office. Records will be stored electronically in the project file, which will be maintained in a suitable environment to prevent damage, deterioration, or loss. The PM, in consultation with the QA/QC Officer, is responsible for identifying the records to be retained and establishing protection and controlled-retrieval procedures for such documents, including applicable retention times and ultimate disposal method(s).

9.0 TRAINING

Athenica will employ only qualified and experienced personnel to execute any task of the scope of work. Junior staff will have role solely for supporting implementation of a project task. The PM is responsible for verifying that each employee assigned to the project has read and understands the requirements of this document and is familiar with its procedures/instructions. Training will consist of in-house technical and non-technical seminars given by qualified and experienced senior staff members. In addition, specific meetings will be designed and held to review quality of work and address any corrective measures needed to correct any non-conforming activities that are identified. Project staff will be required to attend any meetings that are held.

TABLES

Table 1
Chemical Parameters and Data Quality Levels for Soil Samples
500 Third Avenue, Brooklyn, New York

Target Compound List (TCL) Volatile Organic Compounds	Units	Restricted Residential Use SCOs
1,1,1-Trichloroethane	ug/kg	100,000
1,1,2,2-Tetrachloroethane	ug/kg	NS
1,1,2-Trichloroethane	ug/kg	NS
1,1-Dichloroethane	ug/kg	26,000
1,1-Dichloroethene	ug/kg	100,000
1,2,3-Trichlorobenzene	ug/kg	NS
1,2,4-Trichlorobenzene	ug/kg	NS
1,2,4-Trimethylbenzene	ug/kg	52,000
1,2-Dibromo-3-chloropropane	ug/kg	NS
1,2-Dibromoethane	ug/kg	NS
1,2-Dichlorobenzene	ug/kg	100,000
1,2-Dichloroethane	ug/kg	3,100
1,2-Dichloropropane	ug/kg	NS
1,3,5-Trimethylbenzene	ug/kg	52,000
1,3-Dichlorobenzene	ug/kg	49,000
1,4-Dichlorobenzene	ug/kg	13,000
2-Hexanone	ug/kg	NS
4-Methyl-2-pentanone	ug/kg	NS
Acetone	ug/kg	100,000
Aniline	ug/kg	8,100
Benzene	ug/kg	4,800
Bromochloromethane	ug/kg	NS
Bromodichloromethane	ug/kg	NS
Bromoform	ug/kg	NS
Bromomethane	ug/kg	NS
Carbon Disulfide	ug/kg	NS
Carbon tetrachloride	ug/kg	2,400
Chlorobenzene	ug/kg	100,000
Chloroethane	ug/kg	NS
Chloroform	ug/kg	49,000
Chloromethane	ug/kg	NS
cis-1,2-Dichloroethene	ug/kg	100,000
cis-1,3-Dichloropropene	ug/kg	NS
Cyclohexane	ug/kg	NS
Dibromochloromethane	ug/kg	NS
Dichlorodifluoromethane	ug/kg	NS
Ethylbenzene	ug/kg	41,000
Hexachlorobenzene	ug/kg	1,200
Isopropylbenzene	ug/kg	NS
m&p-Xylene	ug/kg	NS
Methyl ethyl ketone	ug/kg	100,000
Methyl t-butyl ether (MTBE)	ug/kg	100,000
Methylacetate	ug/kg	NS
Methylcyclohexane	ug/kg	NS
Methylene chloride	ug/kg	100,000
Naphthalene	ug/Kg	100,000
Nitrobenzene	ug/Kg	1,800
n-Butylbenzene	ug/Kg	100,000
n-Propylbenzene	ug/Kg	100,000
o-Xylene	ug/kg	NS
p-Isopropyltoluene	ug/Kg	NS
sec-Butylbenzene	ug/Kg	100,000
Styrene	ug/kg	NS
tert-Butylbenzene	ug/Kg	100,000
Tetrachloroethene	ug/kg	19,000
Toluene	ug/kg	100,000
Total Xylenes	ug/kg	100,000
trans-1,2-Dichloroethene	ug/kg	100,000
trans-1,3-Dichloropropene	ug/kg	NS
Trichloroethene	ug/kg	21,000
Trichlorofluoromethane	ug/kg	NS
Trichlorotrifluoroethane	ug/kg	NS
Vinyl chloride	ug/kg	900
Total Xylenes	ug/kg	100,000

Note:
ug/kg = microgram per kilogram
NS = no standard

Table 1
Chemical Parameters and Data Quality Levels for Soil Samples
500 Third Avenue, Brooklyn, New York

TCL Semivolatile Organic Compounds	Units	Restricted Residential Use SCOs
1,1-Biphenyl	ug/Kg	NS
1,2,4,5-Tetrachlorobenzene	ug/Kg	NS
2,2'-Oxybis(1-Chloropropane)	ug/Kg	NS
2,3,4,6-tetrachlorophenol	ug/Kg	NS
2,4,5-Trichlorophenol	ug/Kg	NS
2,4,6-Trichlorophenol	ug/Kg	NS
2,4-Dichlorophenol	ug/Kg	NS
2,4-Dimethylphenol	ug/Kg	NS
2,4-Dinitrophenol	ug/Kg	NS
2,4-Dinitrotoluene	ug/Kg	NS
2,6-Dinitrotoluene	ug/Kg	NS
2-Chloronaphthalene	ug/Kg	NS
2-Chlorophenol	ug/Kg	NS
2-Methylnaphthalene	ug/Kg	NS
2-Methylphenol (o-cresol)	ug/Kg	100,000
2-Nitroaniline	ug/Kg	NS
2-Nitrophenol	ug/Kg	NS
3&4-Methylphenol (m&p-cresol)	ug/Kg	NS
3,3'-Dichlorobenzidine	ug/Kg	NS
3-Nitroaniline	ug/Kg	NS
4,6-Dinitro-2-methylphenol	ug/Kg	NS
4-Bromophenyl phenyl ether	ug/Kg	NS
4-Chloro-3-methylphenol	ug/Kg	NS
4-Chloroaniline	ug/Kg	NS
4-Chlorophenyl phenyl ether	ug/Kg	NS
4-Nitroaniline	ug/Kg	NS
4-Nitrophenol	ug/Kg	NS
Acenaphthene	ug/Kg	100,000
Acenaphthylene	ug/Kg	100,000
Acetophenone	ug/Kg	NS
Anthracene	ug/Kg	100,000
Atrazine	ug/Kg	NS
Benz(a)anthracene	ug/Kg	1,000
Benzaldehyde	ug/Kg	NS
Benzo(a)pyrene	ug/Kg	1,000
Benzo(b)fluoranthene	ug/Kg	1,000
Benzo(ghi)perylene	ug/Kg	100,000
Benzo(k)fluoranthene	ug/Kg	3,900
Benzyl butyl phthalate	ug/Kg	NS
Bis(2-chloroethoxy)methane	ug/Kg	NS
Bis(2-chloroethyl)ether	ug/Kg	NS
Bis(2-ethylhexyl)phthalate	ug/Kg	NS
Caprolactam	ug/Kg	NS
Carbazole	ug/Kg	NS
Chrysene	ug/Kg	3,900
Dibenz(a,h)anthracene	ug/Kg	330
Dibenzofuran	ug/Kg	59,000
Diethyl phthalate	ug/Kg	NS
Dimethylphthalate	ug/Kg	NS
Di-n-butylphthalate	ug/Kg	NS
Di-n-octylphthalate	ug/Kg	NS
Fluoranthene	ug/Kg	100,000
Fluorene	ug/Kg	100,000
Hexachlorobenzene	ug/Kg	1,200
Hexachlorobutadiene	ug/Kg	NS
Hexachlorocyclopentadiene	ug/Kg	NS
Hexachloroethane	ug/Kg	NS
Indeno(1,2,3-cd)pyrene	ug/Kg	500
Isophorone	ug/Kg	NS
m-Cresol	ug/Kg	100,000
Naphthalene	ug/Kg	100,000
Nitrobenzene	ug/Kg	NS
N-Nitrosodimethylamine	ug/Kg	NS
N-Nitrosodi-n-propylamine	ug/Kg	NS
N-Nitrosodiphenylamine	ug/Kg	NS
o-Cresol	ug/Kg	100,000
p-Cresol	ug/Kg	100,000
Pentachlorophenol	ug/Kg	6,700
Phenanthrene	ug/Kg	100,000
Phenol	ug/Kg	100,000
Pyrene	ug/Kg	100,000

Note:
ug/kg = microgram per kilogram
NS = no standard

Table 1

Chemical Parameters and Data Quality Levels for Soil Samples

500 Third Avenue, Brooklyn, New York

TAL Metals	Units	Restricted Residential Use SCOs
Aluminum	mg/Kg	NS
Antimony	mg/Kg	NS
Arsenic	mg/Kg	16
Barium	mg/Kg	400
Beryllium	mg/Kg	72
Cadmium	mg/Kg	4.3
Calcium	mg/Kg	NS
Chromium*	mg/Kg	NS
Cobalt	mg/Kg	NS
Copper	mg/kg	270
Iron	mg/Kg	NS
Lead	mg/Kg	400
Magnesium	mg/Kg	NS
Manganese	mg/Kg	2,000
Mercury	mg/Kg	0.81
Nickel	mg/Kg	310
Potassium	mg/Kg	NS
Selenium	mg/Kg	180
Silver	mg/Kg	180
Sodium	mg/Kg	NS
Thallium	mg/Kg	NS
Total Cyanide	mg/Kg	27
Trivalent Chromium	mg/kg	180
Vanadium	mg/Kg	NS
Zinc	mg/Kg	10,000
TCL Pesticides	Units	Restricted Residential Use SCOs
4,4' -DDD	ug/Kg	13,000
4,4' -DDE	ug/Kg	8,900
4,4' -DDT	ug/Kg	7,900
a-BHC	ug/Kg	480
a-Chlordane	ug/Kg	4,200
Alachlor	ug/Kg	NS
Aldrin	ug/Kg	97
b-BHC	ug/Kg	360
Chlordane	ug/Kg	NS
Dibenzofuran	ug/Kg	59,000
d-BHC	ug/Kg	100,000
Dieldrin	ug/Kg	200
Endosulfan I	ug/Kg	24,000
Endosulfan II	ug/Kg	24,000
Endosulfan sulfate	ug/Kg	24,000
Endrin	ug/Kg	11,000
Endrin aldehyde	ug/Kg	NS
Endrin ketone	ug/Kg	NS
g-BHC	ug/Kg	1,300
g-Chlordane	ug/Kg	NS
Heptachlor	ug/Kg	2,100
Heptachlor epoxide	ug/Kg	NS
Lindane	ug/Kg	1,300
Methoxychlor	ug/Kg	NS
Silvex	ug/Kg	100,000
Toxaphene	ug/Kg	NS
TCL Polychlorinated Biphenyls	Units	Restricted Residential Use SCOs
PCB-1016	ug/Kg	NS
PCB-1221	ug/Kg	NS
PCB-1232	ug/Kg	NS
PCB-1242	ug/Kg	NS
PCB-1248	ug/Kg	NS
PCB-1254	ug/Kg	NS
PCB-1260	ug/Kg	NS
PCB-1262	ug/Kg	NS
PCB-1268	ug/Kg	NS
Total PCBs	ug/Kg	1,000

Note:
ug/Kg = microgram per kilogram
mg/Kg = miligram per kilogram
NS = no standard

Table 1
Chemical Parameters and Data Quality Levels for Soil Samples
500 Third Avenue, Brooklyn, New York

1,4-dioxane	Units	Restricted Residential Use SCOs
1,4-dioxane	ug/kg	13,000
PFOA/PFAS (NYSDEC List)	Units	NYSDEC Guidance Values
11Cl-PF3OUdS	ng/g	500
1H,1H,2H,2H-Perfluorodecanesulfonic acid	ng/g	500
1H,1H,2H,2H-Perfluorohexanesulfonic Acid	ng/g	500
1H,1H,2H,2H-Perfluorooctanesulfonic acid	ng/g	500
3:3FTCA	ng/g	500
5:3FTCA	ng/g	500
7:3FTCA	ng/g	500
9Cl-PF3ONS	ng/g	500
ADONA	ng/g	500
HFPO-DA	ng/g	500
NEtFOSA	ng/g	500
NEtFOSAA	ng/g	500
NEtFOSE	ng/g	500
NFDHA	ng/g	500
NMeFOSA	ng/g	500
NMeFOSAA	ng/g	500
NMeFOSE	ng/g	500
Perfluoro-1-decanesulfonic acid (PFDS)	ng/g	500
Perfluoro-1-heptanesulfonic acid (PFHpS)	ng/g	500
Perfluoro-1-octanesulfonamide (FOSA)	ng/g	500
Perfluorobutanesulfonic acid (PFBS)	ng/g	500
Perfluorodecanoic acid (PFDA)	ng/g	500
Perfluorododecane Sulfonic Acid (PFDoDS)	ng/g	500
Perfluorododecanoic acid (PFDoA)	ng/g	500
Perfluoroheptanoic acid (PFHpA)	ng/g	500
Perfluorohexanesulfonic Acid (PFHxS)	ng/g	500
Perfluorohexanoic acid (PFHxA)	ng/g	500
Perfluoro-n-butanoic acid (PFBA)	ng/g	500
Perfluorononanesulfonic Acid (PFNS)	ng/g	500
Perfluorononanoic acid (PFNA)	ng/g	500
Perfluorooctanesulfonic Acid (PFOS)	ng/g	500
Perfluorooctanoic acid (PFOA)	ng/g	500
Perfluoropentanesulfonic Acid (PFPeS)	ng/g	500
Perfluoropentanoic acid (PFPeA)	ng/g	500
Perfluorotetradecanoic acid (PFTA)	ng/g	500
Perfluorotridecanoic acid (PFTrDA)	ng/g	500
Perfluoroundecanoic acid (PFUnA)	ng/g	500
PFEESA	ng/g	500
PFMBA	ng/g	500
PFMPA	ng/g	500

Note:

ug/kg = microgram per kilogram

ng/g = nanogram per kilogram

Table 2
Chemical Parameters and Data Quality Levels for Groundwater Samples
500 Third Avenue, Brooklyn, New York

Target Compound List (TCL) Volatile Organic Compounds	Units	TOGS GQS
1,1,1,2-Tetrachloroethane	ug/L	5
1,1,1-Trichloroethane	ug/L	5
1,1,2,2-Tetrachloroethane	ug/L	5
1,1,2-Trichloroethane	ug/L	1
1,1-Dichloroethane	ug/L	5
1,1-Dichloroethene	ug/L	5
1,1-Dichloropropene	ug/L	5
1,2,3-Trichlorobenzene	ug/L	
1,2,3-Trichloropropane	ug/L	0.04
1,2,4-Trichlorobenzene	ug/L	
1,2,4-Trimethylbenzene	ug/L	5
1,2-Dibromo-3-chloropropane	ug/L	0.04
1,2-Dibromoethane	ug/L	0.0006
1,2-Dichlorobenzene	ug/L	NS
1,2-Dichloroethane	ug/L	0.6
1,2-Dichloropropane	ug/L	1
1,3,5-Trimethylbenzene	ug/L	5
1,3-Dichlorobenzene	ug/L	3
1,3-Dichloropropane	ug/L	5
1,4-Dichlorobenzene	ug/L	NS
2,2-Dichloropropane	ug/L	5
2-Chlorotoluene	ug/L	5
2-Hexanone	ug/L	50
2-Isopropyltoluene	ug/L	5
4-Chlorotoluene	ug/L	5
4-Methyl-2-pentanone	ug/L	NS
Acetone	ug/L	50
Acrylonitrile	ug/L	5
Benzene	ug/L	1
Bromobenzene	ug/L	5
Bromochloromethane	ug/L	5
Bromodichloromethane	ug/L	50
Bromoform	ug/L	50
Bromomethane	ug/L	5
Carbon Disulfide	ug/L	NS
Carbon tetrachloride	ug/L	5
Chlorobenzene	ug/L	5
Chloroethane	ug/L	5
Chloroform	ug/L	7
Chloromethane	ug/L	5
cis-1,2-Dichloroethene	ug/L	5
cis-1,3-Dichloropropene	ug/L	0.4
Dibromochloromethane	ug/L	50
Dibromomethane	ug/L	5
Dichlorodifluoromethane	ug/L	5
Ethylbenzene	ug/L	5
Hexachlorobutadiene	ug/L	0.5
Isopropylbenzene	ug/L	5
m&p-Xylene	ug/L	NS
Methyl ethyl ketone	ug/L	50
Methyl t-butyl ether (MTBE)	ug/L	NS
Methylene chloride	ug/L	5
Naphthalene	ug/L	10
n-Butylbenzene	ug/L	5
n-Propylbenzene	ug/L	5
o-Xylene	ug/L	5
p-Isopropyltoluene	ug/L	5
sec-Butylbenzene	ug/L	5
Styrene	ug/L	5
tert-Butylbenzene	ug/L	5
Tetrachloroethene	ug/L	5
Tetrahydrofuran (THF)	ug/L	50
Toluene	ug/L	5
Total Xylenes	ug/L	5
trans-1,2-Dichloroethene	ug/L	5
trans-1,3-Dichloropropene	ug/L	0.4
trans-1,4-dichloro-2-butene	ug/L	5
Trichloroethene	ug/L	5
Trichlorofluoromethane	ug/L	5
Trichlorotrifluoroethane	ug/L	5
Vinyl chloride	ug/L	2

Note:
ug/L = microgram per liter
NS = no standard

Table 2
Chemical Parameters and Data Quality Levels for Groundwater Samples
500 Third Avenue, Brooklyn, New York

TCL Semivolatile Organic Compounds	Units	TOGS GQS
1,2,4,5-Tetrachlorobenzene	ug/L	NS
1,2,4-Trichlorobenzene	ug/L	NS
1,2-Dichlorobenzene	ug/L	NS
1,2-Diphenylhydrazine	ug/L	NS
1,3-Dichlorobenzene	ug/L	3
1,4-Dichlorobenzene	ug/L	NS
2,2'-Oxybis(1-Chloropropane)	ug/L	5
2,4,5-Trichlorophenol	ug/L	1
2,4,6-Trichlorophenol	ug/L	1
2,4-Dichlorophenol	ug/L	1
2,4-Dimethylphenol	ug/L	1
2,4-Dinitrophenol	ug/L	1
2,4-Dinitrotoluene	ug/L	5
2,6-Dinitrotoluene	ug/L	5
2-Chloronaphthalene	ug/L	10
2-Chlorophenol	ug/L	1
2-Methylphenol (o-cresol)	ug/L	1
2-Nitroaniline	ug/L	5
2-Nitrophenol	ug/L	1
3&4-Methylphenol (m&p-cresol)	ug/L	NS
3,3'-Dichlorobenzidine	ug/L	5
3-Nitroaniline	ug/L	5
4,6-Dinitro-2-methylphenol	ug/L	1
4-Bromophenyl phenyl ether	ug/L	NS
4-Chloro-3-methylphenol	ug/L	1
4-Chloroaniline	ug/L	5
4-Chlorophenyl phenyl ether	ug/L	NS
4-Nitroaniline	ug/L	5
4-Nitrophenol	ug/L	1
Acetophenone	ug/L	NS
Aniline	ug/L	5
Benzidine	ug/L	5
Benzoic acid	ug/L	NS
Benzyl butyl phthalate	ug/L	50
Bis(2-chloroethoxy)methane	ug/L	5
Bis(2-chloroethyl)ether	ug/L	1
Bis(2-ethylhexyl)phthalate	ug/L	5
Carbazole	ug/L	NS
Dibenzofuran	ug/L	NS
Diethyl phthalate	ug/L	50
Dimethylphthalate	ug/L	50
Di-n-butylphthalate	ug/L	50
Di-n-octylphthalate	ug/L	50
Hexachloroethane	ug/L	5
Isophorone	ug/L	50
N-Nitrosodi-n-propylamine	ug/L	NS
N-Nitrosodiphenylamine	ug/L	50
Pentachloronitrobenzene	ug/L	NS
Phenol	ug/L	1
TCL Semivolatile Organic Compounds (SIM)	Units	TOGS GQS
2-Methylnaphthalene	ug/L	NS
Acenaphthene	ug/L	20
Acenaphthylene	ug/L	NS
Anthracene	ug/L	50
Benz(a)anthracene	ug/L	0.002
Benzo(a)pyrene	ug/L	NS
Benzo(b)fluoranthene	ug/L	0.002
Benzo(ghi)perylene	ug/L	NS
Benzo(k)fluoranthene	ug/L	0.002
Chrysene	ug/L	0.002
Dibenz(a,h)anthracene	ug/L	NS
Fluoranthene	ug/L	50
Fluorene	ug/L	50
Hexachlorobenzene	ug/L	0.04
Hexachlorobutadiene	ug/L	0.5
Hexachlorocyclopentadiene	ug/L	5
Indeno(1,2,3-cd)pyrene	ug/L	0.002
Naphthalene	ug/L	10
Nitrobenzene	ug/L	0.4
N-Nitrosodimethylamine	ug/L	NS
Pentachlorophenol	ug/L	1
Phenanthrene	ug/L	50
Pyrene	ug/L	50
Pyridine	ug/L	50

Note:
ug/L = microgram per liter
NS = no standard

Table 2
Chemical Parameters and Data Quality Levels for Groundwater Samples
500 Third Avenue, Brooklyn, New York

TAL Metals (Total and Dissolved)	Units	TOGS GQS
Aluminum	mg/L	0.1
Antimony	mg/L	0.003
Arsenic	mg/L	0.025
Barium	mg/L	1
Beryllium	mg/L	0.003
Cadmium	mg/L	0.005
Calcium	mg/L	NS
Chromium	mg/L	0.05
Cobalt	mg/L	NS
Copper	mg/L	0.2
Iron	mg/L	0.3
Lead	mg/L	0.025
Magnesium	mg/L	35
Manganese	mg/L	0.3
Mercury	mg/L	0.0007
Nickel	mg/L	0.1
Potassium	mg/L	NS
Selenium	mg/L	0.01
Silver	mg/L	0.05
Sodium	mg/L	20
Thallium	mg/L	0.0005
Vanadium	mg/L	NS
Zinc	mg/L	5
TCL Pesticides	Units	TOGS GQS
4,4' -DDD	ug/L	0.3
4,4' -DDE	ug/L	0.2
4,4' -DDT	ug/L	0.2
a-BHC	ug/L	0.01
Alachlor	ug/L	0.5
Aldrin	ug/L	NS
b-BHC	ug/L	0.04
Chlordane	ug/L	0.05
d-BHC	ug/L	0.04
Dieldrin	ug/L	0.004
Endosulfan I	ug/L	NS
Endosulfan II	ug/L	NS
Endosulfan Sulfate	ug/L	NS
Endrin	ug/L	NS
Endrin Aldehyde	ug/L	5
Endrin ketone	ug/L	5
g-BHC (Lindane)	ug/L	0.05
Heptachlor	ug/L	0.04
Heptachlor epoxide	ug/L	0.03
Methoxychlor	ug/L	35
Toxaphene	ug/L	0.06
TCL Polychlorinated Biphenyls	Units	TOGS GQS
PCB-1016	ug/L	0.09
PCB-1221	ug/L	0.09
PCB-1232	ug/L	0.09
PCB-1242	ug/L	0.09
PCB-1248	ug/L	0.09
PCB-1254	ug/L	0.09
PCB-1260	ug/L	0.09
PCB-1262	ug/L	NS
PCB-1268	ug/L	NS

Note:
ug/L = microgram per liter
mg/L = miligram per liter
NS = no standard

Table 2
Chemical Parameters and Data Quality Levels for Groundwater Samples
500 Third Avenue, Brooklyn, New York

1,4-dioxane	Units	TOGS GQS
1,4-dioxane	ug/L	NS
PFOA/PFAS (NYSDEC List)	**Units**	**NYSDEC Guidance**
11Cl-PF3OUdS	ng/L	100
1H,1H,2H,2H-Perfluorodecanesulfonic acid	ng/L	100
1H,1H,2H,2H-Perfluorohexanesulfonic acid	ng/L	NS
1H,1H,2H,2H-Perfluorooctanesulfonic acid	ng/L	100
3:3FTCA	ng/L	NS
5:3FTCA	ng/L	NS
7:3FTCA	ng/L	NS
9Cl-PF3ONS	ng/L	100
ADONA	ng/L	100
HFPO-DA	ng/L	100
NEtFOSA	ng/L	NS
NEtFOSAA	ng/L	100
NEtFOSE	ng/L	NS
NFDHA	ng/L	NS
NMeFOSA	ng/L	NS
NMeFOSAA	ng/L	100
NMeFOSE	ng/L	NS
Perfluoro-1-decanesulfonic acid (PFDS)	ng/L	100
Perfluoro-1-heptanesulfonic acid (PFHpS)	ng/L	100
Perfluoro-1-octanesulfonamide (FOSA)	ng/L	100
Perfluorobutanesulfonic acid (PFBS)	ng/L	100
Perfluorodecanoic acid (PFDA)	ng/L	100
Perfluorododecane Sulfonic Acid (PFDoDS)	ng/L	NS
Perfluorododecanoic acid (PFDoA)	ng/L	100
Perfluoroheptanoic acid (PFHpA)	ng/L	100
Perfluorohexanesulfonic Acid (PFHxS)	ng/L	100
Perfluorohexanoic acid (PFHxA)	ng/L	100
Perfluoro-n-butanoic acid (PFBA)	ng/L	100
Perfluorononanesulfonic Acid (PFNS)	ng/L	NS
Perfluorononanoic acid (PFNA)	ng/L	100
Perfluorooctanesulfonic Acid (PFOS)	ng/L	10
Perfluorooctanoic acid (PFOA)	ng/L	10
Perfluoropentanesulfonic Acid (PFPeS)	ng/L	NS
Perfluoropentanoic acid (PFPeA)	ng/L	100
Perfluorotetradecanoic acid (PFTA)	ng/L	100
Perfluorotridecanoic acid (PFTrDA)	ng/L	100
Perfluoroundecanoic acid (PFUnA)	ng/L	100
PFEESA	ng/L	NS
PFMBA	ng/L	NS
PFMPA	ng/L	NS

Note:
ug/kg = microgram per kilogram
ng/g = nanogram per kilogram

Table 3
Analytical Parameters, Methods, Preservation and Container Requirements
500 Third Avenue, Brooklyn, New York

Sample Matrix	Analytical Parameter	Sample Type	No. of Samples	USEPA Analytical Method	Sample Preservation	Holding Time	Sample Container
Soil	TCL VOCs	Grab	≥31	USEPA Method 8260	Cool to 4° C; Terra Core Kit	48 hours (14 days after frozen)	One terra core kit
	TCL SVOCs	Grab	≥31	USEPA Method 8270	Cool to 4° C	14 days	4 oz. glass jar
	TAL Metals (Except Hg)	Grab	≥31	USEPA Method 6010	Cool to 4° C	6 months	4 oz. glass jar
	Hg	Grab	≥31	USEPA Method 6010	Cool to 4° C	28 days	4 oz. glass jar
	TCL PCBs	Grab	≥31	USEPA Method 8082	Cool to 4° C	14 days	4 oz. glass jar
	TCL Pesticides	Grab	≥31	USEPA Method 8081	Cool to 4° C	14 days	4 oz. glass jar
	1,4-dioxane	Grab	≥31	USEPA Method 8270 SIM	Cool to 4° C	14 days	2 oz. glass jar
	PFOA/PFAS	Grab	≥31	USEPA Method 1633 (NYSDEC list of compounds)	Cool to 4° C	14 days	HDPE Only
Groundwater	TCL VOCs	Grab	12	USEPA Method 8260	pH<2 with HCl; Cool to 4° C; no headspace	14 days	(3) 40 mL VOA vials
	TCL SVOCs	Grab	12	USEPA Method 8270	Cool to 4° C; no headspace	7 days	(2) 1 Liter Amber Jars
	Total TAL Metals (Except Hg)	Grab	12	USEPA Method 6010	Nitric acid; cool to 4° C; no headspace	6 months	250 ml plastic bottle

Table 3
Analytical Parameters, Methods, Preservation and Container Requirements
500 Third Avenue, Brooklyn, New York

Sample Matrix	Analytical Parameter	Sample Type	No. of Samples	USEPA Analytical Method	Sample Preservation	Holding Time	Sample Container
	Total Hg	Grab	12	USEPA Method 6010	Nitric acid; cool to 4º C; no headspace	28 days	250 ml plastic bottle
	Dissolved TAL Metals (Except Hg)	Grab	12	USEPA Method 7471	Cool to 4º C; no headspace	6 months	250 ml plastic bottle
	Dissolved Hg	Grab	12	USEPA Method 7471	Cool to 4º C; no headspace	28 days	250 ml plastic bottle
	PCB	Grab	12	USEPA Method 8082	Cool to 4º C; no headspace	7 days	1 Liter Amber Jar
	Pesticides	Grab	12	USEPA Method 8081	Cool to 4º C; no headspace	7 days	1 Liter Amber Jar
	1,4-dioxane	Grab	12	USEPA Method 8270 SIM	Sodium bisulfate; Cool to 4º C; no headspace	28 days	8 oz. Amber Jar
	PFOA/PFAS	Grab	12	USEPA Method 1633 (NYSDEC list of compounds)	Cool to 4º C; no headspace	14 days	HDPE Only

Table 4
QA/QC Sampling Summary
500 Third Avenue, Brooklyn, New York

Matrix/Analysis	Analytical Method	Field Duplicate	Equipment Blank	Trip Blank	Matrix Spike	Matrix Spike Duplicate
Soil TCL VOCs	EPA Method 8260	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Soil TCL SVOCs	EPA Method 8270	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Soil TCL Pesticides	EPA Method 8081	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Soil TCL PCBs	EPA Method 8082	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Soil TAL Metals	EPA Method 6010	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Soil 1,4-Dioxane	EPA Method 8270 SIM	1 per 20 samples	1 per day of sampling		1 per 20 samples	1 per 20 samples
Soil PFOA/PFAS	EPA Method 1633 (NYSDEC Compound List)	1 per 20 samples	1 per day of sampling		1 per 20 samples	1 per 20 samples
Groundwater TCL VOCs	EPA Method 8260	1 per 20 samples -	-	1 per day of sampling	1 per 20 samples	1 per 20 samples
Groundwater TCL SVOCs	EPA Method 8270	1 per 20 samples -	-	-	1 per 20 samples	1 per 20 samples
Groundwater TCL Pesticides	EPA Method 8081	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Groundwater TCL PCBs	EPA Method 8082	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Groundwater TAL Metals (Total and Dissolved)	EPA Methods 6010/7471	1 per 20 samples	-	-	1 per 20 samples	1 per 20 samples
Groundwater 1,4-Dioxane	EPA Method 8270 SIM	1 per 20 samples	1 per day of sampling		1 per 20 samples	1 per 20 samples
Groundwater PFOA/PFAS	EPA Method 1633	1 per 20 samples	1 per day of sampling	-	1 per 20 samples	1 per 20 samples
Soil Vapor VOCs	EPA Method TO-15 SIM	1 per 20 samples	-	-	-	-

Table 5
Laboratory Minimum Detection Limits for PFAS
500 Third Avenue, Brooklyn, New York

Analyte	MDL (ng/L)
11CL-PF3OUdS	2.23
1H,1H,2H,2H-Perfluorodecanesulfonic acid (8:2 FTS)	2.25
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	2.82
1H,1H,2H,2H-Perfluorooctanesulfonic acid (6:2 FTS)	2.32
3-Perfluoroheptyl propanoic acid (FHpPA)	23.07
3-Perfluoropentyl propanoic acid (FPePA)	6.73
3-Perfluoropropyl propanoic acid (FPrPA)	2.36
9CL-PF3ONS	2.75
ADONA	2.97
HFPO-DA (Gen-X)	3.14
N-EtFOSA	1.05
N-EtFOSAA	1.05
N-EtFOSE	7.28
N-MeFOSA	0.71
N-MeFOSAA	0.50
N-MeFOSE	7.10
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	0.50
Perfluoro-1-decanesulfonic acid (PFDS)	0.62
Perfluoro-1-heptanesulfonic acid (PFHpS)	0.31
Perfluoro-1-nonanesulfonic acid (PFNS)	0.75
Perfluoro-1-octanesulfonamide (FOSA)	0.37
Perfluoro-1-pentanesulfonate (PFPeS)	0.75
Perfluoro-3,6-dioxaheptanoic acid (NFDHA)	3.00
Perfluoro-4-oxapentanoic acid (PFMPA)	0.70
Perfluoro-5-oxahexanoic acid (PFMBA)	1.40
Perfluorobutanesulfonic acid (PFBS)	0.78
Perfluorodecanoic acid (PFDA)	0.57
Perfluorododecanesulfonic acid (PFDoS)	0.89
Perfluorododecanoic acid (PFDoA)	0.60
Perfluoroheptanoic acid (PFHpA)	0.70
Perfluorohexanesulfonic acid (PFHxS)	0.89
Perfluorohexanoic acid (PFHxA)	0.36
Perfluoro-n-butanoic acid (PFBA)	1.63
Perfluorononanoic acid (PFNA)	0.99
Perfluorooctanesulfonic acid (PFOS)	0.76
Perfluorooctanoic acid (PFOA)	0.79
Perfluoropentanoic acid (PFPeA)	0.89
Perfluorotetradecanoic acid (PFTA)	1.58
Perfluorotridecanoic acid (PFTrDA)	1.20
Perfluoroundecanoic acid (PFUnA)	0.71

APPENDIX A

USEPA Region I
Low-Flow Groundwater Sampling Procedure

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

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Prepared by: ROBERT REINHART Digitally signed by ROBERT REINHART Date: 2017.09.19 16:15:38 -04'00' ____________
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Approved by: JOHN SMALDONE Digitally signed by JOHN SMALDONE Date: 2017.09.20 15:11:00 -04'00' ____________
(John Smaldone, Quality Assurance Unit) Date

Revision Page

Date	**Rev #**	**Summary of changes**	**Sections**
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

Table 3
Analytical Parameters, Methods, Preservation and Container Requirements
500 Third Avenue, Brooklyn, New York

Sample Matrix	Analytical Parameter	Sample Type	No. of Samples	USEPA Analytical Method	Sample Preservation	Holding Time	Sample Container
Soil	TCL VOCs	Grab	≥31	USEPA Method 8260	Cool to 4° C; Terra Core Kit	48 hours (14 days after frozen)	One terra core kit
	TCL SVOCs	Grab	≥31	USEPA Method 8270	Cool to 4° C	14 days	4 oz. glass jar
	TAL Metals (Except Hg)	Grab	≥31	USEPA Method 6010	Cool to 4° C	6 months	4 oz. glass jar
	Hg	Grab	≥31	USEPA Method 6010	Cool to 4° C	28 days	4 oz. glass jar
	TCL PCBs	Grab	≥31	USEPA Method 8082	Cool to 4° C	14 days	4 oz. glass jar
	TCL Pesticides	Grab	≥31	USEPA Method 8081	Cool to 4° C	14 days	4 oz. glass jar
	1,4-dioxane	Grab	≥31	USEPA Method 8270 SIM	Cool to 4° C	14 days	2 oz. glass jar
	PFOA/PFAS	Grab	≥31	USEPA Method 1633 (NYSDEC list of compounds)	Cool to 4° C	14 days	HDPE Only
Groundwater	TCL VOCs	Grab	12	USEPA Method 8260	pH<2 with HCl; Cool to 4° C; no headspace	14 days	(3) 40 mL VOA vials
	TCL SVOCs	Grab	12	USEPA Method 8270	Cool to 4° C; no headspace	7 days	(2) 1 Liter Amber Jars
	Total TAL Metals (Except Hg)	Grab	12	USEPA Method 6010	Nitric acid; cool to 4° C; no headspace	6 months	250 ml plastic bottle

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	Dissolved TAL Metals (Except Hg)	Grab	12	USEPA Method 7471	Cool to 4° C; no headspace	6 months	250 ml plastic bottle
	Dissolved Hg	Grab	12	USEPA Method 7471	Cool to 4° C; no headspace	28 days	250 ml plastic bottle
	PCB	Grab	12	USEPA Method 8082	Cool to 4° C; no headspace	7 days	1 Liter Amber Jar
	Pesticides	Grab	12	USEPA Method 8081	Cool to 4° C; no headspace	7 days	1 Liter Amber Jar
	1,4-dioxane	Grab	12	USEPA Method 8270 SIM	Sodium bisulfate; Cool to 4° C; no headspace	28 days	8 oz. Amber Jar
	PFOA/PFAS	Grab	12	USEPA Method 1633 (NYSDEC list of compounds)	Cool to 4° C; no headspace	14 days	HDPE Only

Table of Contents

1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the “Monitoring Indicator Field Parameters” section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site's SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a "best practice". For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump's recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A. If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic ”tape”, pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A "T" connector coupled with a valve is connected between the pump's tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump’s tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump’s tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods (e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, *DNAPL Site Evaluation*; C.K. Smoley (CRC Press), Boca Raton, Florida.

Robert W. Puls and Michael J. Barcelona, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996 (EPA/540/S-95/504).

U.S. Environmental Protection Agency, 1992, *RCRA Ground-Water Monitoring: Draft Technical Guidance*; Washington, DC (EPA/530-R-93-001).

U.S. Environmental Protection Agency, 1987, *A Compendium of Superfund Field Operations Methods*; Washington, DC (EPA/540/P-87/001).

U.S Environmental Protection Agency, Region 1, *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017 or latest version.

U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

U.S Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

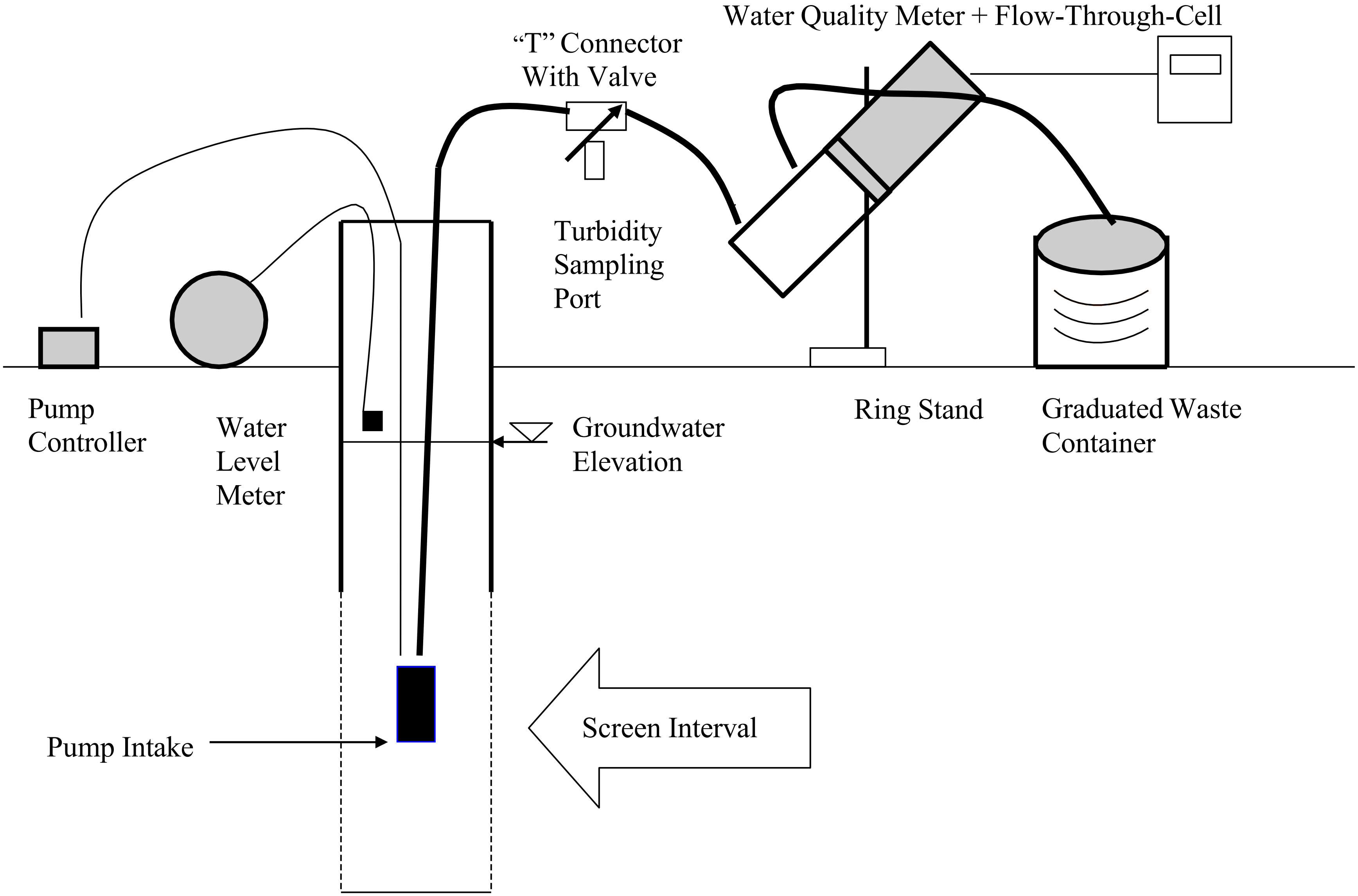
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)______________________________
Well Number________________ Date_______________________
Field Personnel____
Sampling Organization______________________________________
Identify MP____

Depth to ________/________ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_________
Purging Device; (pump type)__________
Total Volume Purged _______________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments

Stabilization Criteria 3% 3% ±0.1 ±10 mv 10% 10%

[1] Pump dial setting (for example: hertz, cycles/min, etc).
[2] µSiemens per cm(same as µmhos/cm)at 25°C.
[3] Oxidation reduction potential (ORP)

APPENDIX B

NYSDEC April 2023 Guidance Document

Sampling, Analysis, and Assessment of Per- And Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023

www.dec.ny.gov

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April 2023

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt).Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	3/28/2023
Testing for Imported Soil Page 4	If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

April 2023

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

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[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	0.8	1.0

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These

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[2] The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification.   Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the current SOP developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8). This SOP should be followed when collecting fish for contaminant analysis. Note, however, that the Bureau of Ecosystem Health will not be supplying bags or tags. All supplies are the responsibility of the collector

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:
   No materials containing Teflon.
   No Post-it notes.
   No ice packs; only water ice or dry ice.
   Any gloves worn must be powder free nitrile.
   No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
   No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
   Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
   Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
   Wear clothing washed at least six times since purchase.
   Wear clothing washed without fabric softener.
   Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________

Preservation Method: ☐Freezing ☐Other ______________ Notes (SWFDB survey number): ____________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ___________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of _______________________________________, in _________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ____________________________________, 20______.

____ ___________________________
Signature Date

I, __________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

_______________________________________ ___________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

APPENDIX C

Project Team Resumes

SPIRO DONGARIS, P.E., M. ASCE

Principal

Spiro Dongaris, founder of Athenica Environmental Services Inc. (Athenica), is a Professional Engineer with over 30 years of extensive experience in Environmental Engineering, Industrial Hygiene, Phase I and Phase II Environmental Site Assessments (ESAs), remediation system design, and remediation and abatement projects. Mr. Dongaris has comprehensive knowledge of environmental regulations as they apply to the various projects that our company undertakes. Mr. Dongaris has designed and overseen a large number of environmental remediation and abatement projects throughout the New York metropolitan area. As the principal of Athenica, he is responsible for the overall quality of work for the firm and acts as the primary client contact for the firm’s projects.

His professional experience includes performing Phase I ESAs at various commercial and industrial properties throughout the New York Metropolitan area and New Jersey in accordance with the current ASTM standard practice for Phase I ESAs. He also has received training and performed Phase I ESAs consistent with the United States Environmental Protection Agency (USEPA) “All Appropriate Inquiries Final Rule”.

He has performed or managed numerous site assessments to characterize subsurface conditions utilizing conventional drill rig for installation of soil borings and permanent groundwater monitoring wells, direct-push unit for collection of soil, soil gas and groundwater samples and use of a membrane interface probe (MIP) for profiling the vertical extent of solvent-related soil and groundwater contamination, and geophysical surveying techniques for identifying buried utilities and underground storage tanks (USTs). His site assessment experience also includes sub-slab vapor, indoor air, and soil gas sampling to evaluate soil vapor intrusion in accordance with regulatory guidance documents in New York and New Jersey.

Mr. Dongaris has participated or managed comprehensive remedial investigations at inactive hazardous waste or Brownfield properties. He has prepared and overseen the implementation of detailed work plans for the investigation of inactive hazardous waste sites in New York and New Jersey. These remedial investigations included the identification and delineation of soil and/or groundwater impacted by the release of petroleum products, chlorinated solvents, and metals hydroxides, and typically required collection of soil, groundwater, and soil vapor samples in accordance with an approved Quality Assurance Project Plan (QAPP) and site-specific Health and Safety Plan. Based on careful review of remedial investigation findings and results, and proposed development plans for the property, he has prepared and submitted final reports to clients and regulatory agencies. He has managed over twenty projects in the New York City Voluntary Cleanup Program that resulted in the successful future development of these properties.

For both private and public clients, he has evaluated off-site disposal or beneficial use facilities for receipt of excavated materials as well as evaluated off-site sources for prospective imported fill material. Mr. Dongaris has prepared or reviewed detailed excavated material disposal plans for constructions projects of new public schools in New York City.

Mr. Dongaris has prepared and/or reviewed detailed demolition specifications that addressed potential hazardous building materials, including polychlorinated biphenyls (PCBs), lead-based paint (LBP), mercury, and asbestos-containing materials (ACMs). Preparation of the specifications included conducting surveys of buildings to identify and quantify these potential hazardous building materials within structures to be demolished or renovated.

Mr. Dongaris experience also includes the supervision of UST removal/closure and associated reporting; the supervision of the installation, operation and maintenance of various types of remedial systems (groundwater multi-phase extraction, soil-vapor extraction). He has prepared or reviewed final work plans, health & safety plans, and reports based on careful consideration of laboratory results, applicable cleanup standards or guidance values, and proposed plans for the property.

Mr. Dongaris also has extensive experience in cost estimating and bid negotiating, and oversees all aspects of the firm’s work in these areas.

Education

Master of Engineering in Environmental Engineering,
Stevens Institute of Technology, New Jersey, 1994

Bachelor of Engineering in Electrical Engineering,
City College of New York, New York, 1986

Technical Societies and Certifications

Professional Engineer, Licensed in NY (095954)

American Society of Civil Engineers (M.ASCE)

Association of Energy Engineers (A.E.E.)
Subcontractors Trade Association
American Industrial Hygiene Association (AIHA)
Environmental & Water Resources Institute (EWRI)
ASTM Technical and Professional Training,
Environmental Site Assessments, Norfolk Virginia, 2007
ASTM Technical and Professional Training,
Phase II Site Assessment Process, Norfolk Virginia, 2007
NYSDOL Certified Asbestos Designer, Management Planner, Inspector
NYCDEP Licensed Asbestos Investigator

Summary of Professional Experience

1988 – Present
Athenica Environmental Services, Inc., Queens, NY
Principal and Founder

1986 - 1987
East Coast Fireproofing, Inc., Old Bridge, NJ
Consulting Engineer

1985 - 1987,
Central Jersey Coatings, Inc., Woodbridge, NJ
Estimating Engineer/Project Manager

Relevant Experience

NYC, Five Boroughs – New York City School Construction Authority – Since 1992, as principal in charge, Mr. Dongaris has negotiated and oversaw the successful completion of more than ten contracts with the NYCSCA totaling over thirty Million dollars. As principal in charge he has performed and oversaw the asbestos, lead, PCB and mold inspections, design and air monitoring during the multimillion dollar abatement of thousands of school projects. As a licensed Professional Engineer, he also prepared the Work Safety Plans to ensure compliance with current applicable NYCDEP regulations and the safety of tenants, workers and employees of the schools.

Brooklyn, NY – Greenpoint Market Fire – Project manager and principal-in-charge of a hazardous material spill response. For this project, Mr. Dongaris directed the firm's rapid response to a hazardous materials spill caused by a fire. Mr. Dongaris evaluated prior environmental reports to evaluate the potential hazardous materials released by the fire in order to determine the appropriate level of worker protection for the survey team. Mr. Dongaris assembled and managed a hazmat survey team to identify materials and chemicals of concern at the Site, provided daily report project management.

Brooklyn, NY – North 7th Street LLC – Lead engineering manager and principal-in-charge of a property with an E-Designation due to the potential presence of hazardous materials. In addition, an active petroleum spill case was assigned to the Site by the New York State Department of Environmental Conservation (NYSDEC). For this project, Mr. Dongaris oversaw the preparation of final work products and presented to the client, the NYCDEP, and the NYSDEC. The final work products included a focused site investigation work plan, site investigation report, spill closure report, remediation oversight and remedial action work plan.

52-01 Queens Boulevard– Private Developer – As Head of Athenica's Hazardous Materials Group for the investigation and remediation of a property with a "E" zoning designation for hazardous materials. Environmental consulting services were performed under New York City's Voluntary Cleanup Program overseen by the Mayor Office of Environmental Remediation (OER) and included participation in this agency's first clean soil bank program. This entailed completion of a Beneficial Re-use Application for placement of excavated native soil at a New York City public park that resulted in significant savings to both the developer and the City of New York. The project also required a supplemental groundwater investigation to determine the likely source of solvent-related contamination found in soil gas vapor and perched groundwater. The groundwater investigation consisted of installing groundwater monitoring wells to 90 feet below ground surface (bgs) by utilizing a sonic rig. Based on the findings of this supplemental groundwater investigation, OER and the New York State Department of Environmental Conservation (DEC) concluded that solvent-related contamination found at the Site originated from an off-site source and allowed for the future development of the Site and OER's removal of the "E" zoning designation for hazardous materials after the successful installation of the required engineering controls. For this project, Mr. Dongaris responsibilities included meeting with the client and regulatory agencies to establish the scope of required investigation or remediation, and the overall management of field activities, review of project deliverables, and obtaining available grant funding to the client. This project was awarded the 2015 Big Apple Brownfield Award for Sustainable Remediation by the New York City Brownfield Partnership.

Former Tunnel Diner, Jersey City. New Jersey – Several Private Developers – As Lead engineering manager, principal-in-charge and head of firm's remediation services Mr. Dongaris oversaw the preparation of a Preliminary Assessment (PA), Site Investigation (SI), and Remedial Investigation (RI) of a ½-acre property in accordance with the New Jersey Technical Requirements for Site Remediation (TRSR) document. Responsibilities included reviewing the final reports for each phase of investigation and overseeing field activities. Based on the findings and results of the final reports, a remedial action work plan (RAWP) was prepared that was reviewed and approved by the New Jersey Department of Environmental Protection (NJDEP). After NJDEP approval of the RAWP, Mr. Dongaris directed pilot tests at the Site to determine the appropriate design parameters for a groundwater remediation system and prepared a remedial action work plan (RAWP) and oversaw its implementation. Work included excavation of grease-contaminated soils, backfilling of the excavated area with clean fill, end-point soil sampling, and post-remediation groundwater sampling. Additional work also consisted of preparing a Groundwater Classification Exception Area (CEA) for the entire Site, and issuing a Remedial Action Outcome (RAO) for one of the AOCs at the Site. Additional remedial work consisted of excavating gasoline-impacted soils at and below the water table at the Site, discharging of an oxygen-releasing compound by Permit-by-Rule and backfilling excavated areas with clean fill or uncontaminated fill. Final deliverables prepared by Athenica included final Remedial Action Report, a Deed Notice, permits for soil and groundwater, and an updated CEA for entire Site. Based on the documented remediation completed at the Site, the LSRP has committed to issuing a RAO for the entire Site after installation of the final Site covers.

Brooklyn, New York– Residential CO-OP – Lead engineering manager and principal-in-charge of the Hazardous Materials Group for investigation and mitigation of vapor intrusion at a residential property. Prior environmental due-diligence by others identified the likely presence of a former on-site dry cleaner. Environmental consulting services included a soil vapor intrusion (VI) study and design and implementation of a sub-slab depressurization system (SSDS). The VI study consisted of collecting representative samples of sub-slab vapor and indoor and outdoor air in accordance with applicable New York State guidance. Findings of the VI indicated that former dry cleaner compounds were present in both the sub-slab vapor and indoor air and that mitigation measures were warranted at the property. Mitigation measures consisted of designing and overseeing the installation of a SSDS system that prevents the migration of vapors into the basement of the building. After successful installation of the SSDS, the CO-OP obtained financing from the prospective lender.

Various Properties, New York City– Private Developers – Department Head of Athenica's Hazardous Materials Group for the investigation and remediation of over 40 properties with a "E" zoning designation for hazardous materials. Environmental consulting services for these properties were provided under the City's VCP program or "E" designation program and included characterization of subsurface conditions and remediation of soils, soil vapor, or groundwater as required. For these projects, his responsibilities included meeting with OER staff to determine the nature and scope of required work, managing field activities and report preparation, reviewing project deliverables, and maintaining project budgets and schedules.

Brooklyn, New York – Arnell Construction– Senior Environmental Project Manager for construction of a public school. The scope of work for the project included implementation of a site-specific Health & Safety Plan and Community Air Monitoring Plan (CAMP) relating to elevated concentrations of lead in soils being excavated for construction of a new school. His responsibilities for the project included the management of the overall project and overseeing the preparation of environmental plans and overseeing construction work for compliance with applicable regulations and NYCSCA specifications.

Five Boroughs, New York – Oversaw closure of petroleum USTs at various properties, reported petroleum spills to the NYSDEC, and prepared spill closure reports.

Manhattan, NY – New Yorker Hotel - As principal in charge, Mr. Dongaris performed and oversaw the asbestos inspection, design and air monitoring during the multimillion dollar renovation of the Hotel. As the Engineer for the abatement project, he also prepared the Work Safety Plans to ensure compliance with current applicable NYCDEP regulations and the safety of tenants, workers and employees of the Hotel. He also assisted the Hotel Management in negotiating with the Local Union of Hotel employees in the preparation and implementation of standard operating procedures for the disturbance of asbestos, lead and.

Brooklyn, NY – Greenpoint Market Fire – Project manager and principal-in-charge of a hazardous material spill response. For this project, Mr. Dongaris directed the firm's rapid response to a hazardous materials spill caused by a fire. Mr. Dongaris evaluated prior environmental reports to evaluate the potential hazardous materials released by the fire in order to determine the appropriate level of worker protection for the survey team. Mr. Dongaris assembled and managed a hazmat survey team to identify materials and chemicals of concern at the Site, provided daily report project management.

USEPA/NYCDEP Ground Zero, New York, NY - As principal in charge, oversaw the cleanup and decontamination of over 1200 apartments in the vicinity of the World Trade Center after the 9/11 terrorist attacks. In addition, investigated and oversaw the cleanup of the heating, ventilation, air conditioning (HVAC) systems in over 100 buildings.

Kenneth Wenz, Jr., PG, LEP, CPG

Kenneth Wenz, Jr. is a senior project manager and geologist with more than 38 years of wide-ranging experience in the environmental field, comprising both consulting and regulatory positions. His experience has included designing, implementing, and managing a wide range of environmental investigation and remediation programs for sites in New York, New Jersey, Connecticut, Pennsylvania, Vermont, Illinois, and California. He has conducted and managed all phases of environmental assessment and remediation projects, including due diligence/Phase I site assessments, Phase II/III investigations, and remediation/OM&M projects, ranging from individual residential properties to regional projects encompassing multiple properties. Mr. Wenz has substantial experience with projects involving regulatory involvement and oversight, including state and federal Superfund, Brownfield, and Voluntary Cleanup programs. He is a Licensed Professional Geologist in New York, a Registered Professional Geologist in Pennsylvania, a Licensed Environmental Professional in Connecticut, and a Certified Professional Geologist.

Education

Bachelor of Arts, Colgate University, Hamilton, NY, 1983
Master of Science, University of Massachusetts, Amherst, MA 1988

Licenses and Certifications

New York State Professional Geologist, No. 000096
Connecticut Licensed Environmental Professional, No. 408
Pennsylvania Registered Professional Geologist, No. PG-001273-G
Certified Professional Geologist (American Institute of Professional Geologists), No. CPG. 8934
OSHA HAZWOPER-certified
OSHA 30-hour Construction Safety and Health-certified

Summary of Professional Experience

July 2018 to Present
Senior Project Manager
Athenica Environmental Services, Inc., Queens, NY

May 2016 to July 2018
Senior Project Manager
Laurel Environmental Associates, Ltd., Huntington Station, NY

April 2011 to May 2016
Senior Project Manager/Senior Geologist
Genesis Engineering & Redevelopment, Inc., Commack, NY

March 2007 to October 2010
Senior Project Manager/Senior Geologist
Holzmacher, McLendon & Murrell PC, Melville, NY

September 1997 to March 2007
Senior Associate
Dvirka & Bartilucci Consulting Engineers, Woodbury, NY

July 1989 to July 1997
Senior Project Hydrogeologist
ERM-Northeast, Woodbury, NY

April 1987 to July 1989
Geologist
U.S. Environmental Protection Agency, New York, NY

Selected Relevant Experience:

Phase I Environmental Site Assessments

Prepared and/or served as Project Manager for more than 1,000 Phase I Environmental Site Assessments (ESAs), for numerous private and government clients, at sites ranging from single parcels to regional areas encompassing multiple properties. Phase I ESAs were prepared in accordance with applicable ASTM and AAI standards, for due diligence associated with property transfers and/or to meet regulatory requirements, at properties throughout New York City, Nassau County, Suffolk County, Westchester County, Rockland County, and New Jersey.

Private Developer, Long Island City, NY

Project Manager for NYCOER and NYS Brownfield Cleanup Program (BCP) investigation and remediation program at an E-designated property on 38th Avenue, being redeveloped for mixed commercial and residential use. Responsibilities include review of Phase I ESA, scoping of remedial investigations, preparation of BCP application, preparation of investigation work plans, coordination of sampling, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation reports, development of remediation plans in conjunction with the Site's redevelopment scenario, management of field staff and subcontractors during remedial construction, preparation and review of remediation reports and site management plan, coordination of post-remediation quarterly groundwater monitoring, and regulatory coordination.

New York City Department of Parks and Recreation - Various Sites throughout New York City

Project Manager for environmental investigation and due diligence projects at 15 NYC Parks locations, including properties slated for acquisition and existing sites undergoing reconstruction. His responsibilities included project scoping; coordination with NYC Parks staff; preparation and technical review of documents; field inspections and oversight of investigation and sampling activities implemented by Athenica and subcontractors; and project management, staffing, and scheduling.

New York City School Construction Authority - Various Sites throughout New York City

Mr. Wenz has served as Program Manager and Lead Environmental Scientist for Athenica's Hazardous Materials consulting contracts with the NYCSCA. His responsibilities under that contract include coordination with NYCSCA for all due diligence, water disinfection, soil characterization, and miscellaneous HazMat projects conducted under the contract; providing technical review of submittals and comment documents prepared by Athenica staff; field inspections and oversight of HazMat activities implemented by Athenica and NYCSCA contractors, and project management, staffing, and scheduling.

Community Air Monitoring Program (CAMP) Implementation at Various Sites

Responsibilities include preparation and review of CAMP plans for numerous Sites throughout New York City and the surrounding area, implementation of CAMP plans, management of field staff for CAMP plan implementation, review of CAMP data, and preparation and review of reports documenting CAMP monitoring results, findings, and any actions taken in response to identified exceedances of specified action levels. In accordance with regulatory requirements, plans were developed for all NYCOER, Superfund, and Brownfield Program Sites described below, as well as for other projects where third-party, independent monitoring was required. Plans are prepared based on New York State and/or local CAMP guidance, as well as Client-specific and Site-specific requirements, and specify monitoring parameters, frequencies, action levels, steps to be implemented if action levels are exceeded, and reporting requirements. Required monitoring typically included levels of volatile organic compounds (VOCs) and/or particulates, with additional parameters (e.g., hydrogen sulfide, methane, etc.) incorporated as needed based on Site conditions or potential contaminants of concern.

Private Developer, Long Island City, NY

Project Manager for NYCOER investigation and remediation program at an E-designated property on 29th Street, being redeveloped for mixed commercial and residential use. Responsibilities include review of Phase I ESA, scoping of remedial investigation, work plan preparation, coordination of sampling, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, development of remediation plan in conjunction with the Site’s redevelopment plans, management of field staff and subcontractors during remedial construction, preparation and review of remediation report, and regulatory coordination.

Private Developer, Long Island City, NY

Project Manager for NYCOER investigation and remediation program at an E-designated property on 38th Avenue, which was subsequently entered into the New York State Brownfield Cleanup Program (BCP). The Site is being redeveloped for mixed commercial and residential (with an affordable housing component) uses. Responsibilities for the initial investigative phase (with NYCOER oversight) include review of previous Phase I ESA, scoping of remedial investigation, work plan preparation, coordination of sampling, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, and coordination with NYCOER. Following transfer of the Site into the BCP, responsibilities include coordination with NYSDEC technical and legal staff, preparation of BCP application, remedial investigation scoping, preparation of remedial investigation work plan and citizen participation plan, management of field staff and subcontractors, and review and assessment of investigation sample data.

Disinfection Projects at Various NYCSCA Sites within New York City

Project Manager and technical lead for NYCSCA projects documenting proper disinfection of newly-installed piping and plumbing fixtures at numerous New York City schools and municipal facilities. Responsibilities include coordination with NYCSCA personnel and contractors, review of disinfection plans from contractors for compliance with project specifications and NYCSCA requirements, pre-disinfection meetings to coordinate project activities and schedules, management of field staff providing oversight of disinfection and verification sampling activities, preparation and review of lead sampling plans (as required), review of sample data, and preparation and review of reports documenting disinfection and lead testing programs.

Private Developer, Long Island City, NY

Project Manager for NYCOER investigation and remediation program at an E-designated property on Crescent Street, being redeveloped for mixed commercial and residential (with an affordable housing component) use. Responsibilities include preparation and review of Phase I ESA, scoping of remedial investigation, work plan preparation, coordination of sampling and closure of a previously-unknown underground fuel oil tank, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, development of remediation plan in conjunction with the Site’s redevelopment plan, management of field staff and subcontractors during remedial construction, preparation and review of remediation report, and regulatory coordination.

Private Developer, Long Island City, NY

Project Manager for NYCOER remediation program at an E-designated property on 40th Avenue, being redeveloped for mixed commercial and residential use. Responsibilities include preparation and review of Phase I ESA, review of historic sample data, scoping of the remedial investigation, work plan preparation, coordination of sampling, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, development of remediation plan in conjunction with the Site’s redevelopment plans, and regulatory coordination.

Private Developer, Brooklyn, NY

Project Manager for NYCOER remediation program at an E-designated property on North 5th Street, being redeveloped for commercial use. Responsibilities include review of previous Phase I ESA, scoping of the remedial investigation, work plan preparation, coordination of sampling, management of field staff and subcontractors, development and management of follow-up sampling program to delineate identified “hot spot” of contamination and assess potential off-Site impacts, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, development of remediation plan in conjunction with the Site’s redevelopment plans, and regulatory coordination.

Dry Cleaner, Long Island City, New York

Project Manager for site investigation at a dry cleaning plant, both before and after a major fire. Responsibilities included development and implementation of pre-fire multi-phase investigation programs, including preparation of work plans, sample collection, data assessment and interpretation, report preparation, development of remediation plans, and coordination with regulatory personnel. Project Manager for post-fire investigation and remediation program, including work plan preparation (with sampling and analysis of soil and groundwater samples for emerging contaminants), coordination of sampling, data assessment, reporting, preparation of remediation documents, and coordination with regulatory personnel.

Due Diligence Projects at Various NYCSCA Sites within New York City

Project Manager and technical lead for NYCSCA due diligence projects for numerous potential school Sites throughout New York City. Responsibilities include coordination with NYCSCA personnel and contractors, review of available historic documents and environmental reports, Site inspections, preparation and review of Phase I ESAs and findings memoranda, development of work scopes for sampling programs, management of field staff during sampling activities, review of sample data, and preparation and review of reports documenting sampling programs.

Private Developer, Long Island City, NY

Project Manager for NYCOER remediation program at an E-designated property on 29th Street, being redeveloped for mixed commercial and residential use. Responsibilities include scoping of the remedial investigation, work plan preparation, coordination of sampling, management of field staff and subcontractors, review and assessment of investigation sample data, assessment of areas where remediation is warranted, preparation and review of investigation report, development of remediation plan in conjunction with the Site's redevelopment plans, and regulatory coordination.

Private Developer, Brooklyn, New York

Project Manager for NYCOER remediation program at a former industrial facility on 6th Street, undergoing redevelopment. Responsibilities include review and assessment of historic sample data, scoping and management of follow-up sampling program to fine-tune delineation of hazardous waste areas and provide additional waste characterization data, data assessment, management of field staff and subcontractors, coordination for disposal of hazardous and non-hazardous soil, review of technical reports, and regulatory coordination.

Private Developer, Long Island City, NY

Project Manager for NYCOER remediation program at an E-designated property on 31st Street, being redeveloped for mixed commercial and residential use. Responsibilities include coordination of remedial action inspections, management of field staff, review and assessment of investigation sample data, preparation and review of technical reports, and regulatory coordination.

Preparation of Excavated Materials Disposal Plans (EMDPs) and Waste Characterization Submittals, Various NYCSCA Sites within New York City, for Various NYCSCA Contractors

Prepared and/or served as Project Manager for preparation of EMDPs for NYCSCA projects at schools in Brooklyn, Queens, the Bronx, and Staten Island. Each EMDP includes review of site-specific construction documents, determination of limits and depth of excavation, volume calculations, identification and vetting of waste transporters and disposal facilities, development of a waste characterization sampling plan in conformance with NYCSCA and disposal facility requirements, and quality assurance/quality control procedures for the excavation program. After completion of the field portion of the EMDP, the sample data are reviewed and incorporated into a Waste Characterization submittal, which documents the sample procedures, provides the analytical data, and includes an assessment regarding appropriate disposal for the excavated material.

Implementation of EMDPs, Various NYCSCA Sites within New York City, for Various NYCSCA Contractors

Project Manager for implementation of EMDPs for NYCSCA projects at schools in Brooklyn, Queens, the Bronx, and Staten Island. Implementation of each EMDP includes collection and laboratory analysis of waste characterization samples in accordance with the approved EMDP, as well as, in select cases, geophysical surveys of the areas to be excavated and coordination with the waste transporters and disposal facilities during the excavation program.

Private Developer, Long Island City, NY

Project Manager for NYCOER soil remediation program at an E-designated property on 38th Avenue that is being redeveloped for residential use. Responsibilities include coordination of remedial action inspections, management of field staff, review and assessment of post-remediation sample data, preparation and review of technical reports, and regulatory coordination.

Private Developer, Long Island City, NY

Project Manager for testing program to address a NYC E-designation for noise for a parcel on 31st Street. Responsibilities include development of scope of work for noise testing program to confirm adequate attenuation from installed windows and doors, data assessment, review of technical reports, and regulatory coordination.

Former Automotive Repair Facility, Woodside, NY

Project Manager for petroleum spill remediation/closure program at a former automotive repair facility. Responsibilities include coordination of quarterly well gauging and semi-annual groundwater sampling events, assessment and interpretation of data, preparation and review of technical reports, identification and evaluation of alternative remediation technologies, and coordination with regulatory personnel and stakeholders.

Former Gasoline Station and Pine Tar Manufacturer, Jersey City, NJ

Project Manager for closure of a long-term remediation program. Responsibilities include assessment of historic data, scoping of additional sampling programs to address regulatory concerns and outstanding issues, preparation of documents in support of establishing a groundwater Classification Exception Area, and coordination with Licensed Site Remediation Professional and regulatory personnel.

Active Military Installation, Upstate New York

Project Manager for petroleum storage tank testing program, for aboveground fuel oil storage tanks associated with emergency generators. Responsibilities include project scoping in conjunction with NYSDEC tank testing requirements, development of testing protocol/work plan and health and safety plan for testing program, management of subcontractors, data review, and preparation of report documenting the successful testing of each tank for submittal to the NYSDEC.

Private Dry Cleaner, Englewood, New Jersey

Project Manager for site investigation at an active dry cleaner. Responsibilities included development and implementation of multi-phase investigation program, including preparation of work plans and receptor evaluation documents, sample collection, data assessment and interpretation, report preparation, development of remediation plans, and coordination with regulatory personnel, legal counsel, and stakeholders.

Private Developer, Brooklyn, New York

Project Manager for New York State Brownfield site characterization and remedial design program at a vacant industrial facility. Responsibilities include review and assessment of historic sample data, project scoping, work plan and budget preparation, management of field staff, data evaluation, assessment of required remediation, preparation and review of technical reports, and regulatory and stakeholder coordination.

Private Developer, Westhampton, NY

Project Manager for environmental due diligence program for redevelopment of a 53-acre portion of a military airbase and airport. Responsibilities included project scoping, preparation of Phase I ESA comprising approximately 20 existing buildings, review of historic documents, oversight of investigation and remediation activities conducted by the current property owner, management of field personnel and subcontractors, data evaluation, budget development/management, reporting, and negotiations and coordination with regulatory personnel and stakeholders.

Liberty Industrial Superfund Site, Farmingdale, NY

Project Manager for large-scale soil quality investigation in support of planned acquisition of a portion of the property by the Town of Oyster Bay. Responsibilities include project design and scoping, preparation and implementation of work plan, management of field personnel and subcontractors, technical review of reports, regulation and data interpretation, assessment of need for additional remediation based on planned reuse, report preparation, budget development and management, coordination with USEPA personnel and stakeholders, and presentations at meetings.

Former Fashion Cleaners Superfund Site, Long Beach, NY

Project Manager for NYSDEC RI/FS program at a former dry cleaner. Responsibilities included project scoping, data interpretation, preparation of technical reports, determination of areas where remediation is required, identification and assessment of potential remediation alternatives, monitoring and reporting for on-going Interim Remedial Measures, scoping and coordination of supplemental sampling for emerging contaminants, data assessment, and coordination with regulatory personnel, legal counsel, and stakeholders.

Former Parkway Hospital, Forest Hills, NY

Project Manager for NYCOER investigation/remediation program. Responsibilities included scoping of remedial investigation and UST removal programs, UST removal oversight, management of field personnel and subcontractors, data interpretation, spill closure documentation, report preparation and review, development of remediation plan, preparation of grant applications, and coordination with regulatory personnel.

Brownfield Site Assessments, Various Sites in New York City, Nassau County, Suffolk County, and Westchester County, NY

Project Manager for Brownfield site characterization and remedial design programs at approximately 30 Brownfield sites, mostly conducted using state and federal grant funds. For each site, responsibilities included review and assessment of historic sample data (where available), project scoping, work plan and budget preparation, sample collection and/or management of field staff and subcontractors, data evaluation, assessment of areas where remediation would be warranted, development of remediation plans, preparation and review of technical reports, preparation and implementation of remedial action plans (in some cases), and coordination with regulatory personnel, government agencies, legal counsel, and stakeholders.

Various New York State Superfund Sites throughout New York State

Assistant Program Manager and Project Manager for New York State Superfund investigation (preliminary site assessment, remedial investigation, supplemental investigation) and remediation (feasibility study, remedial design, remedial construction oversight) projects at more than 160 individual sites located throughout New York State, under a long-term Superfund Standby contract with the NYSDEC. For each site, responsibilities included review and assessment of previous sample data (where available); development of an investigation/remedial scope of work, work plan and budget; sample collection and/or management of field staff and subcontractors; data evaluation; assessment of areas where remediation would be warranted; development and implementation of remediation plans; preparation and review of technical reports; and coordination with regulatory personnel, government agencies, legal counsel, and stakeholders.

Jessica Collins, Project Manager

ATHENICA ENVIRONMENTAL SERVICES, INC.
Environmental Consultants

Jessica Collins is a geologist and project manager with more than 18 years of wide-ranging experience in the environmental consulting field. Her experience has included designing, implementing, and managing a wide range of environmental investigation and remediation programs for sites in New York. She has scoped, implemented, and managed all phases of environmental assessment and remediation projects, including due diligence/Phase I site assessments, Phase II/III investigations, and remediation/OM&M projects, that have ranged from individual residential properties to regional projects encompassing multiple properties. Ms. Collins has substantial experience with projects involving regulatory involvement and oversight, including local, state and federal Superfund, Brownfield, and Voluntary Cleanup programs, and has served as field team leader for numerous investigation and remediation programs, and has managed and trained field personnel. She also has considerable experience in data assessment and interpretation; preparation of work plans, scoping documents, investigation reports, remediation plans, remediation reports; technical review of documents prepared by others; and development and management of project budgets.

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Education

Bachelor of Arts in Geology, Binghamton University, Binghamton, NY, 2006
Bachelor of Arts in Environmental Science, Binghamton University, Binghamton, NY, 2006

Licenses and Certifications

OSHA HAZWOPER-certified
OSHA 30-hour Construction Safety and Health-certified

Summary of Professional Experience

March 2023 to Present
Project Manager
Athenica Environmental Services, Inc., Queens, NY

April 2022 to March 2023
Senior Project Manager
Langan Engineering & Environmental Services, New York, NY

September 2021 to April 2022
Senior Project Manager/Senior Geologist
Stantec, New York, NY

August 2018 to September 2021
Senior Project Manager
VHB Engineering, New York, NY

October 2006 to August 2018
Senior Project Hydrogeologist
Roux Associates, Inc, Islandia, NY

Relevant Experience:

Private Developer, Yonkers, New York

Project Manager for redevelopment project in New York under the NYSDEC Brownfield Cleanup Program (BCP). The project included preparation of the BCP application, remedial investigation work plan, design, coordination and oversight of remedial investigation, in situ waste characterization sampling, excavation and proper disposal of soil. In addition to project scoping and overseeing the initial stages of project development, she was also responsible for preparing the Remedial Action Work Plan (RAWP) and implementing and managing remedial work to address site-specific contaminants within the project footprint, including in situ chemical oxidation, hot-spot removal, soil excavation, and associated endpoint sampling. She provided agency support for NYSDEC, acting as the main liaison between the State and Client.

Multiple Clients, New York City

Jessica was the Senior Project Manager responsible for preparing Hazardous Materials analysis chapters for City Environmental Quality Review (CEQR) Environmental Assessment Statements (EAS) and Environmental Impact Statements (EIS) for a variety of projects throughout New York City, including large-scale rezonings, residential developments, and mixed-use developments. Her responsibilities included conducting Phase I ESA reviews, regulatory database research, historical land use evaluations, preparation of Phase II ESA scopes of work, and oversight and implementation of subsurface investigations. Jessica also developed mitigation strategies including E-Designations, Restrictive Declarations, and Remedial Action Plans (RAPs), and coordinated extensively with the New York City Department of Environmental Protection (DEP) and the Office of Environmental Remediation (OER) to ensure regulatory compliance, negotiate approval conditions, and facilitate project approvals.

Private Developer, Brooklyn, New York

Jessica was the Senior Project Manager and Field Manager for the one of the largest ongoing redevelopment projects in New York. The project included design, coordination and oversight of in-situ waste characterization sampling, identification and coordination with potential disposal facilities, and oversight of excavation and proper disposal of more than 600,000 tons of soil. In addition, she was responsible for implementing and managing remediation work at several NYSDEC spill sites within the project area, including implementation of in-situ chemical oxidation (ISCO), UST removal, and soil excavation. Responsibilities also included preparation of work plans and remedial action plans. She provided agency support for NYSDEC, NYCDEP, NYCOER, MTA (LIRR/NYCT), and ESDC.

Private Developer, Queens, New York

Jessica was the Senior Project Manager for a major redevelopment project in Flushing, New York. She was responsible for the design and management of a large-scale remedial investigation and waste characterization sampling program conducted under NYCOER VCP and E-designation programs. The project included preparation of Remedial investigation work plan, remedial action work plan, development of an in-situ waste characterization sampling program, management of the sampling activities, coordination and oversight of excavation and proper disposal of over 450,000 tons of soil. The project also included managing remediation work for a NYSDEC spill case that was identified within the project footprint.

Via 57 West, New York, New York

Jessica was the Senior Project Manager responsible for management, investigation, and remediation of a one-acre brownfield site encompassing an area over one city block in Manhattan, that included soil and groundwater contaminated with chlorinated solvents, heavy metals, and petroleum compounds, and soil vapor containing elevated concentrations of chlorinated solvents and petroleum compounds. . This project included implementation of a thorough remedial investigation and completion of a Track 1 Unrestricted Use Remedial Action through the NYSDEC BCP. The project also included coordination and oversight of in situ waste characterization sampling; excavation and proper disposal of soil; and construction management, and support of excavation activities of 400,000 tons of soil. Responsibilities also included preparation of work plans, Final Engineering Report, and daily and monthly progress reports.

Private Developer, Queens, NY

Senior Project Manager for a NYSDEC BCP investigation and remediation program at two parcels in Queens that were planned to be redeveloped for mixed-use, affordable housing. Responsibilities included due diligence environmental assessment and investigation activities, development of NYSDEC-approved BCP Remedial Investigation Work Plans for multiple project phases, management of field personnel during implementation of the investigation and remediation activities, preparation of NYSDEC-approved BCP Remedial Action Work Plans, data interpretation, preparation of reports documenting the findings of the investigations and remedial action, and coordination with NYCHPD and NYCDEP to meet regulatory requirements to obtain project funding from outside sources.

Nassau Coliseum, Uniondale, NY

Senior Project Manager for the environmental management of decommissioning and replacement of an existing UST for an emergency generator, asbestos remediation, and associated reporting during renovation of the Nassau Coliseum. Responsible for coordinating inspections, NYSDEC notification and managing UST closure and endpoint sampling activities, preparing UST closure report, managing delineation of ACM, preparing abatement budget estimates, and providing bid support for implementation of the full ACM abatement program.

Private Developer, Bronx, NY

Project manager for a property transfer and BCP project at a heavily-contaminated former MGP site in the Bronx, that was being addressed by the NYSDEC under the New York State Voluntary Cleanup Program (VCP) facility. The site was planned to be redeveloped as a state-of-the-art distribution facility and the buyer was interested in conducting site investigation and remediation under the BCP. Responsibilities included management of preparation of a Phase I ESA for the buyer, review of the Phase I ESA report, development of scopes of work and cost estimates for a Phase II ESA and site remediation activities under the BCP, negotiations with the NYSDEC to limit the scope of the required investigation and cleanup, negotiations with the seller and the seller's consultant regarding cost-sharing, management of the investigation and remediation activities, and report preparation.

ExxonMobil, Multiple Sites, NY & NJ

Project and Field Manager for multiple Phase I and Phase II ESAs at more than 40 retail gasoline stations in New York and New Jersey. Scopes of work included preparation of Phase I ESAs, oversight of drilling and sampling activities, health and safety management, subcontractor coordination, data interpretation, and preparation of a Phase II ESA report for each of the 40 sites.

Private Developer, Brooklyn, New York

Project Manager for redevelopment of four properties in Brooklyn, to address the requirements of the "E" designation for potential hazardous materials assigned to each site. Responsibilities included coordination with NYCOER to develop investigation scope of work, preparation of remedial investigation work plan, management of field investigation activities, data interpretation, preparation of remedial investigation report, coordination with NYCOER to develop remediation scope of work, and preparation of remedial action work plan.

Private Developer, Westchester, New York

Senior Project Manager for the completion of Phase I and Phase II ESA activities associated with the potential purchase of a waterfront parcel located in Westchester, NY, that was proposed to be redeveloped for mixed-use purposes. Responsibilities included management and review of the Phase I ESA report, management of subsurface investigation activities to characterize soil conditions based on former USTs and historic fill at the site, data interpretation, identification and evaluation of multiple remediation/disposal alternatives, integration of the proposed remediation activities into the site’s redevelopment plan, and report preparation.

Private Developer, Bronx, New York

Senior Project Manager for the redevelopment of a Bronx property with an “E” designation for potential hazardous materials into supportive housing. Responsibilities included coordination with NYCOER to develop investigation scope of work, preparation of remedial investigation work plan, management of field investigation activities, data interpretation, preparation of remedial investigation report, coordination with NYCOER to develop remediation scope of work, preparation of remedial action work plan, management of field staff during implementation of the remedial action, and preparation of remedial action report.

Private Developer, New York, New York

Senior Project Manager for expansion and renovation of a Manhattan automobile dealer/service center, located on a parcel with an “E“ Designation for potential hazardous materials and an open spill case, into the US Flagship dealership for a major European luxury car brand. Ms. Collins evaluated whether an immediately off-site release of 19,000 gallons of dielectric fluid (by others) impacted the Site, provided environmental input to support the client and legal team during lease negotiations, coordinated with NYCOER to develop investigation scope of work, prepared remedial investigation work plan, managed field investigation, interpreted sample data, prepared remedial investigation report, coordinated with NYCOER to develop remediation scope of work, prepared remedial action work plan, managed field staff during remedial action implementation, and prepared remedial action report, including Site Materials Management Plan and closure of the open on-site spill case.

WILLIAM SILVERI, PG/CHMM

ATHENICA ENVIRONMENTAL SERVICES, INC.
Environmental Consultants

William Silveri's experience includes Phase I Environmental Site Assessment (Phase I ESAs), Phase II Site Assessments (Phase II ESAs), comprehensive remedial investigations, industrial hygiene related work, and oversight of remediation projects. William Silveri serves as the Quality Control Officer for Athenica's term contracts for municipal agencies. Mr. Silveri has more than 35 years of experience in the environmental consulting field, and is a Licensed Professional Geologist in New York and a Certified Hazardous Materials Manager. He has managed and conducted numerous environmental investigations and remediation projects in the New York City area, which has included substantial experience in report preparation, data review and assessment, and technical review of project deliverables (reports, specifications, etc.) prepared by others. As Quality Control officer, he is responsible for detailed technical review and evaluation of laboratory data, as well as providing quality control review of project deliverables, to ensure that all work plans, reports, specifications, etc. meet the quality and technical standards of Athenica and the applicable entity.

Education

Bachelor of Science (BS) Geology, Allegheny
Bachelor of Arts in Writing, University of Colorado at Denver
Master of Science in Geology, Brooklyn College

Technical Societies and Certifications

American Institute of Professional Geologist (CPG-11150)
Certified Hazardous Materials Manager (CHMM 15637)
OSHA 29 CFR 1910.120 Hazwoper Training

Summary of Professional Experience

September 2017 – Present
Principal
William Silveri, LLC, Manhattan, New York

January 2016 – September 2017
Director of New York City Hazardous Materials Group
WCD Group, Manhattan, New York

March 2008 to January 2016
Director of Hazardous Materials Group
Athenica Environmental Services, Inc., Queens, NY

March 2000 to March 2008
Senior Project manager
TRC Environmental Corporation, New York NY

January 1993 to March 2000
Technical Director
AKRF, Inc. New York, NY

September 1990 to December 1993
Field Geologist/Proposal Coordinator
Testwell Craig, Ossining, New York

September 1988 to September 1990
Quality Assurance/Quality Control Office
ATC Environmental. Inc., New York, NY

Relevant Experience

NYCSCA – Various Sites throughout New York City

As Quality Assurance Officer for Athenica's NYCSCA hazardous materials consulting contract, Mr. Silveri provides final QA/QC review of reports to be submitted to the NYCSCA.

Brooklyn, New York

Arnell Construction – Senior Environmental Project Manager for construction of a public school. The scope of work for the project included implementation of a site-specific Health & Safety Plan and Community Air Monitoring Plan (CAMP) relating to elevated concentrations of lead and soils being excavated for construction of a new school. His responsibilities for the project included preparing environmental plans and overseeing construction work for compliance with applicable regulations and construction specifications.

Long Island City, New York

Private Developer – Senior Project Manager for Phase I and Phase II ESAs, in preparation and implementation of remediation for a property with an "E" zoning designation for hazardous materials. Responsibilities include preparing investigation and remediation of work plans reviewed and approved by the New York City Department of Environmental Protection (NYCDEP), overseeing field work, and preparing a final Phase II ESA report documenting subsurface conditions to the satisfaction of the NYCDEP.

Queens, New York

Long Island Rail Road (LIRR) – Senior Project Manager for a groundwater remedial investigation (RI) of the Morris Park Yards in Queens, New York. The overall objective of the RI was to investigate and delineate the extent of chlorofluorocarbon (CFC) contamination that exists on and off the Site, evaluate the risk of CFC contamination to potential receptors, and provide sufficient data to evaluate and appropriate remedies for the contamination. The scope of the RI included the installation of shallow and deep groundwater wells in the unconsolidated aquifer, installation of soil gas monitoring probes, and collection and analysis of soil, groundwater, and soil gas samples. His responsibilities for RI included preparing RI work plan reviewed and approved by the New York State Department of Environmental Conservation (NYSDEC), overseeing field activities, and preparing the final report.

First Avenue Properties, New York

Consolidated Edison of New York (Con-Ed) – Task leader for preparation of a remedial action work plans (RAWPs) for a 9-acre former power plant located in Manhattan. Responsibilities included preparing a detailed remediation work plan for each of the four properties comprising the Site and assisted efforts in evaluating the risk posed by remaining contaminants. The RAWPs were prepared and submitted to the New York State Department of Environmental Conservation (NYSDEC) within the Voluntary Cleanup Program (VCP), which were reviewed and approved by the NYSDEC and New York State Department of

Health (NYSDOH). The scope of remediation for the project included excavation and off-site disposal of contaminated soils, groundwater remediation via source removal and application of an oxygen releasing compound, and decommissioning and removal of petroleum USTs.

Queens West Development Site, New York

Confidential Client – Task Leader for preparation of investigation and remedial work plans and oversight of field activities, including installation of soil borings and groundwater monitoring wells, sediment sampling, excavation of test pits, advancement of direct-push boings for use of a membrane interface probe in a suspected area of solvent-related soil and groundwater contamination, and well gauging of groundwater monitoring wells over a tidal cycle. For this project, he also prepared an interim remedial measures (IRM) that consisted of removing petroleum USTs and excavating localized areas of petroleum-impacted soils (i.e. “hot spots”).

Former Tunnel Diner, Jersey City, New Jersey

Tunnel Realty LLC – Senior Project Manager for a Preliminary Assessment (PA), Site Investigation (SI), and Remedial Investigation (RI) of a ½ -acre property in accordance with the New Jersey Technical Requirements for Site Remediation (TRSR) document. Responsibilities included preparing final reports for each phase of investigation and overseeing field activities. Based on the findings and results of the final reports, Mr. Silveri prepared a remedial action work plan (RAWP) that was reviewed and approved by the New Jersey Department of Environmental Protection (NJDEP). After NJDEP approval of the RAWP, Mr. Silveri directed pilot tests at the Site to determine the appropriate design parameters for a groundwater remediation system.

Queens, New York

New York City Economics Development Agency – Senior Project Manager for the remedial investigation of a 30-acre waterfront property. Responsibilities included preparing investigation work plan reviewed and approved by the New York City Department of Environmental Protection (NYCDEP), preparing preliminary and final cost estimates for remediation, overseeing field work, attending meetings, and reviewing of final report. In addition, Mr. Silveri completed a Phase I Environmental Site Assessment of the property.

APPENDIX D

Laboratory Standard Operating Procedure for PFAS Analysis

Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, and Biosolids Samples by LC-MS/MS: EPA 1633A

DOCUMENT ID: PFAS_LCMSMS1633A Revision 1.0

Michelle

Prepared By: ___________________________________ Date: 6/27/2025
PFAS Technical Manager, Michelle Onofrio

Approved By: ___________________________________ Date: 6/27/2025
Laboratory Director, Jimmy Dodsworth

Raj Pandey

Approved By: ___________________________________ Date: 6/27/2025
Quality Manager, Raj Pandey

1) Scope & Applicability

1.1 This Standard Operating Procedure (SOP) describes the method used for trace analysis of Per- and Polyfluoroalkyl Substances (PFAS) by high performance liquid chromatography/tandem mass spectrometry (LC-MS/MS). A list of analyte acronyms is given in Appendix A. This method describes both the extraction and chromatographic procedures used to determine the target analytes. The reporting limits for target analytes at the time of this revision are listed in Appendix A.

1.2 This procedure is used to determine the analytes of interest in aqueous and solid matrices. The procedure may be applied to other miscellaneous sample matrices providing that the analyst demonstrates the ability of the procedure to give data of acceptable quality in that matrix.

1.3 This method is “performance-based,” which means that modifications may be made without additional EPA review to improve performance (*e.g.*, overcome interferences, or improve the sensitivity, accuracy, or precision of the results) provided that all performance criteria in this method are met.

1.4 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP specific requirements to the laboratory. In general, project specific QAPPs supersede method specific requirements.

1.5 This SOP is based upon EPA 1633A and reported under test method EPA 1633A.

2) Summary of Procedure

2.1 Environmental samples are prepared and extracted using method-specific procedures. Sample extracts are subjected to cleanup procedures and solid-phase extraction designed to remove interferences and concentration target analytes in a final extract. Analyses of the sample extracts are conducted by LC-MS/MS in the multiple reaction monitoring (MRM) mode. Sample concentrations are determined by isotope dilution (extracted internal standard quantification) using isotopically labeled compounds added to the samples before extraction and non-extracted internal standards after extraction. This group of compounds will provide a broad view of common per- and polyfluorinated compounds (PFAS) found in the environment. This procedure provides low ng/L (ppt) determination for these analytes in water, and low ng/g (ppb) in solid samples.

2.2 Extraction

2.2.1 Aqueous samples are spiked with isotopically labeled standards, extracted using solid-phase extraction (SPE) cartridges and undergo cleanup using carbon before analysis.

2.2.2 Solid samples are spiked with isotopically labeled standards, extracted into basic methanol, and cleaned up by carbon and SPE cartridges before analysis.

2.3 The quantitative analysis is performed using isotope dilution techniques and a multipoint calibration for all target analytes. Isotope dilution provides correction of the target analyte concentrations for losses in extraction and variations in instrument sensitivity. See Appendix C for labeled isotope to native analyte association.

2.4 The method calibrates and quantifies PFAS analytes using isotopically labeled standards. Where linear and branched isomers are present in the sample and either qualitative or quantitative standards containing branched and linear isomers are commercially available, the PFAS analyte is reported as a single analyte consisting of the sum of the linear and branched isomer concentrations. If a standard containing the branched isomer(s) is not available, only the area of the linear isomer may be integrated.

3) Definitions

3.1 Analysis Sequence - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc…) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2 Bile Salt Standard – A standard containing Taurodeoxycholic Acid (TDCA) or Sodium taurodeoxychloate hydrate used to monitor the risk of interference from bile salts in samples when using acetonitrile as the instrument mobile phase. If using other mobile phases, taurochenodeoxycholic acid (TCDCA) and tauroursodeoxycholic acid (TUDCA) would need to be evaluated for interferences as well.

3.3 Continuing Calibration Verification Standard (CCV) - A mid-level standard injected into the instrument at specified intervals. Used to verify that the initial calibration curve is still valid for quantitative purposes. See QA/QC section 12 for specified acceptance criteria and frequency intervals.

3.4 Electrospray Ionization (ESI) – A liquid phase ionization mode for LC/MS/MS in which the ions are formed in solution before the mobile phase is desolvated. A proton donor such as acetic or formic acid, or a proton acceptor such as ammonium hydroxide are commonly added to the mobile phase. A potential is applied to the electrospray needle to assist in ionization of the solution prior to desolvation. This ionization may be used in either the positive (producing [M+H]+ ions) or negative (producing [M-H]-) mode.

3.5 Extracted internal standard (EIS) – An analog of a target analyte in the method which has been synthesized with one or more atoms in the structure replaced by a stable (non-radioactive) isotope of that atom. Common stable isotopes used are ^{13}C (Carbon-13) or Deuterium (D or ^{2}H). These labeled compounds do not occur in nature, so they can be used for isotope dilution quantitation or other method-specific purposes. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to extraction and analysis. These are also referred to as surrogates for the purpose of this method.

3.6 Independent Calibration Verification (ICV) - Initial calibration verification standards which are analyzed after initial calibration with newly prepared standards but prior to sample analysis, in order to verify the validity of the standards used in calibration. The ICV standards are prepared from materials obtained from a source different from that used to prepare calibration standards or prepared from neat material by a second analyst.

3.7 Instrument Blank (CCB) - The instrument blank (also called continuing calibration blank) is a volume of clean solvent analyzed on each column and instrument used for sample analysis. The purpose of the instrument blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples into subsequent sample analyses.

3.8 Internal standard – A labeled compound used as a reference for quantitation of other labeled compounds. See internal standard quantitation.

3.9 Internal standard quantitation – A means of determining the concentration of (1) a naturally occurring (native) compound by reference to its associated labeled analog acting as the extracted internal standard, and (2) a labeled compound by reference to another labeled compound acting as the non-extracted internal standard.

3.10 Instrument sensitivity check (ISC) – solution used to check the sensitivity of the instrument. The solution contains the native compounds at the concentration of the RL

(Section 3.26) as well as extracted and non-extracted internal standards. Typically, one of the low-end calibration level standards is injected, nominally at the quantitation limit of each analyte. Injecting multiple levels may be necessary if analytes have varying limits.

3.11 Isotope dilution (ID) quantitation – A means of determining a naturally occurring (native) compound by reference to the same compound in which one or more atoms has been isotopically enriched. The labeled PFAS are spiked into each sample and allow identification and correction of the concentration of the native compounds in the analytical process.

3.12 LC – Liquid chromatograph or liquid chromatography

3.13 Laboratory Control Sample (or Blank Spike) and Laboratory Control Sample Duplicate (or Blank Spike Duplicate) (LCS/LCSD and BS/BSD) – An LCS is an aliquot of analyte free water to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control. A duplicate LCS (LCSD) can be prepared with an extraction batch in place of matrix spikes (MS/MSD) to monitor precision and repeatability. The LCSD is prepared, spiked, extracted, and analyzed in exactly the same manner as the LCS.

3.14 MS/MS – Tandem Mass Spectrometry

3.15 Matrix Duplicate (DUP) – A second aliquot of a field sample that is prepared and analyzed in each sample batch to demonstrate precision and repeatability of analytes present in the field sample. An additional bottle of the field sample is used, as dividing the contents of a single container is not permitted. The matrix duplicate is prepared, extracted, and analyzed in exactly the same manner as the parent sample. The use of a matrix duplicate is generally not required by this method but may be done on an as-needed basis for client requests. A matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD) fulfills this requirement when applicable.

3.16 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample extraction and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Aliquots of field samples are spiked with a known concentration of target analytes, prior to sample preparation and extraction, and analyzed for matrix interferences. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the samples is calculated and used to assess analytical precision. The use of MS/MSD samples is generally not required in isotope dilution methods because the labeled compounds added to every sample provide more performance data than spiking a single sample in each preparation batch. The concentration of the spike should be about 3 to 5 times the background concentration determined by screening, at the mid-level calibration point if screening was not performed, or at levels specified by a project analysis plan.

3.17 Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water and is designed to monitor the introduction of artifacts into the analytical process. The method blank is spiked with the EIS compounds before extraction and is carried through the entire analytical procedure.

3.18 Multiple reaction monitoring (MRM) – Also known as selected reaction monitoring (SRM). An LC/MS/MS technique where most background noise/interfering compounds are filtered out by the tandem mass spectrometer. MRM mode allows multiple parent ions (generally the $[M+H]^+$ ions in positive mode and the $[M-H]^-$ ions in negative mode) through the first quadrupole. In the collision cell, the parent ions are fragmented. In the third quadrupole (Q3) all ions except the quantitation fragments (product ions) are filtered out. The only ions that are allowed through the instrument are ions that have the same parent mass producing the same product mass during a particular segment of analysis time. MRM mode analyzes multiple mass transitions during sequential time segments. Each analysis segment is specified for a particular retention time range that corresponds to the retention time of a certified standard.

3.19 Non-extracted internal standard (NIS) – Labeled PFAS compounds spiked into the concentrated extract immediately prior to injection of an aliquot of the extract into the LC-MS/MS.

3.20 PFAS – Per- and Polyfluoroalkyl substances – A group of man-made fluorinated compounds manufactured and used in a variety of industries globally. These compounds are persistent in the environment as well as in the human body.

3.21 Precursor Ion – For the purpose of this method, the precursor ion is the deprotonated molecule ([M-H]-) of the method analyte. In MS/MS, the precursor ion is mass selected and fragmented by collision activated dissociation to produce distinctive product ions of smaller *m/z*.

3.22 Qualitative Identification Standards (QIS) – A standard that contains mixtures of the branched and linear isomers of the target analytes. This allows for the proper integration of suspected branched isomer peaks in field samples. The QIS mix is analyzed once daily, at the beginning of the analytical sequence, and confirms the linear and known branched isomer or isomer group retention times. Also known as branched isomer mix.

3.23 Deionized (DI) water – Water generated by the laboratory, demonstrated to be free from the analytes of interest and potentially interfering substances at the method detection limit for the analyte.

3.24 Relative standard deviation (RSD) – The standard deviation multiplied by 100 and divided by the mean. Also termed “coefficient of variation.”

3.25 Relative Standard Error (RSE) – The standard error of the mean divided by the mean and multiplied by 100.

3.26 Reporting Limit (RL) – The reporting limit is the lowest concentration that can be reliably quantitated during routine laboratory operating conditions. The RL is also known as the limit of quantitation (LOQ), the method reporting limit (MRL), the method limit (ML), or the practical quantitation limit (PQL).

3.27 RT – Retention time; the time it takes for an analyte or labeled compound to elute off the HPLC/UPLC column.

3.28 Signal-to-noise ratio (S/N) – The height of the signal as measured from the mean (average) of the noise to the peak maximum divided by the width of the noise.

3.29 SPE – Solid-phase extraction; a technique in which an analyte is extracted from an aqueous solution or a solid/tissue extract by passage over or through a material capable of reversibly adsorbing the analyte.

3.30 Standard Curve - A standard curve is a calibration curve which plots concentrations of a known analyte standard versus the instrument response to the analyte. Other calibration models may be used as described in the calibration section of this SOP. The appropriate criteria for assessing the validity of the calibration curve must be followed prior to quantitation of target analytes in actual sample analyses.

3.31 Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to extraction and analysis. Percent recoveries are calculated for each surrogate. Surrogates in this method are the extracted internal standards (EIS).

4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

4.2 It is the responsibility of the department supervisor and the laboratory's QA Officer to maintain up-to-date training documentation for all analysts.

5) Interferences

5.1 The reporting limits for these analytes are in the low ng/L (ppt) level for aqueous samples and in the low ng/g (ppb) level for solid matrices. PFAS are organic compounds used in the manufacture of PTFE as well as a wide variety of common products in household use; therefore, contamination is a concern when conducting this method. Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

5.2 The compounds listed in Appendix A have been chromatographically resolved adequately for quantitation purposes.

5.3 Clean all equipment prior to and after each use to avoid PFAS cross-contamination. Typical cleaning solvents used include water, methanol, and methanolic ammonium hydroxide. The residual PFAS content of disposable plasticware and filters must be verified by batch/lot number and may be used without cleaning if PFAS levels are less than the Method Detection Limit (MDL).

5.4 Raw LC/MS-MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences. Subtraction of blank results is not permitted.

5.5 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample injection syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross contamination.

5.6 The automated SPE unit must be cleaned between batches using a cleaning method that includes rinsing all tubing with methanol and/or methanolic ammonium hydroxide (1%). An example cleaning method is detailed in Appendix H.

5.7 Interferences co-extracted from samples will vary considerably from source to source, depending on the diversity of the site being sampled. Interfering compounds may be present at concentrations several orders of magnitude higher than the native PFAS. Because low levels of PFAS are measured by this method, elimination of interferences is essential. The cleanup steps described in the procedure in Section 11 can be used to reduce or eliminate these interferences and thereby permit reliable determination of the PFAS at the reporting levels found in LIMS. The most frequently encountered interferences are fluoropolymers; however, when analyzing certain sample matrices, including wastewaters, bile salts (*e.g.*, Taurodeoxycholic Acid [TDCA]) can interfere in the chromatography. For this reason, analysis of a standard containing TDCA is required as part of establishing the initial chromatographic conditions and monitoring daily chromatographic conditions for continued adequate resolution from target analytes for all sample matrices.

6) Safety

6.1 Chemicals, reagents and standards must be handled as described in the York/ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

6.2 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

6.3 The toxicity or carcinogenicity of each compound or reagent used in this method has not been precisely determined; however, each chemical compound should be treated as a potential health hazard. Exposure to these compounds should be reduced to the lowest possible level.

7) Sample Collection, Containers, Preservation, and Storage

7.1 Sample Collection – Containers for sample collection must be entirely free of any PTFE or PFAS. Water samples should be collected in duplicate, in 250-mL or 500-mL polypropylene or HDPE bottles. Note that sample collection in 250-mL bottles will double the RLs listed in Appendix A. Solid samples should be collected in 250-mL polypropylene or HDPE bottles. Sample container lids should not be lined.

7.2 Sample Preservation and Storage – Aqueous samples must be refrigerated in the dark at or below 6ºC from time of collection until extraction. Optionally, aqueous samples may be stored at or below -20ºC in the dark to extend the holding time. Solid samples and biosolids samples may be stored in the dark at either 0-6ºC, or at ≤-20ºC. The laboratory must confirm that the sample temperature is at or below 6ºC upon receipt. Sample extracts must be stored in the dark at or below 6ºC in polypropylene containers.

7.3 Aqueous samples must be extracted within 28 days of sampling if stored at or below 6ºC or 90 days of sampling if stored ≤-20ºC. Solid and tissue samples must be extracted within 90 days of sampling. For all other miscellaneous matrix samples such as paperboards/packaging, plastic products, synthetic turf products, etc., no preparation holding time applies. Extracts are stored under refrigeration (at or below 6ºC) until analysis and must be analyzed within 90 days of extraction. If 11Cl-PF3OUdS and/or 9Cl-PF3ONS are specifically analytes of interest for a particular project, extractions should be analyzed within 28 days of extraction.

7.3.1 If NMeFOSE, NEtFOSE, NMeFOSAA or NEtFOSAA are analytes of interest in aqueous samples, samples should be extracted within 7 days of collection if stored between 0 - 6˚C. If stored at ≤-20˚C, the 90-day holding time applies to these compounds.

7.3.2 If NFDHA is an analyte of interest in solid samples (not including biosolids), samples should be extracted within 3 days of collection regardless of the storage temperature.

7.3.3 If a shorter preparation hold time is needed on a project-specific basis, this must be clearly communicated by the client in advance of receiving the samples.

8) Standards, Reagents, and Consumable Materials

8.1 Reagents

8.1.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. All solvents must be verified by lot number and stored in accordance with manufacturer specifications or safety guidelines.

8.1.2 Acetonitrile (ACN), CH_3CN – LCMS grade (Supelco Cat# AX0156-1 or equivalent)

8.1.3 Methanol, CH_3OH – HPLC Plus or LCMS grade (Sigma Aldrich Cat# 646377 or equivalent)

8.1.4 Formic Acid – ACS reagent grade, >96% (Sigma Aldrich Cat# 695076 or equivalent). Store at manufacturer's recommendation. Replace within two years of opening or at manufacturer's expiration date, whichever is sooner.

8.1.5 DI Water – generated using the laboratory's water purification system (Med Water Systems PCP115 or equivalent)

8.1.6 Ammonium Acetate (NH_4OAc) – Reagent grade 97% or higher (Sigma Aldrich Cat# 238074, or equivalent) replace 2 years after opened date or at manufacturer's expiration date, whichever is sooner.

NOTE: Ammonium Acetate is hygroscopic. The solid should be stored in a desiccator, the bottle should be open for a minimum amount of time, and the solid should be weighed quickly so moisture is not absorbed by the ammonium acetate.

8.1.7 Mobile Phase – (A) 5mM ammonium acetate in 95:5 water:acetonitrile and (B) acetonitrile. The mobile phase A is prepared by adding the appropriate amount of NH_4OAc to the appropriate volume of water:acetonitrile as shown in Table 8.1. Shake vigorously to mix; sonication may be employed if needed. Prepared mobile phase solutions may be used for up to 2 months from date of preparation or at manufacturer's expiration date, whichever is sooner.

Table 8.1

Mobile Phase A – 5 mM Ammonium Acetate in 95:5 Water:Acetonitrile

Mass of Ammonium Acetate	Volume of Acetonitrile	Volume of Water	Concentration of Ammonium Acetate	Final Volume
0.385 g	50 mL	950 mL	5 mM	1 L

NOTE: It is recommended to sonicate the mobile phase, use an inline degasser, or to allow the mobile phase to equilibrate for several hours or overnight before use to reduce the risk of gas bubbles in the instrument lines.

8.1.8 Potassium hydroxide – certified ACS grade (Sigma Aldrich Cat# 221473-25G or equivalent) store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.9 Ammonium Hydroxide - ACS reagent grade, > 25%, (Sigma Aldrich Catalog # 221228, or equivalent) Store at room temperature. Replace within two years of opening or at manufacturer's expiration date, whichever is sooner.

8.1.10 Acetic acid (glacial) – ACS reagent grade, >99.7% (Sigma Aldrich Catalog # 695092 or equivalent). Store at manufacturer's recommendation. Replace within two years of opening or at manufacturer's expiration date, whichever is sooner.

8.1.11 Aqueous ammonium hydroxide (3%) – add ammonium hydroxide (10mL, 30%) to DI water (90mL), store at room temperature, replace after 3 months or at manufacturer's expiration date, whichever is sooner.

8.1.12 Methanolic ammonium hydroxide (0.3%) – add ammonium hydroxide (2.5 mL, 30%) to methanol (247.5mL) store at room temperature, replace after 1 month or at manufacturer's expiration date, whichever is sooner. If low/high surrogate recoveries are observed, this could be a sign of degradation and the solution should be replaced.

8.1.13 Methanolic ammonium hydroxide (1%) – add ammonium hydroxide (8.25mL, 30%) to methanol (241.75mL), store at room temperature, replace after 1 month or at manufacturer's expiration date, whichever is sooner. If low/high surrogate recoveries are observed, this could be a sign of degradation and the solution should be replaced. This solution is also used for cleaning of the automated extraction units. 250 mL should be made per unit of 8 positions being cleaned.

8.1.14 Methanolic ammonium hydroxide (3%) – add ammonium hydroxide (24.8mL, 30%) to methanol (225.2mL), store at room temperature, replace after 1 month or at manufacturer's expiration date, whichever is sooner. If low/high surrogate recoveries are observed, this could be a sign of degradation and the solution should be replaced.

8.1.15 Methanolic potassium hydroxide (0.05M) – add 3.3g of potassium hydroxide to 1L of methanol, store at room temperature, replace after 3 months or at manufacturer's expiration date, whichever is sooner.

8.1.16 Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid – add ammonium hydroxide (3.3mL, 30%), DI water (1.7mL) and acetic acid (0.625mL) to methanol (92mL), store at room temperature, replace after 1 month or at manufacturer's expiration date, whichever is sooner.

8.1.17 Formic acid (aqueous, 0.1M) – dissolve formic acid (0.873mL) in DI water for a final volume of 250mL. Store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.18 Formic acid (aqueous, 0.3M) – dissolve formic acid (2.62mL) in DI water for a final volume of 250mL. Store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.19 Formic acid (aqueous, 5% v/v) – mix 12.5mL formic acid with DI water for a final volume of 250mL. Store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.20 Formic acid (aqueous, 50% v/v) – mix 50mL formic acid with 50mL DI water, store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.21 Formic acid (methanolic 1:1, 0.1M formic acid:methanol) – mix equal volumes of methanol and 0.1M formic acid, store at room temperature, replace after 2 years or at manufacturer's expiration date, whichever is sooner.

8.1.22 Matrix Sand – Ottawa sand (Fisher Scientific, Cat# S2350 or equivalent). Sand must be demonstrated to be free of PFAS above the Method Detection Limit (MDL).

8.1.23 Isopropyl Alcohol, IPA – LCMS grade. (Tedia Cat# PS2032 or equivalent)

8.1.24 Sodium Hydroxide – ACS reagent grade, >98% (Sigma Aldrich Catalog # S8045, or equivalent). Store at manufacturer's recommendation. Replace within two years of opening or at manufacturer's expiration date, whichever is sooner.

8.2 Standards

8.2.1 Stock standard solutions containing a mixture of the native perfluoroalkyl carboxylic acids included in Appendix A are purchased from Wellington (Cat#'s PFAC-MXJ, PFAC-MXI, PFAC-MXH, PFAC-MXG, and PFAC-MXF) at varying concentrations. The stock standards are used to prepare intermediate standard solutions, and are used as-is to prepare calibration levels 7 and 8. The expiration date and storage conditions specified by the manufacturer for the purchased standards are applied. The expected solution concentrations of analytes in each stock solution is listed in Appendix F. Stock solutions from other vendors may be used in place of the listed standards.

NOTE: Some target analytes are not available as acids but rather as their corresponding salts, such as K+ or Na+. The concentrations must be corrected for the salt content accordingly. This can be done in the solution makeup or in the instrument calibration software.

Standards are prepared in polypropylene vials that have been pre-rinsed with 5mM NaOH in methanol and allowed to dry.

8.2.2 The intermediate standard solutions for target analytes and EIS are prepared in methanol from purchased stock standards using appropriate syringes or autopipettors, according to Table 8.2 below. These solutions expire 6 months after preparation.

Standard solutions are stored in polypropylene or HDPE bottles/vials at ≤ 4ºC and may be used for up to 6 months from the date of preparation unless degradation is noted first. The expiration date cannot exceed that of its stock standards. The intermediate standard solutions are used to prepare calibration standards for levels 1-6. A separate intermediate solution is used to spike Extraction QC, and is prepared as shown in Table 8.3. Extraction QC (LCS_LL/LCS/MS/MSD) are to be spiked with the intermediate spike standard solution to yield a sample concentration at the RL or at 2x the RL and at the mid-level of the calibration curve (see Procedure Section 11 for spike volumes).

Table 8.2 Intermediate Standard Solutions (for calibration standards)

Supplier	Catalog Number	Concentration of Stock Standard (ppb)	Initial Volume of Stock Standard (µL)	Final Concentration (ppb)
Wellington	PFAC-MXF	2000	100	200
Wellington	PFAC-MXG	2000	100	200
Wellington	PFAC-MXH	1000-4000	100	100-400
Wellington	PFAC-MXI	1000-10000	100	100-1000
Wellington	PFAC-MXJ	4000-20000	100	400-2000
Wellington	MPFAC-HIF-ES	250-5000	100	25-500
Wellington	MPFAC-HIF-IS	250-1000	500	125-500

Each prepared individually for a final volume (in methanol) of 1000 µL each

Table 8.3 Intermediate Target Spike Standard Solution (for spiking QC)

Supplier	Catalog Number	Concentration of Stock Standard (ppb)	Initial Volume of Stock Standard (µL)	Final Concentration (ppb)
Wellington	PFAC-MXF	2000	1000	400
Wellington	PFAC-MXG	2000	1000	400
Wellington	PFAC-MXH	1000-4000	1000	200-800
Wellington	PFAC-MXI	1000-10000	1000	200-2000
Wellington	PFAC-MXJ	4000-20000	1000	800-4000

Prepared as a mixed standard with a final volume (in methanol) of 5000 µL

8.2.3 The EIS solution is a purchased mix (MPFAC-HIF-ES, or equivalent) in methanol. The concentrations in the purchased mix are listed in Appendix F. Once the glass ampoule is cracked, the EIS stock solution is transferred into a polypropylene vial and is stored at ≤ 4ºC and may be used for up to 6 months from the date of preparation unless degradation is noted first. The expiration date cannot exceed that of the manufacturer expiration date. The expiration date and storage conditions specified by the manufacturer are applied. An aliquot of EIS solution is added to each sample prior to extraction.

8.2.4 The NIS solution is a purchased mix (Wellington MPFAC-HIF-IS, or equivalent) in methanol. The solution concentrations in the purchased mix are listed in Appendix F. Once the glass ampoule is cracked, the NIS stock solution is transferred into a polypropylene vial and is stored at ≤ 4ºC and may be used for up to 6 months from the date of preparation unless degradation is noted first.

The expiration date cannot exceed that of its stock standards. The expiration date and storage conditions specified by the manufacturer are applied. An intermediate NIS solution is prepared at a 1:1 dilution in methanol. An aliquot of this intermediate NIS solution is added to each standard, QC, and sample prior to instrumental analysis. NIS should be added in a ratio of 1:100 (e.g., 3µL of the 1:1 NIS dilution added to every 300µL of standard, QC, or sample).

8.2.5 Qualitative Identification Standards (QIS) contain mixtures of the branched and linear isomers of the method analytes and that are used for comparison against suspected branched isomer peaks in field samples. These qualitative standards are **not** required for those analytes where the quantitative calibration standards already contain the branched and linear isomers. Additional isomers will be added as they become available. An intermediate solution at a concentration of 100ppb is made from stock standards purchased from Wellington in methanol. The intermediate solution is prepared in a polypropylene vial using syringes. The QIS intermediate is stored at or below 6ºC for up to one year from the date of preparation and cannot exceed the manufacturer expiration dates of the stock standards. See Table 8.4 for preparation of the intermediate QIS standard at 100ppb. The final QIS standard is prepared at 20ppb in the calibration matrix (Section 8.3.2) and is detailed in Table 8.5. EIS and NIS are added to the final QIS standard at the same concentrations as calibration standards and samples.

Table 8.4 QIS Intermediate [100ppb]

Supplier	Catalog Number	Concentration of Stock Standard (ppb)	Initial Volume of Stock Standard (uL)	Final Concentration (ppb)
Wellington	T-PFOA	50,000	2	100
Wellington	lp-PFNA	50,000	2	100
Wellington	br-FOSA	50,000	2	100
Wellington	br-NEtFOSA	50,000	2	100
Wellington	br-NMeFOSA	50,000	2	100
Wellington	br-NEtFOSE	50,000	2	100
Wellington	br-NMeFOSE	50,000	2	100

Diluted in 1000 uL Methanol

Table 8.5 QIS final standard [20 ppb]

100ppb QIS Intermediate volume (µL)	Calibration Matrix volume (µL)	1633 EIS Isotope Mix volume (µL)	QIS Final Concentration (ppb)
200	750	50	20

8.2.6 Taurodeoxycholic Acid (TDCA) or Sodium taurodeoxychloate hydrate is used to evaluate the chromatographic program relative to the risk of an interference from bile salts in samples. The stock solution is prepared at a concentration of 1 mg/mL in a 15-mL polypropylene centrifuge tube from neat material. The purchased neat material is weighed and diluted in methanol to 5 mL using an analytical balance and an autopipette (Table 8.6). An intermediate is then prepared at 100 (Table 8.7). See Table 8.8 for preparation of the final TDCA standard to be injected with each sequence at 1 ug/mL with target compounds included.

Table 8.6 TDCA Stock Solution [1 mg/mL]

Supplier	Catalog Number	Initial Weight of Neat Material (g)	Final Concentration (mg/mL)
Sigma Aldrich	580221-5GM	0.0050	1.0
Final Volume (in Methanol): 5000 uL			

Table 8.7 TDCA Intermediate [100 ppb]

TDCA Stock Solution Concentration (ppb)	Initial Volume of TDCA Stock Solution (µL)	Final Concentration (ppb)
1000	100	100
Final Volume (in Methanol): 1000 uL		

Table 8.8 TDCA + Target Compounds: Final Standard

100 ppb TDCA volume (µL)	Calibration Matrix Volume (µL)	MXH intermediate volume (µL)	MXG intermediate volume (µL)	MXF intermediate volume (µL)	MXI intermediate volume (µL)	MXJ intermediate volume (µL)	Intermediate EIS Volume (uL)	Final Target Concentration TDCA (µg/mL in vial)
10	790.7	25	25	50	25	31.3	50	1

8.2.7 The stock standard for the ICV is purchased from Absolute Standards. The ICV intermediate solution is prepared at 200ppb in a polypropylene vial using syringes (concentrations and volumes in Table 8.9). The ICV intermediate solution is stored at ≤ 4ºC and may be used for up to 6 months from the date of preparation unless degradation is noted first. The expiration date cannot exceed that of its stock standards. The ICV final standard is prepared in the calibration matrix solution (Section 8.3.2) at 10 ppb as described in Table 8.10. Extracted Internal Standards (EIS) and Non-extracted Internal Standard (NIS) are spiked as in the calibration standards. The ICV is used to check the initial calibration curve.

Table 8.9 Independent Calibration Verification (ICV) Intermediate Solution [200ppb]

Supplier	Catalog Number	Stock Standard Concentration (ppb)	Stock Standard Volume (uL)	Final Concentration (ppb)
Absolute Standards	65735	2000	100	200

Table 8.10 ICV Final Standard [1 mg/mL]

200ppb ICV Intermediate Solution volume (µL)	Calibration Matrix volume (µL)	1633 EIS Isotope Mix volume (µL)	Final Concentration (ppb)
50	900	50	10

8.3 Calibration

8.3.1 Calibration standards containing all target analytes listed in Appendix A are prepared at eight concentration levels in the appropriate calibration matrix solution (Section 8.3.2) in polypropylene vials using syringes. Calibration levels 1-6 are spiked with the intermediate standard solutions at 100ppb (Table 8.2), while calibration levels 7 and 8 are prepared using the purchased stock solutions directly. All levels are spiked with EIS and NIS. See Table 8.11 below for calibration level concentrations. The calibration standards are stored refrigerated at ≤ 4ºC and may be used for up to six months unless degradation is noted first. The expiration date cannot exceed that of its stock standards.

8.3.2 The calibration matrix solution is methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid. 200mL of this solution should be prepared using 184 mL methanol, 3.4 mL DI water, 6.6 mL ACS reagent grade ammonium hydroxide (>25%), and 1.25 mL glacial acetic acid.

Table 8.11 Initial Calibration Standards Preparation

Calibration Level	Calibration Matrix Volume (µL)	MXH intermediate or stock /volume (µL)	MXG intermediate or stock /volume (µL)	MXF intermediate or stock /volume (µL)	MXI intermediate or stock /volume (µL)	MXJ intermediate or stock /volume (µL)	Intermediate EIS Volume (uL)
CCB (Instrument Blank)	950	-	-	-	-	-	50
1 (ISC level)	937.5	int / 2	int / 2	int / 4	int / 2	int / 2.5	50
2	918.75	int / 5	int / 5	int / 10	int / 5	int / 6.25	50
3	871.9	int / 12.5	int / 12.5	int / 25	int / 12.5	int / 15.6	50
4 (CCV level)	793.7	int / 25	int / 25	int / 50	int / 25	int / 31.3	50
5	637.5	int / 50	int / 50	int / 100	int / 50	int / 62.5	50
6	309.4	int / 125	int / 125	int / 250	int / 125	stock / 15.6	50
7	793.8	stock / 25	stock / 25	stock / 50	stock / 25	stock / 31.2	50
8	559.5	stock / 62.5	stock / 62.5	stock / 125	stock / 62.5	stock / 78	50
1:1 dilution of NIS (section 8.2.4) is added to each standard in a ratio of 1:100 NIS:standard (e.g., 3µL 1:1 NIS for a 300µL aliquot of standard)							

NOTE: Data users are advised that this list of analytes may not perform as well as others: perfluorooctane sulfonamido substances (PFOSA, NMeFOSA, NEtFOSA, NMeFOSAA, NEtFOSAA, NMeFOSE, NEtFOSE).

8.3.3 The Continuing Calibration Verification (CCV) standard is spiked at or below the mid-point of the calibration and is prepared in the same manner as calibration standards in Table 8.11. The purpose of the CCV is to verify the calibration curve and must run prior to the batch and after every ten samples. The CCV standard is stored refrigerated at ≤ 4ºC and may be used for up to six months unless degradation is noted first. The expiration date cannot exceed that of its stock standards.

8.3.4 Instrument Blank (also called Continuing Calibration Blank (CCB)) is a volume of final volume solution with extracted internal standards (EIS) and non-extracted internal standard (NIS) spiked as in the calibration standards (see Table 8.11).

9) Apparatus and Equipment

9.1 Liquid Chromatography – Triple Quadrupole Mass Spectrometry (LC-MS/MS) system

9.1.1 Analytical system – Agilent 1290 or 1260 LC system, coupled with Agilent 6460C or 6470A mass spectrometer, or equivalent.

9.1.2 Analytical column – Phenomenex Luna Omega 1.6µm PS C18, 100x2.1mm (Cat # 00D-4725-AN) for use with Agilent 1290 LC, Phenomenex Kinetex 2.6µm C18 100x2.1mm (Cat # 00D-4780-AN) for use with Agilent 1260 LC, or equivalents.

9.1.3 Delay column (Phenomenex Luna Omega PS-C18 5µm 50x3.0mm (Cat # 00B-4753-Y0 or equivalent) is installed between the mobile phase mixer and the injector. This isolator column delays elution of PFAS contaminants from the instrument pumps in order to allow resolution from the target PFAS compounds native to the injected extracts and standards. The delay column will significantly increase pump backpressure, but the pressure should remain within system tolerances.

9.1.4 Guard column (Phenomenex PS-C18 2.1 mm ID Guard Cartridges, Cat # AJ0-8951, or equivalent)

9.1.5 Inline HPLC Filters – Agilent 5067-1613, 0.2 µm porosity, or equivalent.

9.1.6 Windows based computer system, including monitor and printer, with acquisition analysis software.

9.2 Phenomenex WAX SPE cartridges with integrated carbon cleanup (Phenomenex Strata PFAS (WAX/GCB), 200mg/10mg/6mL, 30/Pk (Phenomenex Cat # CS0-9218 and Phenomenex Strata PFAS (GCB/WAX) 10mg/200mg/6mL (Phenomenex Cat # CS0-9219 or equivalent.

9.3 Balance capable of measurements of ±0.0001g (Mettler Toledo Cat # AG104)

9.4 Disposable nylon cartridge filters – 0.20µm/15mm diameter (Agilent 5190-5092, or equivalent).

9.5 Disposable Luer lock syringes – 5 mL (Henke Sass Wolf Cat # 4050-X00V0, or equivalent)

9.6 Disposable glass serological (Kimble Cat # 72120-10110, or equivalent) and Pasteur pipettes (Laboratory Sales and Service Cat # 1331012, or equivalent), appropriate sizes.

9.7 Automated Solvent Evaporation System (Biotage TurboVap LV (48 nozzles) Catalog # 415408SP, or equivalent) with rack inserts for 50 mL centrifuge tubes (Biotage Catalog # 415129, or equivalent), 15 mL centrifuge tubes (Biotage Catalog # 414964, or equivalent), and 2 mL vials (Biotage Catalog # 415489, or equivalent).

9.8 Autosampler Vial, 2 mL polypropylene (Agilent Cat # 5182-0567, or equivalent) with non-Teflon lined caps (Agilent Cat # 5181-1513, or equivalent).

9.9 Glass micro syringes, appropriate sizes (Hamilton multiple sizes, or equivalent)

9.10 Centrifuge – capable of reaching 3000rpm (Fisher Sorvall ST4 Plus Centrifuge Series CAT#75009511, or equivalent), 750mL bucket rotor (Fisher CAT#75003180, or equivalent), and 15mL (Fisher CAT#75003639, or equivalent) and 50mL adaptors (Fisher CAT#75003638, or equivalent)

9.11 Shaker table (Fisher Solaris Open Air Orbital Shaker CAT#SK4000, or equivalent) including platform (Fisher CAT#SK1830, or equivalent) and 26 to 30 mm tube rack (Fisher CAT#236093, or equivalent)

9.12 Automated extraction unit (PromoChrom SPE-03 MOD-004, or equivalent) or vacuum manifold (Agilent Vac Elut SPS 24 Manifold Catalog # 12234004, or equivalent).

9.13 Centrifuge tubes with caps in polypropylene or HDPE 15mL (Globe Scientific # 6264, or equivalent) and 50mL (SSE Catalog # 220-3550-080, or equivalent)

9.14 Bottles, HDPE or polypropylene with linerless HDPE or polypropylene lids. Various sizes, used to store prepared standards and reagents.

9.15 pH Paper – range from 1-14 in 0.5 increments (Fisher Catalog # 88-841, or equivalent)

9.16 Water Purification System – capable of producing DI, PFAS-free water. (Med Water Systems Catalog # PCP115, or equivalent)

9.17 Autopipettors – variable 500-5000µL (Brand Cat # 705882IC5), variable 100-1000µL (Brand Cat # 705880IC5), variable 0.1-1µL (Brand Cat # 705868IC5)

10) Preventative Maintenance

10.1 All maintenance activities are recorded in a logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. Maintenance entries should include date, symptom/problem, description of maintenance or corrective action(s), and name.

10.2 HPLC System

10.2.1 Mobile phase solvents are vacuum degassed inline.

10.2.2 The entire system is flushed with water and isopropyl alcohol when necessary, usually indicated by high backpressure that does not decrease when replacing system components (needle, needle seat, columns, capillary lines, etc.). Remove the analytical and delay columns before flushing, and connect tubing with unions. Pump DI water through both Pumps A and B at equal concentrations and a total flow rate of 2 mL/min for 1.5 hours and then isopropyl alcohol at the same conditions for 1 hour. Then re-equilibrate the instrument with the normal operating conditions for 30 minutes prior to starting analysis. Other mobile phases, times, and flow rates may be used as necessary.

10.2.3 The system (including the column) may be flushed with water and organic solvents (e.g., methanol, acetonitrile, isopropyl alcohol) at a low flow rate to help clean out the system and extend the life of the column. Flow should be set to the MS instead of waste (check instrument settings to confirm the correct status setting). MS and oven should be turned on at normal method conditions. With water through pump A and organic solvent through pump B, the system may be flushed at various ratios of aqueous/organic (but never <10% organic) for a total flow rate of 0.4 mL/min for several hours. After flushing, replace method specific mobile phase and allow to equilibrate under method conditions for at least 30 minutes prior to beginning a sequence. Other flushing durations and flow rates may be used as necessary.

10.2.4 Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

10.2.5 The most common issue with LC systems is high backpressure. When this occurs, the source of the elevated backpressure should be determined by systematically testing the flow path. The needle, needle seat, capillary tubing, columns, and inline filters are the most likely sources of backpressure.

10.3 MS/MS system

10.3.1 The ionization chamber and associated parts (nebulizer, spray shield, spray cap) should be cleaned with methanol routinely, and especially if residues are observed on chamber surfaces and/or if a loss of sensitivity is observed. Rinse all parts thoroughly with water then methanol to ensure no residue is left. Other solvents and the use of sonication may assist with cleaning the instrumentation as needed.

10.3.2 The electrospray needle should be cleaned or replaced if the spray appears irregular or if a loss of sensitivity is observed.

10.3.3 The capillary, quadrupoles, and lenses can be cleaned per manufacturer instruction if a loss of sensitivity is observed. This level of cleaning requires breaking vacuum to the MS/MS and is typically only performed after exhausting other maintenance options. A maintenance technician may be required for this level of maintenance.

10.4 The instrument should be recalibrated following major maintenance events that impact performance and response.

11) Procedure

11.1 Promochrom SPE-03 Automated Extraction Manifold Cleaning and Maintenance Procedures (may vary depending on vendor/model used)

11.1.1 Prior to and immediately following each extraction batch, place each sample line in a clean bottle. Run the “Clean System” program (Appendix H).

11.1.2 Syringes should be cleaned and lubricated every 3 months, or when performance begins to degrade.

11.1.3 Pump sensors should be inspected regularly and cleaned on an as-needed basis.

11.2 Aqueous samples that contain high amounts of particles and suspended solids may clog the SPE cartridge and compromise the sample extraction. The potential for clogging due to suspended solids in aqueous samples is determined prior to sample preparation. The concentration of solids may be determined by a comparing the samples to examples in the laboratory. If TSS is determined likely to cause clogging upon extraction, a dilution using a lower initial volume may be done. In some cases, the matrix of the sample should be re-evaluated for amendment to a solid with client notification. A record of the TSS evaluation must be kept for each sample.

11.3 Aqueous samples that are determined to contain 50mg or more suspended solids may be sub-aliquoted such that the extracted volume contains less than 50mg suspended solids; this must meet project-specific requirements and requires notification of the client.

NOTE: If the sample volume contains more than 50 mg of TSS, the analyst may choose to prepare a second SPE cartridge to continue the extraction in the event of clogging. Alternatively, the sample may be centrifuged prior to adding the EIS and the aqueous phase and solid phase may be treated as separate samples. In this case, the original container must be rinsed after the extraction of either the aqueous phase or solid phase. The bottle rinse for an aqueous sample should be added to the aqueous portion of the sample in most cases, but if there is visible solid left in the bottle, the lab may add the bottle rinse to the solid portion of the sample. In extreme cases (aqueous samples with TSS > 10%) the entire sample might be treated as a sediment sample.

11.4 Samples may be screened prior to quantitative analysis to inform the analyst of the need for reduced initial mass/volume or dilutions on the final extract. Screening is not required if PFAS levels in the samples are known, or in accordance with project-specific instructions or reporting limit requirements. The screening samples are prepared with a method blank.

11.4.1 Solid Sample Screen:

11.4.1.1 Gather materials: Per sample, 20mL 0.3% NH4OH in MeOH, 2 polypropylene 15 mL centrifuge tubes with caps, 20uL EIS, 1 Nylon 0.2um filter and 1 2mL Luer lock syringe, 1 amber glass or polypropylene vial, 3uL NIS, 270uL MeOH. MeOH rinse for syringe. If weighing out, MeOH rinsed scoops.

11.4.1.2 Weigh 1.0±0.1g sample into 50-mL polypropylene centrifuge tubes. Use 1g matrix sand for QC.

11.4.1.3 Add 20mL of 0.3% methanolic ammonium hydroxide to each sample. Vortex and mix on a shaker table (or equivalent) for 10 min.

11.4.1.4 Allow to settle and/or centrifuge at 2500rpm for 5 min to produce a clear extract.

11.4.1.5 Add 400uL of the sample and 20uL EIS to a 15-mL centrifuge tube and vortex.

11.4.1.6 Filter using 0.2um filter/syringe into new 15-mL centrifuge tube.

11.4.1.7 Add 270uL MeOH and 3uL NIS to each vial. Then transfer 30uL of filtrate to the vial.

11.4.1.8 Cap and vortex to mix. Store in the dark.

11.4.1.9 The EIS concentration will be 0.4x the amount for a regular 1633A soil sample. The software allows for dilution factors.

11.4.1.10 The NIS ratio should be the same as normal soil samples. Normal samples are 50uL NIS to 5mL sample. These are 3uL NIS to 0.3mL sample.

11.4.2 Liquid Screen:

11.4.2.1 A typical screen is a direct 4x dilution, but other dilution factors may be used.

11.4.2.2 Prepare tubes: add 1633A Final Volume Solution to all 15-mL centrifuge tubes to allow for a 1mL final volume. For a 4x dilution, all samples and MB will get 730uL of Final Volume Solution. Add DI water to the method blank ONLY (250uL for a 4x dilution). Cap tubes.

11.4.2.3 Invert samples to homogenize. Add sample aliquot (250uL for 4x) to each tube. To avoid contamination, make sure only one sample is opened at a time.

11.4.2.4 Add 10uL of EIS and 10uL of NIS to all QC and samples. Vortex all samples.

11.4.2.5 Typical screens are pipetted directly into vials. If there is noticeable particulate, filter samples into vials with 0.2um nylon filters.

11.5 Sample Preparation – Aqueous Samples

11.5.1 Homogenize the sample by inverting the sample 3-4 times and allowing the sample to settle. Do not filter the sample. The standard procedure is to analyze the entire sample, plus a basic methanol rinse of the container.

11.5.2 A duplicate sample (or MS/MSD when requested) are prepared similarly. Using a syringe, the matrix spikes are fortified with 100 µL of the intermediate target spike at a concentration at or below the midpoint of the calibration.

11.5.3 The volume of the aqueous sample analyzed is determined by weighing the full sample bottle and subtracting the weight of the empty sample bottle post extraction. Weigh each sample bottle (with the lid) to 0.1g; a density of 1 g/mL is assumed unless the client provides additional information about the sample density. The nominal initial volume is approximately 500mL.

11.5.4 Prepare a method blank (MB) and the LCS's using DI water in HDPE bottles. Using syringes, spike the LCS_LL aliquot with 10 µL of the intermediate target spike standard solution for a final concentration at 2x the RL. Spike the LCS aliquot with 100 µL of the intermediate target spike solution for a final concentration near the concentration of the mid-level calibration point. If insufficient client sample volume is received to perform a duplicate sample (or MS/MSD), the analyst shall prepare a Duplicate Laboratory Control Sample (LCSD) spiked at the concentration of the mid-level calibration point. The mid-level LCS/LCSD will be used to determine Relative Percent Difference (RPD) for the batch.

11.5.5 Using syringes, spike 25µL of EIS stock solution directly into the sample in the original bottle (or subsampled bottle) as well as into the bottles prepared for the QC samples. Mix by swirling the sample container.

11.5.6 Check that the pH is 6.5±0.5. If necessary, adjust pH with 50% acetic acid or 30% ammonium hydroxide. Lower concentrations such as 5% acetic acid or 3% aqueous ammonium hydroxide can be used to adjust pH if smaller adjustments are required. Record pH for each sample/QC in LIMS. The sample is now ready for solid-phase extraction (SPE) and cleanup.

NOTE: If the sample is highly buffered and cannot be properly pH-adjusted, extraction of a smaller sample volume (diluted up to 500mL) may be necessary. Since sub-aliquoting may introduce a bias due to inability to rinse the original sample bottle, extraction of a sub-aliquot requires project manager and/or client notification and documentation on the associated bench sheet.

11.6 Solid Sample Preparation

11.6.1 Samples are homogenized and aliquoted prior to extraction. The nominal sample size is 5.00g dry weight, and samples are weighed into clean 50-mL polypropylene centrifuge tubes. Additional sample is aliquoted for sample matrix spike and duplicate sample or matrix spike duplicate if requested.

11.6.2 Aliquot a minimum 5.00g of matrix sand wetted with 2.50g of DI water into clean 50-mL polypropylene centrifuge tubes for the LCS, LCS_LL, and method blank (MB). Using a syringe or autopipettes, add 25µL of the extracted internal standards (EIS) spiking solution to each field and QC sample. Using a syringe or autopipettes, add the intermediate target spike standard solution to each QC spiked sample (MS, MSD, LCS, LCS_LL). Spike the LCS_LL tube with 10µL of the intermediate target spike solution for a final concentration at 2x the RL. Spike the LCS/LCSD/MS/MSD aliquots with 100µL of the intermediate target spike solution for a final concentration near the concentration of the mid-level calibration point. Vortex the samples to mix and allow to equilibrate 30 minutes.

11.6.3 Add 10mL of 0.3% methanolic ammonium hydroxide to each sample. Vortex to disperse, then shake for 30 minutes on a variable speed mixing table. Centrifuge at 1400 RCF for 10 minutes and transfer the supernatant to a clean 50-mL polypropylene centrifuge tube.

11.6.4 Add 15mL of the 0.3% methanolic ammonium hydroxide to the remaining solid sample in each centrifuge tube. Vortex to disperse, then shake for 30 minutes on a variable speed mixing table. Centrifuge at 1400 RCF for 10 minutes and decant the supernatant from the second extraction into the centrifuge tube with the supernatant from the first extraction.

11.6.5 Add another 5mL of 0.3% methanolic ammonium hydroxide to the remaining sample in each centrifuge tube. Shake by hand to disperse, centrifuge at 1400 RCF for 10 minutes and decant the supernatant from the third extraction into the centrifuge tube with supernatant from the first and second extractions.

11.6.6 Dilute to approximately 35mL with DI water. Samples containing more than 50%

water may yield extracts that are greater than 35mL in volume; therefore, do not add water to these.

11.6.7 Concentrate each extract at approximately 55ºC on the TurboVap to a final volume that is based on the water content of the sample (*see table below*). Allow extracts to concentrate for 25 minutes, then mix by vortex. Continue concentrating and mixing every 25 minutes until the extract has been reduced to the required volume as specified in Table 11.1. Mark the volume after each vortex. If the extract volume appears to stop dropping, the concentration must be stopped and the volume at which it was stopped recorded. There should be <20% MeOH remaining in the final concentrate.

NOTE: Slowly concentrating extracts, in 1mL increments, is necessary to prevent excessive concentration and the loss of neutral compounds (methyl- and ethyl-FOSEs and FOSAs) and other highly volatile compounds. The extract must be concentrated to remove the methanol as excess methanol during SPE clean-up results in poor recovery of C_{13} and C_{14} carboxylic acids and C_{10} and C_{12} sulfonates.

Table 11.1 – Solids - Concentrated Final Volume by Water Content

Water Content in Sample	Concentrated Final Volume
<5g	7mL
5-8g	8mL
8-9g	9mL
9-10g	10mL

11.6.8 Add 40-50mL of DI water to the extract and vortex. Check that the pH is 6.5±0.5 and adjust pH with 50% acetic acid or 30% ammonium hydroxide. Lower concentrations like 5% acetic acid or 3% aqueous ammonium hydroxide can be used to adjust pH if smaller adjustments are required. Record pH for each sample/QC in LIMS. The extracts are ready for SPE and cleanup.

11.7 Extraction, Cleanup, and Concentration

11.7.1 All matrices (including batch QC) must undergo SPE with carbon cleanup to remove interferences. SPE cartridges manufactured with a carbon layer may be used in lieu of carbon cleanup.

11.7.2 The automated SPE unit may be operated in a right-side up (sample bottles/tubes oriented with bottom on lab bench) or upside-down (sample bottles affixed to the unit upside down) configuration. Appendix H includes the PromoChrom methods for both configuration options. Solid samples must be extracted using the right-side up configuration, and aqueous samples may be extracted using either sample configuration. For aqueous samples with high TSS, the right-side up configuration is recommended to prevent clogging of the system during the early stages of sample addition.

11.7.3 All sample matrices (using automated solid-phase extraction – see Appendix H for SPE method details):

11.7.3.1 Clean all positions that will be used during the extraction prior to extraction using the “Clean System” program (Appendix H).

11.7.3.2 Replace used SPE cartridges with new cartridges. Attach sample lines to each bottle, ensuring each sample position correlates to the correctly labeled sample collection tube. Place bottles containing only reagent water and collection tubes in any open positions. Ensure that the nitrogen line is open, and pressure is set to 25 PSI (flow rate of ~2 L/min). Place labeled, 15-mL collection tubes in the appropriate positions. Select the EPA 1633A program (Appendix H) and run the extraction while monitoring the progress. The following steps are included in the extraction program:

11.7.3.3 Pre-condition the cartridges by washing them with 15mL of 1% methanolic ammonium hydroxide followed by 5mL of 0.3M formic acid in water. Do not allow the cartridge to go dry.

11.7.3.4 Add the sample onto the cartridge at 5mL/min.

NOTE: In the event the SPE cartridge clogs during sample loading, the analyst may place a second pre- conditioned cartridge and continue loading the remaining sample aliquot using the same reservoir.

11.7.3.5 Rinse the walls of the cartridge with 5mL DI water twice, followed by 5mL of 1:1 0.1M formic acid/methanol and pass those rinses through the cartridge using vacuum. Dry the cartridge by pulling air through for 15 seconds. Discard the rinse solution. Continue to the elution and concentration steps based on the matrix.

11.7.4 Elution and Extract Concentration of Aqueous Samples (11.7.3.1 included in automated solid-phase extraction – see Appendix H for SPE method details):

11.7.4.1 Rinse the sample bottle with 5mL of 1% methanolic ammonium hydroxide. Add the solvent rinse from each sample bottle into each cartridge. Use vacuum to pull the elution solvent through the cartridge and into the collection tubes.

11.7.4.2 If two cartridges were used for one sample (see Note in Section 11.7.2.4 above), perform the following with each cartridge. Filter the eluates through a 15mm, 0.20µm syringe filter. Combine both sets of filtered eluates into a clean tube, add the NIS solution, and vortex to mix. Transfer 300µL of the filtered extract into a 2-mL polypropylene autosampler vial and mark the level. Add another 300µL portion and using a gentle stream of nitrogen (water bath at 40ºC), concentrate to the 300µL mark and submit for LC-MS/MS analysis. This concentration step is only applicable to situations where two SPE cartridges were eluted, each with 5mL of elution solvent.

11.7.4.3 Air dry the empty sample bottle after the rinse is transferred. Weigh the empty bottle with the cap for sample volume determination.

11.7.4.4 Add 25µL of concentrated acetic acid to each sample eluted in the collection tubes and vortex to mix.

11.7.4.5 Place a syringe filter on a 10.0mL polypropylene syringe with the plunger removed. Carefully decant the sample supernatant into the syringe barrel. Replace the plunger and filter the entire extract into the new collection tube. Aliquot 300µL of each extract into a polypropylene vial. Add 3µL NIS solution into the vial. Vortex to mix and proceed to LC-MS/MS analysis. Cap the collection tube containing the remaining extract and store refrigerated at 0-6˚C in the dark.

11.7.4.6 Clean all positions that will be used during the extraction prior to extraction using the "Clean System" program (Appendix H).

11.7.5 Elution and Extract Concentration of Solid Samples (11.7.4.1 included in automated solid-phase extraction – see Appendix H for SPE method details):.

11.7.5.1 Rinse the sample tube with exactly 5mL of 1% methanolic ammonium hydroxide. Add the solvent rinse from each sample tube into each cartridge. Use the vacuum to pull the elution solvent through the cartridge and into the collection tubes.

11.7.5.2 Add 25µL of concentrated acetic acid to each sample extract in its collection tube and swirl to mix. Place a syringe filter on a 10-mL polypropylene syringe with the plunger removed. Use a variable volume pipette to transfer the sample extract into the syringe barrel. Replace the plunger and filter into a new collection tube. Transfer 300µL of extract into a polypropylene vial, and add 3µL of NIS solution. Proceed to LC-MS/MS analysis. Cap the collection tube containing the remaining extract and store refrigerated at or below 6˚C in the dark.

11.8 LC-MS/MS Analysis

11.8.1 The mass detector should be tuned in accordance with manufacturer recommendations with respect to frequency and standards used to tune. Tuning should be performed at least annually or following manufacturer recommendations, whichever is more frequent. The mass detector should also be tuned after any major maintenance events or on an as-needed basis including QC failures, ion masses fall outside of the required mass window, or if the instrument is moved. A tune verification must be performed prior to calibration annually and after a major maintenance event. Mass calibration and verification are achieved using the tuning solution and software function provided by the manufacturer.

11.8.2 ESI negative analysis: Establish the operating parameters on the instrument by loading the appropriate method into the MassHunter acquisition software.

NOTE: If any updates have been made to the method MRM table, confirm the primary and secondary mass transitions in the method properly match those specified in Appendix B.

The recommended chromatographic conditions are shown in Table 11.2 below:

Table 11.2 – Recommended Chromatographic Conditions

Time (min)	Acetonitrile	5mM NH_4OAc in 95:5 H_2O:Acetonitrile	Flow Rate (mL/min)
0.2	2%	98%	0.45
4	30%	70%	0.45
7	55%	45%	0.45
9	75%	25%	0.45
10	95%	5%	0.45
10.4	2%	98%	0.45

Analytical Column:	Phenomenex Luna Omega 1.6µm PS-C18, 100x2.1mm (or equivalent) for Agilent 1290 Phenomenex Kinetex 2.6 µm PS-C18, 100x2.1mm (or equivalent) for Agilent 1260
Column temperature:	40ºC
Injection Volume:	3.0µL
LC Time:	12.2 minutes
Posttime	2.5 minutes

11.8.3 The autosampler is programmed to wash the needle with 1:1 Methanol/Isopropyl Alcohol after every injection to minimize carryover.

11.8.4 All analytes shall have a minimum 10 scans across each chromatographic peak.

11.8.5 Calibration

11.8.5.1 Calibrate the system prior to conducting any analyses. Initiate the calibration with a Continuing Calibration Blank (CCB) to demonstrate that the system is clean to an acceptable level. Starting with the standard of lowest concentration, analyze each calibration standard and tabulate the area of the product ion against concentration for each compound. Calculate response factors (RFs) for each compound relative to the associated labeled isotope (EIS) (Appendix C) for isotope dilution or the instrument internal standard (NIS) for IS method as follows:

$$RF = (A_nC_{is})/(A_{is}C_n)$$

Where: A_n = Area of the product *m/z* for the native compound.

A_{is} = Area of the product *m/z* for the internal standard.

C_{is} = Concentration of the internal standard (ng/mL).

C_n = Concentration of the compound being measured (ng/mL).

11.8.5.2 The average response factor (RFa) is then calculated. The Relative Standard Deviation (RSD) must be less than 20% when average response factor is used. Alternatively, a statistically valid linear or quadratic regression curve, with or without weighting may be used. In these cases, the Relative Standard Error (RSE) must be less than 20%. See Appendix G for quantitation of RSE.

11.8.5.3 The signal-to-noise ratio of all calibration levels must be greater than or equal to 3:1 for the quantitation and confirmation ions that exist and 10:1 for any analytes that do not have an appropriate ion transition confirmation.

11.8.5.4 Immediately following the highest standard, analyze an instrument blank/CCB to evaluate the level of carry-over observed from the calibration standard. The concentration of each analyte in the instrument blank/CCB must be at or below the MDL. If an analyte is present above the MDL, one or more additional instrument blanks/CCBs must be analyzed until the response is no longer detectable. Additional troubleshooting steps may be necessary if the PFAS contamination persists.

11.8.5.5 Following initial calibration, an ICV is analyzed. The ICV must contain all analytes included in the calibration. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The value determined from the second source must be within 30% of the expected concentration. The signal-to-noise ratio of the ICV standard must be greater than or equal to 3:1 for the quantitation and confirmation ions that exist and 10:1 for any analytes that do not have an appropriate ion transition confirmation.

11.8.5.6 Following initial calibration, the QIS and bile salts interference check must be analyzed.

11.8.5.7 An example analytical sequence after the Initial Calibration has been performed is given in Appendix E.

11.8.6 Instrument Sensitivity Check (ISC)

11.8.6.1 Analyzed daily at the beginning of the analytical sequence.

11.8.6.2 The signal-to-noise ratio of the ISC standard must be greater than or equal to 3:1 for the quantitation and confirmation ions that exist and 10:1 for any analytes that do not have an appropriate ion transition confirmation. The ISC must also meet the ion ratio requirements. If the requirements cannot be met, the problem must be corrected before analyses can proceed.

11.8.6.3 The concentration of the ISC is laboratory specific and depends on the demonstrated quantitation range. The ISC is spiked at or below the RL. See calibration Table 8.11 for spike volumes and concentrations. The recovery of native compounds in the ISC's must be within 70-130% unless the analyte is not of concern for a given project. Native analytes that have greater than 130% recovery without detections for the analytes in the samples may be narrated.

11.8.7 Continuing Calibration Verification (CCV)

11.8.7.1 The working calibration curve or calibration factor must be verified on each analytical sequence by the analysis of a standard (CCV) spiked at the mid-point of the calibration or below. The typical CCV spike level is listed in Table 8.11. The CCV must be injected at the start of each sequence, after every 10 samples or less (not including batch QC), and at the end of the analytical sequence. To verify that carryover is minimized, a CCB must be injected after each CCV.

11.8.7.2 The signal-to-noise ratio of the CCV must be greater than or equal to 3:1 for the quantitation and confirmation ions that exist and 10:1 for any analytes that do not have an appropriate ion transition confirmation.

11.8.7.3 The recovery of native and EIS compounds for the CCVs must be within 70-130% unless the analyte is not of concern for a given project. Native analytes that have greater than 130% recovery without detections for the analytes in the samples may be reported. Any deviations must be clearly qualified/narrated in final reports.

11.8.7.4 For all method analytes with exact corresponding isotopically labeled analogs, method analytes must elute within ±0.1 minutes of the associated EIS.

11.8.7.5 The retention times of each native and isotopically labeled compound must be within ±0.4 minutes of the ICAL or CCV used to establish the RT windows for the samples and batch QC.

11.8.8 Qualitative Identification Standard (QIS)

11.8.8.1 A qualitative identification standard containing all available isomers (branched and linear) that aren’t present in the calibration standards is analyzed after the initial calibration prior to the analysis of samples, and once daily at the beginning of the analytical sequence to confirm the retention time of each linear and known branched isomer or isomer group.

11.8.9 Bile salts interference check

11.8.9.1 Analyze the Bile Salt Standard after the initial calibration, prior to the analysis of samples to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA such that it falls outside the retention window for PFOS by at least one minute, and the initial calibration repeated.

11.8.10 Internal Standard Criteria

11.8.10.1 Compare the NIS peak areas from the QC and field samples to the average area of the corresponding NIS on the calibration standards to check for possible bad injections of NIS solution or loss of instrument sensitivity. NIS response in all QC and field samples must be 50-200% of the average response from the most recent calibration standards. If the areas are low for all of the samples and QC in the batch, it suggests a loss of instrument sensitivity, while low areas on only some QC or field samples suggests a possible bad injection. The chromatographic system must be inspected for malfunctions and corrective action identified, as required. When corrective action is taken, reanalysis of samples analyzed while the system was malfunctioning is required.

11.8.11 Sample Analysis

11.8.11.1 Analyze the samples using the chromatographic and MS conditions used for the calibration curve.

11.8.11.2 Evaluate the sample data and chromatograms. Determine if the analysis was acceptable from a chromatographic standpoint, based on typical responses, chromatographic resolution, baseline, and background.

11.8.11.3 Peak responses must be at least three times the background noise level (S/N 3:1) for both transitions for analytes that have a secondary transition. Analytes that do not have a suitable transition ratio (>20%) must have a S/N ratio of 10:1. This includes PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, and PFMBA. If the S/N ratio is not met due to high background noise, the laboratory must correct the issue (*e.g.*, perform instrument troubleshooting to check and if needed, perform maintenance). If the S/N ratio is not met but the background is low, then the analyte is to be considered a non-detect.

11.8.11.4 Target analyte, EIS analyte, and NIS analyte RTs must fall within ±0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial daily CCV, whichever was used to establish the RT window position for the analytical batch. The retention time window used must be of sufficient width to detect earlier-eluting branched isomers for analytes that have linear and branched isomers in the calibration standard or the QIS. For all method analytes with exact corresponding isotopically labeled analogs, method analytes must elute within ±0.1 minutes of the associated EIS. See the reference method EPA 1633A or LIMS for EIS/NIS recovery criteria. If any of the EIS recoveries fail the criteria listed, a dilution of the extract may be prepared and analyzed. Dilute an aliquot of the sample extract with the methanolic ammonium hydroxide and formic acid solution by the factor required to meet the conditions below. Adjust the amount of the NIS in the diluted extract, then analyze the diluted extract. The EIS recoveries in the diluted extract must be >5%. If EIS recoveries are <5%, a smaller aliquot of the original sample must be extracted and analyzed.

11.8.11.5 The laboratory must follow the identification requirements specified by the client for the project. In the event there are no project-specific requirements, the following general requirements apply. For concentrations at or above the method RL, the total (branched and linear isomer) quantification ion response to the total (branched and linear isomer) confirmation ion response ratio must fall within ±50% of the ratio observed in the mid-point initial calibration standard. If project-specific requirements involve reporting sample concentrations below the RL, the response ratio must fall within ±50% of the ratio observed in either the mid-point initial calibration standard or the initial CCV. The ion response ratio may be calculated as quantification ion response over qualification ion response, or as qualification ion response over quantification ion response, depending on limitations in software. The calculation used must remain consistent between the initial calibration and all associated QC and samples analyzed with that calibration to allow for direct comparison.

The response of all isomers in the quantitative standards should be used to define ratio. In samples, the total response should include only the branched isomer peaks that have been identified in either the quantitative (calibration) or qualitative (QIS) standard. If standards (either quantitative or qualitative) are not available for purchase, only the linear isomer can be identified and quantitated in samples. For analytes with low (less than 20%) relative abundances in their confirmation ions, the ratio requirement is not applicable.

11.8.11.6 If the field sample result does not all meet the criteria stated in Sections 11.9.11.4 and 11.9.11.5, in any potential sample preparation avenue (*e.g.*, extract dilution, lower initial weight/volume, etc.), the result may be reported with a data qualifier alerting the data user that the result did not meet the method-required criteria.

11.8.12 Sample dilutions for target analytes over the calibration range

11.8.12.1 If the concentration for any compound exceeds the calibration range of the system, dilute an aliquot of the sample extract with the methanolic ammonium hydroxide and formic acid solution by the factor required to meet the conditions below. Adjust the amount of the NIS in the diluted extract, then analyze the diluted extract. The responses for each EIS in the diluted extract must meet the S/N and retention time requirements, and the EIS recoveries from the analysis of the diluted extract must be greater than 5% recovery of the undiluted extract surrogate concentration. If these criteria are met, then the compounds associated with those EISs may be quantified using isotope dilution. Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit (i.e., if the EIS recovery of the affected analyte in the undiluted analysis is 50%, then the sample cannot be diluted more than 10:1; if the if the EIS recovery of the affected analyte in the undiluted analysis is 30%, then the sample cannot be diluted more than 6:1). Adjust the compound concentrations, detection limits, and minimum levels to account for the dilution.

11.8.12.2 If the EIS responses in the diluted extract do not meet those S/N and retention time requirements, then the compound cannot be measured reliably by isotope dilution in the diluted extract. In such cases, the laboratory must take a smaller aliquot of any affected aqueous sample, dilute it to 500mL with DI water and extract the diluted aqueous sample, or extract a smaller aliquot of soil/solid or biosolid sample. Adjust the compound concentrations, detection limits, and minimum levels to account for the dilution.

11.8.12.3 If the dilution level required to bring the native analyte abundance within the calibration would not meet the criteria specified in 11.10.12.1, then the laboratory must extract and analyze a diluted aqueous sample or a smaller aliquot of a solid sample.

11.8.12.4 Report recoveries of all associated EIS compounds for all field samples and QC standards. If a sample extract was diluted and analyzed, the native analytes required and the recovery of the associated EIS should be reported from the dilution (i.e., the native analytes and the EIS required to quantitate them should be reported from the same injection of the sample).

12) QA/QC Requirements

12.1 Initial Precision and Recovery Validation

12.1.1 The precision of the extraction procedure and the LC-MS/MS procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four control samples are spiked with the appropriate matrix spike solution, extracted, and analyzed according to this SOP and the laboratory’s Quality Assurance Manual section on Demonstrations of Capability.

12.2 Method Detection Limits and Limit of Detection

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the procedure outlined in the Definition and Procedure for the Determination of the Method Detection Limit, Revision 2 (EPA 2016). Follow the extraction and analysis procedures in this SOP to analyze the samples.

12.2.2 Calculate the average concentration found (x) in ng/L, and the standard deviation of the concentrations (s) in ng/L for each analyte. Calculate the MDL for each analyte. The MDL must be evaluated annually (or MDL repeated), with quarterly analyses as outlined in the the Definition and Procedure for the Determination of the Method Detection Limit, Revision 2 (EPA 2016).

12.3 Reporting Limit (RL)

12.3.1 The laboratory must establish a RL for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The RL recoveries should be within 50% of the true values to verify the data reporting limit.

12.4 Ongoing QC Samples required are described in the Quality Manual and throughout this SOP. Additional QC Samples may be required in project specific quality assurance plans (QAPP). The routine QC Samples are as follows:

12.4.1 Method Blank (MB) – an aliquot of DI water or matrix sand extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If any PFAS is found in the blank at 1) at a concentration greater than the RL for the analyte, 2) at a concentration greater than one-third the regulatory compliance limit, or 3) at a concentration greater than one-tenth the concentration in a sample in the extraction batch, whichever is greatest, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re- extraction and reanalysis.

12.4.2 Lab Control Samples (LCS and LCS_LL) – an aliquot of DI water or matrix sand into which all target analytes are spiked. The LCS is designed to monitor the extraction efficiency of the method, since it can be safely presumed that no matrix interferences are present in the sample as prepared. The concentration of the spike in the LCS matrix should be at the mid-level of the calibration curve and the LCS_LL at 2X the RL.

12.4.2.1 Lab control samples (LCS and LCS_LL) must be extracted and analyzed with every batch of 20 (or fewer) samples.

12.4.2.2 See LIMS for LCS/LL_LCS target/EIS/NIS acceptance criteria. Project-specific or program-specific acceptance criteria may supersede this criteria. If the lab control sample (LCS) fails acceptance limits for any of the compounds, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction of the correlated batch and reanalysis. Refer to the *Quality Manual* for guidance in evaluating recoveries that exceed LCS limits.

12.4.3 Matrix Spike (MS) and Matrix Spike Duplicate (MSD) – A matrix spike (MS) and duplicate matrix spike (MSD) may be extracted and analyzed with every batch of 20 (or fewer) samples if requested by a specific client. The MS/MSD is prepared by adding a known volume of the matrix spike solution to the sample and determining the spiked sample concentration. A matrix duplicate (DUP) is usually analyzed in place of an MSD for EPA 1633A.

Calculate percent recovery (%R) as:

$$\%R = \frac{X - X1}{TV} x\ 100$$

Where: X = Concentration of the analyte recovered
X1 = Concentration of the unspiked analyte
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1-R2|}{\frac{R1+R2}{2}} x\ 100$$

Where: R1= Higher result
R2= Lower result

12.4.3.1 Acceptance criteria for MS/MSD is the same as the LCS and can be found in LIMS. The RPD between the MS/MSD should be less than 30% for all native/EIS/NIS compounds. If the MS/MSD recovery is out of acceptance limits for reasons other than matrix effects, corrective action should be taken. Corrective action includes recalculation or reanalysis.

12.4.4 Matrix Duplicate (DUP) – A matrix duplicate (DUP) is typically prepared and extracted in place of a matrix spike duplicate (MSD) for this method. The DUP is extracted and analyzed exactly like the parent field sample. Precision is measured through Relative Percent Difference (RPD) between the DUP and parent field sample (see equation in MS/MSD section 12.4.3 above).

12.4.4.1 Acceptance criteria for RPD is the same as the MS/MSD can be found in LIMS. The RPD between the DUP and parent field sample should be less than 30% for all native/EIS/NIS compounds. If the RPD is out of acceptance limits for reasons other than matrix effects, corrective action should be taken. Corrective action includes recalculation or reanalysis.

12.4.5 Lab Control Sample Duplicate (LCSD) – an aliquot of DI water or matrix sand into which all target analytes are spiked. An LCSD can be prepared and extracted in place of a matrix spike (MS) and matrix spike duplicate (MSD)/matrix duplicate (DUP) when there is insufficient sample volume. Any type of matrix QC (MS, MSD/DUP) is preferable to an LCSD if sample volume is sufficient. The LCSD is designed to monitor the extraction efficiency and precision of the method, since it can be safely presumed that no matrix interferences are present in the sample as prepared. The concentration of the spike in the LCSD matrix should be identical to the LCS.

12.4.5.1 Acceptance criteria is the same as the LCS and can be found in LIMS. If the lab control sample duplicate (LCSD) fails acceptance limits for any of the compounds, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction of the correlated batch and reanalysis. Refer to the Quality Manual for guidance in evaluating recoveries that exceed LCS limits.

12.4.6 Non-Extracted Internal Standards (NIS)

12.4.6.1 QC Limits as published in EPA Method 1633A are listed in LIMS. Acceptance criteria are 50-200% of the average area detected in the most recent calibration standards.

12.4.7 Extracted Internal Standards/Surrogate Standards (EIS/SS)

12.4.7.1 The analyst should monitor the performance of the extraction and the analytical system as well as the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard and DI water blank with the appropriate extracted internal standards (EIS) mix. Extracted internal standards (EIS) spike is added to every sample, blank and spike prior to extraction.

Calculate percent recovery (%R) as:

%R = S/V x 100

Where: S = the concentration of EIS recovered
V = the concentration spiked

12.4.7.2 Acceptance limits as published in EPA Method 1633A are listed in LIMS. If extracted internal standards (EIS) recoveries are outside the acceptance limits for any reasons other than matrix effects, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis.

12.5 Prior to preparation of stock solutions, reagent checks should be run to determine possible interferences with analyte peaks. If the methanol or water blanks show contamination, a different batch should be used.

12.6 Control charts should be maintained for results of LCS and extracted internal standards (EIS) analyses. The charts should be reviewed periodically for trends in results. Control limits for QC analyses are determined using the control charts or similar mechanism on an annual basis.

13) Data Reduction and Reporting

13.1 MassHunter quantitation software generates the raw data used to calculate the standards RF_x values, the sample amounts, and the spike results. When the RF_x is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(RF_x)}$$

Where: C_{ex} = the concentration in the sample extract (ng/mL);
$Resp_x$ = the product ion peak area of the analytes of interest;
$Resp_{ISTD}$ = the product ion peak area of the associated labeled isotope
Amt_{ISTD} = the amount, in ng/mL, of internal standard added;
RF_x = the average response from the initial calibration.

13.2 The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples: $Concentration\left(\frac{ng}{L}\right) = \frac{(Cex)(Vf)}{(Vs)}$

Where: C_{ex} = Concentration in extract in ng/mL
V_f = Final volume of extract in mL

V_s = Volume of sample extracted, liters

Non-aqueous Samples: $Concentration\ (ng/g) = \frac{(Cex)(Vf)}{(W)}$

Where: C_{ex} = Concentration in extract in ng/mL
V_f = Final volume of extract in mL
W = Weight of sample extracted in grams. The wet or dry weight may be used, depending upon the specific client requirements.

13.3 Sample concentrations are reported when all QC criteria for the analysis has been met. Reported results not meeting QC criteria must be qualified with a standard data qualifier.

13.4 Data Review

13.4.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the Quality Manual for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.

13.5 Reporting

13.5.1 Reports are generated in LIMS by compiling the login, sample prep database, instrument data, and client-specified report requirements (when specified). The forms generated may be standard reports or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.5.2 Procedures for applying data qualifiers are described in the Quality Manual, or in project-specific requirements.

13.5.3 When clients request that various sulfonic acids be reported as sulfonates, the results must be converted by using the proper conversion applicable for each compound.

14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP, Corrective Actions and the Quality Manual for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alerted to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2 Handling out-of-control or unacceptable data

14.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.

14.2.2 Some examples when documentation of a nonconformity is required using a Corrective Action Report (CAR):

- Quality control results repeatedly outside acceptance limits for accuracy and precision.
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels repeatedly.
- Sample holding time missed due to laboratory error or operations

- Deviations from SOPs or project requirements.
- Laboratory analysis errors impacting sample or QC results.
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc).
- Sample preservation or handling discrepancies due to laboratory or operations error.

14.3 Appendix D summarizes the quality control criteria and applicable corrective action.

15) Method Performance

15.1 The accuracy and precision of this method were validated through multiple lab studies for aqueous samples and a single laboratory study for solid samples. Refer to EPA Method 1633A for additional method performance data available.

15.2 The method detection limit (MDL) is established using the procedure described in the Determination of the Method Detection Limit, Revision 2 (EPA 2016). Method Reporting Limits are established for this method based on the low calibration points and the MDL study results.

16) Pollution Prevention and Waste Management

16.1 It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

16.2 The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Chemical Hygiene Plan and Lab Waste Management Plan.

16.3 This method uses non-halogenated solvents. Waste solvents generated through the lab ware cleaning, sample prep, and LC mobile phase usage are collected in containers near the point of creation. They are then stored at a satellite storage center in the lab which is transferred as needed to the main facility waste management area. The waste solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

17) Training

17.1 Training outline

17.1.1 Review literature (see references section). Read and understand this SOP. Also review the applicable SDS for all reagents and standards used. Following the reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3 Perform initial demonstration of capability (IDC) study as described in this SOP. Four aliquots of DI water or matrix sand are spiked at the mid-range LCS level and extracted following the Procedure Section 11, along with one method blank per matrix type. Summaries of the IDCs are reviewed and signed by the supervisor. Copies must be stored with the employee's training file. For applicable tests, IDC studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.2 Training is documented following the Quality Manual.

17.3 When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18) Method Modifications

18.1 Mobile phase and instrument acquisition parameters have been optimized for specific instrumentation.

19) References

19.1 SW-846, Chapter One, Revision 1, July 1992.

19.2 Method 1633, Revision A Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, December 2024, U.S. Environmental Protection Agency Office of Water (4303T) Office of Science and Technology Engineering and Analysis Division b1200 Pennsylvania Avenue, NW Washington, DC 20460

19.3 Definition and Procedure for the Determination of the Method Detection Limit, Revision 2, December 2016, EPA Office of Water.

20) Changes Since the Last Revision

Revision Number	Effective Date	Document Editor	Description of Changes
1.0	06/27/2025	M. Onofrio	New SOP

21) Attachments, Tables, and Appendices

21.1 Appendix A – Analyte Acronyms, CAS Numbers, TNI Codes.

21.2 Appendix B – Acquisition Method

21.3 Appendix C – Analyte/Labeled Associations.

21.4 Appendix D – Summary of Corrective Actions.

21.5 Appendix E – Valid Analysis Sequence Example and Corrective Actions.

21.6 Appendix F – Concentrations of Analytes/EIS/NIS in Purchased Standards

21.7 Appendix G – Calculating Relative Standard Error (RSE)

21.8 Appendix H – “Promochrom” Automated Extraction System Parameters

Appendix A – Analyte Acronyms, CAS numbers, TNI Codes, and Reporting Limits

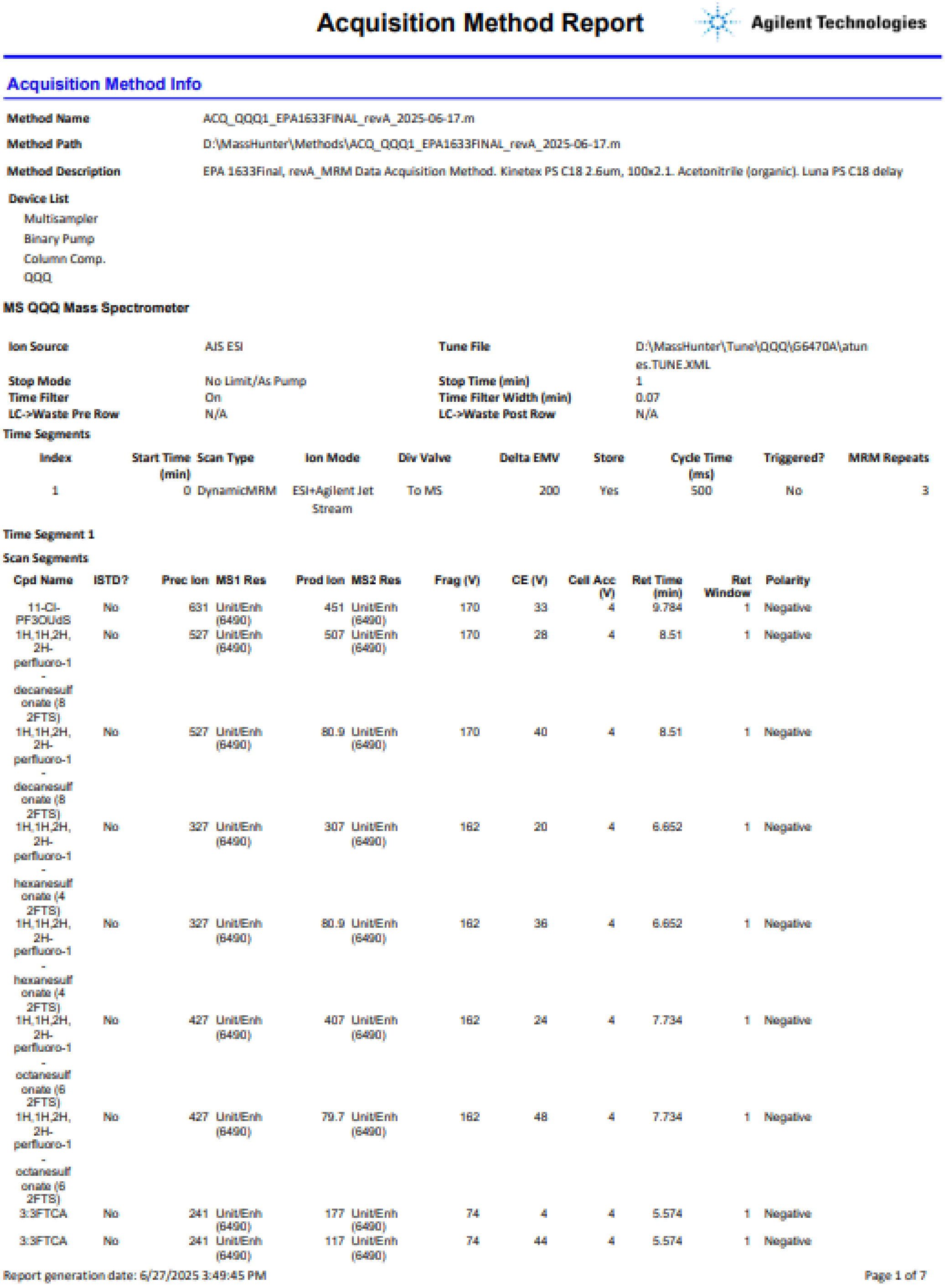
Acronym	Analyte	CAS #	TNI Code	Water Reporting Limit (ng/L)	Soil Reporting Limit (ng/kg)
Perfluoroalkyl Sulfonic Acids (PFSAs)					
PFBS	Perfluorobutane sulfonic acid	375-73-5	6918	1.77	0.177
PFPeS	Perfluoropentane sulfonic acid	2706-91-4	6934	1.88	0.188
PFHxS	Perfluorohexane sulfonic acid	355-46-4	6927	1.83	0.183
PFHpS	Perfluoroheptane sulfonic acid	375-92-8	9470	1.91	0.191
PFOS	Perfluorooctane sulfonic acid	1763-23-1	6931	1.86	0.186
PFNS	Perfluorononane sulfonic acid	68259-12-1	6929	1.92	0.192
PFDS*	Perfluorodecane sulfonic acid	335-77-3	6920	1.93	0.193
PFDoS*	Perfluorododecane sulfonic acid	79780-39-5	6923	1.94	0.194
Perfluoroalkyl Carboxylic Acids (PFCAs)					
PFBA	Perfluorobutanoic acid	375-22-4	6915	8	0.8
PFPeA	Perfluoropentanoic acid	2706-90-3	6914	4	0.4
PFHxA	Perfluorohexanoic acid	307-24-4	6913	2	0.2
PFHpA	Perfluoroheptanoic acid	375-85-9	6908	2	0.2
PFOA	Perfluorooctanoic acid	335-67-1	6912	2	0.2
PFNA	Perfluorononanoic acid	375-95-1	6906	2	0.2
PFDA	Perfluorodecanoic acid	335-76-2	6905	2	0.2
PFUnA	Perfluoroundecanoic acid	2058-94-8	6904	2	0.2
PFDoA	Perfluorododecanoic acid	307-55-1	6903	2	0.2
PFTrDA	Perfluorotridecanoic acid	72629-94-8	9563	2	0.2
PFTA	Perfluorotetradecanoic acid	376-06-7	6902	2	0.2
Perfluoroalkyl Sulfonamido Substances					
PFOSA	Perfluorooctane sulfonamide	754-91-6	6917	2	0.2
NMeFOSA	N-Methylperfluorooctane sulfonamide	31506-32-8	9433	2	0.2
NEtFOSA	N-Ethylperfluorooctane sulfonamide	4151-50-2	9395	2	0.2
MeFOSE	N-Methylperfluorooctane sulfonamido ethanol	24448-09-7	6949	20	2
EtFOSE	N-Ethylperfluorooctane sulfonamido ethanol	1691-99-2	9431	20	2
NMeFOSAA	N-Methylperfluorooctane sulfonamido acetic acid	2355-31-9	4847	2	0.2
NEtFOSAA	N-Ethylperfluorooctane sulfonamido acetic acid	2991-50-6	4846	2	0.2
n:2 Fluorotelomer Sulfonic Acids (n:2 FTSAs)					
4:2 FTS	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid	757124-72-4	6946	7.5	0.75
6:2 FTS	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid	27619-97-2	6947	7.6	0.76
8:2 FTS	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid	39108-34-4	6948	7.68	0.768
Perfluoroalkyl Ether Sulfonic Acids (PFESAs)					

Appendix A – Analyte Acronyms, CAS numbers, TNI Codes, and Reporting Limits

Acronym	Analyte	CAS #	TNI Code	Water Reporting Limit (ng/L)	Soil Reporting Limit (ng/kg)
9-Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	6952	7.48	0.748
11-Cl-PF3OudS*	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	9490	7.56	0.756
Perfluoroalkyl Ether Carboxylic Acids (PFECAs)					
HFPO-DA	Hexafluoropropyleneoxide dimer acid	13252-13-6	9460	8	0.8
ADONA	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	6951	7.56	0.756
PFMPA	Perfluoro-3-methoxypropanoic acid	377-73-1	6965	4	0.4
PFMBA	Perfluoro-4-methoxybutanoic acid	863090-89-5	6966	4	0.4
NFDHA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	6956	4	0.4
n:3 Fluorotelomer Carboxylic Acids (FTCAs)					
3:3 FTCA	4,4,5,5,6,6,6-Heptafluorohexanoic acid	356-02-5	9353	10	1
5:3 FTCA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	9338	50	5
7:3 FTCA	2H,2H,3H,3H-Perfluorodecanoic acid	812-70-4	9340	50	5
Perfluoroalkyl Ether Sulfonic Acids (PFESAs)					
PFEESA	Perfluoro(2-ethoxyethane) sulfonic acid	113507-82-7	6957	3.56	0.356

*These analytes may not perform as well as others in some matrices: PFDS, PFDoS, and 11-Cl-PF3OudS in aqueous samples; PFDoS and 11-Cl-PF3OudS in biosolid samples; and PFDoS in tissue samples.

Appendix B: Acquisition Method



Acquisition Method Report Agilent Technologies

Acquisition Method Info

Method Name	ACQ_QQQ1_EPA1633FINAL_revA_2025-06-17.m
Method Path	D:\MassHunter\Methods\ACQ_QQQ1_EPA1633FINAL_revA_2025-06-17.m
Method Description	EPA 1633Final, revA_MRM Data Acquisition Method. Kinetex PS C18 2.6um, 100x2.1. Acetonitrile (organic). Luna PS C18 delay

Device List

- Multisampler
- Binary Pump
- Column Comp.
- QQQ

MS QQQ Mass Spectrometer

Ion Source	AJS ESI	**Tune File**	D:\MassHunter\Tune\QQQ\G6470A\atunes.TUNE.XML
Stop Mode	No Limit/As Pump	**Stop Time (min)**	1
Time Filter	On	**Time Filter Width (min)**	0.07
LC->Waste Pre Row	N/A	**LC->Waste Post Row**	N/A

Time Segments

Index	Start Time (min)	Scan Type	Ion Mode	Div Valve	Delta EMV	Store	Cycle Time (ms)	Triggered?	MRM Repeats
1	0	DynamicMRM	ESI+Agilent Jet Stream	To MS	200	Yes	500	No	3

Time Segment 1

Scan Segments

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
11-Cl-PF3OUdS	No	631	Unit/Enh (6490)	451	Unit/Enh (6490)	170	33	4	9.784	1	Negative
1H,1H,2H,2H-perfluoro-1-decanesulfonate (8 2FTS)	No	527	Unit/Enh (6490)	507	Unit/Enh (6490)	170	28	4	8.51	1	Negative
1H,1H,2H,2H-perfluoro-1-decanesulfonate (8 2FTS)	No	527	Unit/Enh (6490)	80.9	Unit/Enh (6490)	170	40	4	8.51	1	Negative
1H,1H,2H,2H-perfluoro-1-hexanesulfonate (4 2FTS)	No	327	Unit/Enh (6490)	307	Unit/Enh (6490)	162	20	4	6.652	1	Negative
1H,1H,2H,2H-perfluoro-1-hexanesulfonate (4 2FTS)	No	327	Unit/Enh (6490)	80.9	Unit/Enh (6490)	162	36	4	6.652	1	Negative
1H,1H,2H,2H-perfluoro-1-octanesulfonate (6 2FTS)	No	427	Unit/Enh (6490)	407	Unit/Enh (6490)	162	24	4	7.734	1	Negative
1H,1H,2H,2H-perfluoro-1-octanesulfonate (6 2FTS)	No	427	Unit/Enh (6490)	79.7	Unit/Enh (6490)	162	48	4	7.734	1	Negative
3:3FTCA	No	241	Unit/Enh (6490)	177	Unit/Enh (6490)	74	4	4	5.574	1	Negative
3:3FTCA	No	241	Unit/Enh (6490)	117	Unit/Enh (6490)	74	44	4	5.574	1	Negative

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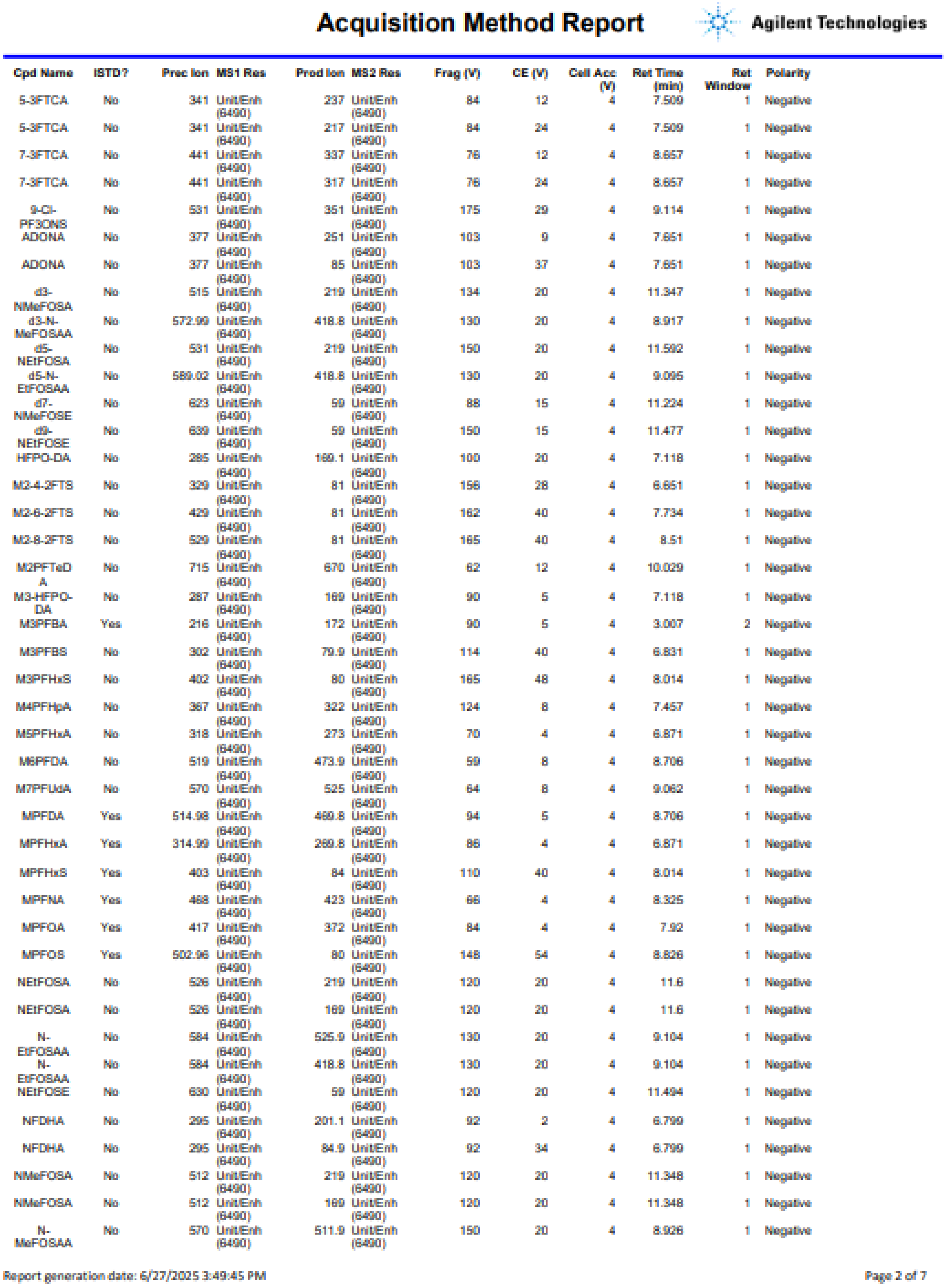

Acquisition Method Report

Agilent Technologies

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
5-3FTCA	No	341	Unit/Enh (6490)	237	Unit/Enh (6490)	84	12	4	7.509	1	Negative
5-3FTCA	No	341	Unit/Enh (6490)	217	Unit/Enh (6490)	84	24	4	7.509	1	Negative
7-3FTCA	No	441	Unit/Enh (6490)	337	Unit/Enh (6490)	76	12	4	8.657	1	Negative
7-3FTCA	No	441	Unit/Enh (6490)	317	Unit/Enh (6490)	76	24	4	8.657	1	Negative
9-Cl-PF3ONS	No	531	Unit/Enh (6490)	351	Unit/Enh (6490)	175	29	4	9.114	1	Negative
ADONA	No	377	Unit/Enh (6490)	251	Unit/Enh (6490)	103	9	4	7.651	1	Negative
ADONA	No	377	Unit/Enh (6490)	85	Unit/Enh (6490)	103	37	4	7.651	1	Negative
d3-NMeFOSA	No	515	Unit/Enh (6490)	219	Unit/Enh (6490)	134	20	4	11.347	1	Negative
d3-N-MeFOSAA	No	572.99	Unit/Enh (6490)	418.8	Unit/Enh (6490)	130	20	4	8.917	1	Negative
d5-NEtFOSA	No	531	Unit/Enh (6490)	219	Unit/Enh (6490)	150	20	4	11.592	1	Negative
d5-N-EtFOSAA	No	589.02	Unit/Enh (6490)	418.8	Unit/Enh (6490)	130	20	4	9.095	1	Negative
d7-NMeFOSE	No	623	Unit/Enh (6490)	59	Unit/Enh (6490)	88	15	4	11.224	1	Negative
d9-NEtFOSE	No	639	Unit/Enh (6490)	59	Unit/Enh (6490)	150	15	4	11.477	1	Negative
HFPO-DA	No	285	Unit/Enh (6490)	169.1	Unit/Enh (6490)	100	20	4	7.118	1	Negative
M2-4-2FTS	No	329	Unit/Enh (6490)	81	Unit/Enh (6490)	156	28	4	6.651	1	Negative
M2-6-2FTS	No	429	Unit/Enh (6490)	81	Unit/Enh (6490)	162	40	4	7.734	1	Negative
M2-8-2FTS	No	529	Unit/Enh (6490)	81	Unit/Enh (6490)	165	40	4	8.51	1	Negative
M2PFTeDA	No	715	Unit/Enh (6490)	670	Unit/Enh (6490)	62	12	4	10.029	1	Negative
M3-HFPO-DA	No	287	Unit/Enh (6490)	169	Unit/Enh (6490)	90	5	4	7.118	1	Negative
M3PFBA	Yes	216	Unit/Enh (6490)	172	Unit/Enh (6490)	90	5	4	3.007	2	Negative
M3PFBS	No	302	Unit/Enh (6490)	79.9	Unit/Enh (6490)	114	40	4	6.831	1	Negative
M3PFHxS	No	402	Unit/Enh (6490)	80	Unit/Enh (6490)	165	48	4	8.014	1	Negative
M4PFHpA	No	367	Unit/Enh (6490)	322	Unit/Enh (6490)	124	8	4	7.457	1	Negative
M5PFHxA	No	318	Unit/Enh (6490)	273	Unit/Enh (6490)	70	4	4	6.871	1	Negative
M6PFDA	No	519	Unit/Enh (6490)	473.9	Unit/Enh (6490)	59	8	4	8.706	1	Negative
M7PFUdA	No	570	Unit/Enh (6490)	525	Unit/Enh (6490)	64	8	4	9.062	1	Negative
MPFDA	Yes	514.98	Unit/Enh (6490)	469.8	Unit/Enh (6490)	94	5	4	8.706	1	Negative
MPFHxA	Yes	314.99	Unit/Enh (6490)	269.8	Unit/Enh (6490)	86	4	4	6.871	1	Negative
MPFHxS	Yes	403	Unit/Enh (6490)	84	Unit/Enh (6490)	110	40	4	8.014	1	Negative
MPFNA	Yes	468	Unit/Enh (6490)	423	Unit/Enh (6490)	66	4	4	8.325	1	Negative
MPFOA	Yes	417	Unit/Enh (6490)	372	Unit/Enh (6490)	84	4	4	7.92	1	Negative
MPFOS	Yes	502.96	Unit/Enh (6490)	80	Unit/Enh (6490)	148	54	4	8.826	1	Negative
NEtFOSA	No	526	Unit/Enh (6490)	219	Unit/Enh (6490)	120	20	4	11.6	1	Negative
NEtFOSA	No	526	Unit/Enh (6490)	169	Unit/Enh (6490)	120	20	4	11.6	1	Negative
N-EtFOSAA	No	584	Unit/Enh (6490)	525.9	Unit/Enh (6490)	130	20	4	9.104	1	Negative
N-EtFOSAA	No	584	Unit/Enh (6490)	418.8	Unit/Enh (6490)	130	20	4	9.104	1	Negative
NEtFOSE	No	630	Unit/Enh (6490)	59	Unit/Enh (6490)	120	20	4	11.494	1	Negative
NFDHA	No	295	Unit/Enh (6490)	201.1	Unit/Enh (6490)	92	2	4	6.799	1	Negative
NFDHA	No	295	Unit/Enh (6490)	84.9	Unit/Enh (6490)	92	34	4	6.799	1	Negative
NMeFOSA	No	512	Unit/Enh (6490)	219	Unit/Enh (6490)	120	20	4	11.348	1	Negative
NMeFOSA	No	512	Unit/Enh (6490)	169	Unit/Enh (6490)	120	20	4	11.348	1	Negative
N-MeFOSAA	No	570	Unit/Enh (6490)	511.9	Unit/Enh (6490)	150	20	4	8.926	1	Negative

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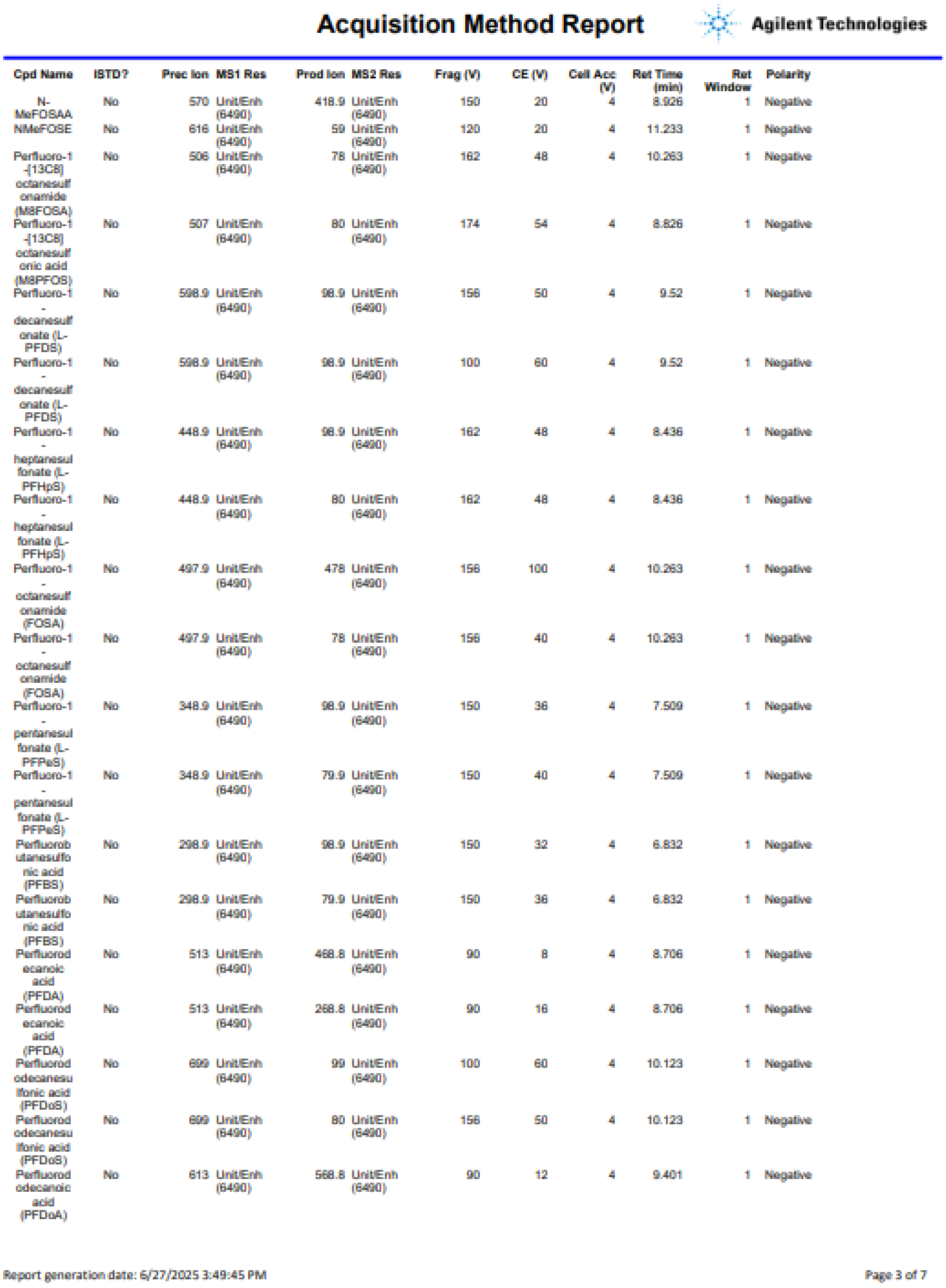

Acquisition Method Report

Agilent Technologies

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
N-MeFOSAA	No	570	Unit/Enh (6490)	418.9	Unit/Enh (6490)	150	20	4	8.926	1	Negative
NMeFOSE	No	616	Unit/Enh (6490)	59	Unit/Enh (6490)	120	20	4	11.233	1	Negative
Perfluoro-1-[13C8]octanesulfonamide (M8FOSA)	No	506	Unit/Enh (6490)	78	Unit/Enh (6490)	162	48	4	10.263	1	Negative
Perfluoro-1-[13C8]octanesulfonic acid (M8PFOS)	No	507	Unit/Enh (6490)	80	Unit/Enh (6490)	174	54	4	8.826	1	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	No	598.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	156	50	4	9.52	1	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	No	598.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	100	60	4	9.52	1	Negative
Perfluoro-1-heptanesulfonate (L-PFHpS)	No	448.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	162	48	4	8.436	1	Negative
Perfluoro-1-heptanesulfonate (L-PFHpS)	No	448.9	Unit/Enh (6490)	80	Unit/Enh (6490)	162	48	4	8.436	1	Negative
Perfluoro-1-octanesulfonamide (FOSA)	No	497.9	Unit/Enh (6490)	478	Unit/Enh (6490)	156	100	4	10.263	1	Negative
Perfluoro-1-octanesulfonamide (FOSA)	No	497.9	Unit/Enh (6490)	78	Unit/Enh (6490)	156	40	4	10.263	1	Negative
Perfluoro-1-pentanesulfonate (L-PFPeS)	No	348.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	150	36	4	7.509	1	Negative
Perfluoro-1-pentanesulfonate (L-PFPeS)	No	348.9	Unit/Enh (6490)	79.9	Unit/Enh (6490)	150	40	4	7.509	1	Negative
Perfluorobutanesulfonic acid (PFBS)	No	298.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	150	32	4	6.832	1	Negative
Perfluorobutanesulfonic acid (PFBS)	No	298.9	Unit/Enh (6490)	79.9	Unit/Enh (6490)	150	36	4	6.832	1	Negative
Perfluorodecanoic acid (PFDA)	No	513	Unit/Enh (6490)	468.8	Unit/Enh (6490)	90	8	4	8.706	1	Negative
Perfluorodecanoic acid (PFDA)	No	513	Unit/Enh (6490)	268.8	Unit/Enh (6490)	90	16	4	8.706	1	Negative
Perfluorododecanesulfonic acid (PFDoS)	No	699	Unit/Enh (6490)	99	Unit/Enh (6490)	100	60	4	10.123	1	Negative
Perfluorododecanesulfonic acid (PFDoS)	No	699	Unit/Enh (6490)	80	Unit/Enh (6490)	156	50	4	10.123	1	Negative
Perfluorododecanoic acid (PFDoA)	No	613	Unit/Enh (6490)	568.8	Unit/Enh (6490)	90	12	4	9.401	1	Negative

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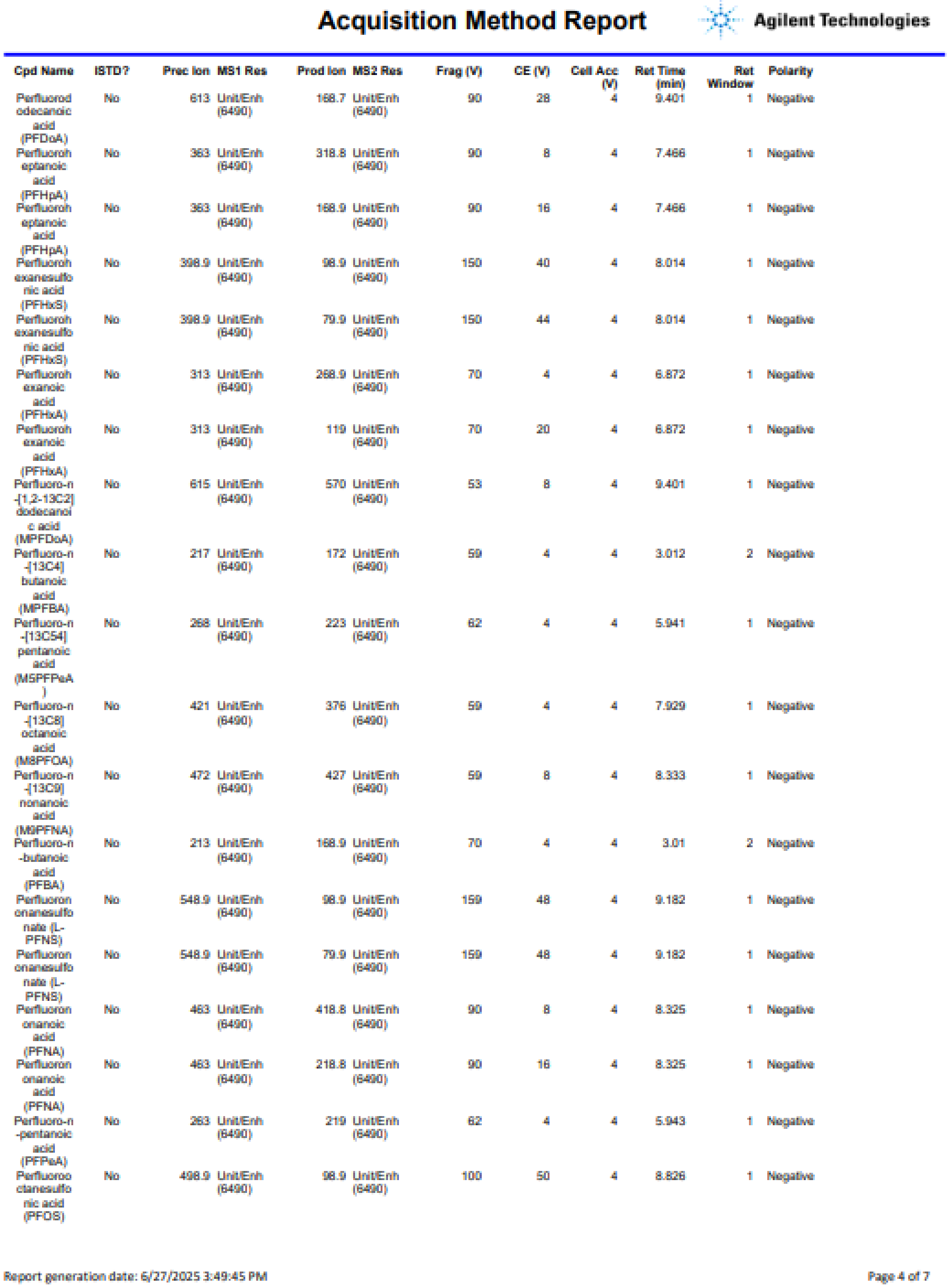

Acquisition Method Report

Agilent Technologies

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
Perfluorododecanoic acid (PFDoA)	No	613	Unit/Enh (6490)	168.7	Unit/Enh (6490)	90	28	4	9.401	1	Negative
Perfluoroheptanoic acid (PFHpA)	No	363	Unit/Enh (6490)	318.8	Unit/Enh (6490)	90	8	4	7.466	1	Negative
Perfluoroheptanoic acid (PFHpA)	No	363	Unit/Enh (6490)	168.9	Unit/Enh (6490)	90	16	4	7.466	1	Negative
Perfluorohexanesulfonic acid (PFHxS)	No	398.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	150	40	4	8.014	1	Negative
Perfluorohexanesulfonic acid (PFHxS)	No	398.9	Unit/Enh (6490)	79.9	Unit/Enh (6490)	150	44	4	8.014	1	Negative
Perfluorohexanoic acid (PFHxA)	No	313	Unit/Enh (6490)	268.9	Unit/Enh (6490)	70	4	4	6.872	1	Negative
Perfluorohexanoic acid (PFHxA)	No	313	Unit/Enh (6490)	119	Unit/Enh (6490)	70	20	4	6.872	1	Negative
Perfluoro-n-[1,2-13C2]dodecanoic acid (MPFDoA)	No	615	Unit/Enh (6490)	570	Unit/Enh (6490)	53	8	4	9.401	1	Negative
Perfluoro-n-[13C4]butanoic acid (MPFBA)	No	217	Unit/Enh (6490)	172	Unit/Enh (6490)	59	4	4	3.012	2	Negative
Perfluoro-n-[13C54]pentanoic acid (M5PFPeA)	No	268	Unit/Enh (6490)	223	Unit/Enh (6490)	62	4	4	5.941	1	Negative
Perfluoro-n-[13C8]octanoic acid (M8PFOA)	No	421	Unit/Enh (6490)	376	Unit/Enh (6490)	59	4	4	7.929	1	Negative
Perfluoro-n-[13C9]nonanoic acid (M9PFNA)	No	472	Unit/Enh (6490)	427	Unit/Enh (6490)	59	8	4	8.333	1	Negative
Perfluoro-n-butanoic acid (PFBA)	No	213	Unit/Enh (6490)	168.9	Unit/Enh (6490)	70	4	4	3.01	2	Negative
Perfluorononanesulfonate (L-PFNS)	No	548.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	159	48	4	9.182	1	Negative
Perfluorononanesulfonate (L-PFNS)	No	548.9	Unit/Enh (6490)	79.9	Unit/Enh (6490)	159	48	4	9.182	1	Negative
Perfluorononanoic acid (PFNA)	No	463	Unit/Enh (6490)	418.8	Unit/Enh (6490)	90	8	4	8.325	1	Negative
Perfluorononanoic acid (PFNA)	No	463	Unit/Enh (6490)	218.8	Unit/Enh (6490)	90	16	4	8.325	1	Negative
Perfluoro-n-pentanoic acid (PFPeA)	No	263	Unit/Enh (6490)	219	Unit/Enh (6490)	62	4	4	5.943	1	Negative
Perfluorooctanesulfonic acid (PFOS)	No	498.9	Unit/Enh (6490)	98.9	Unit/Enh (6490)	100	50	4	8.826	1	Negative

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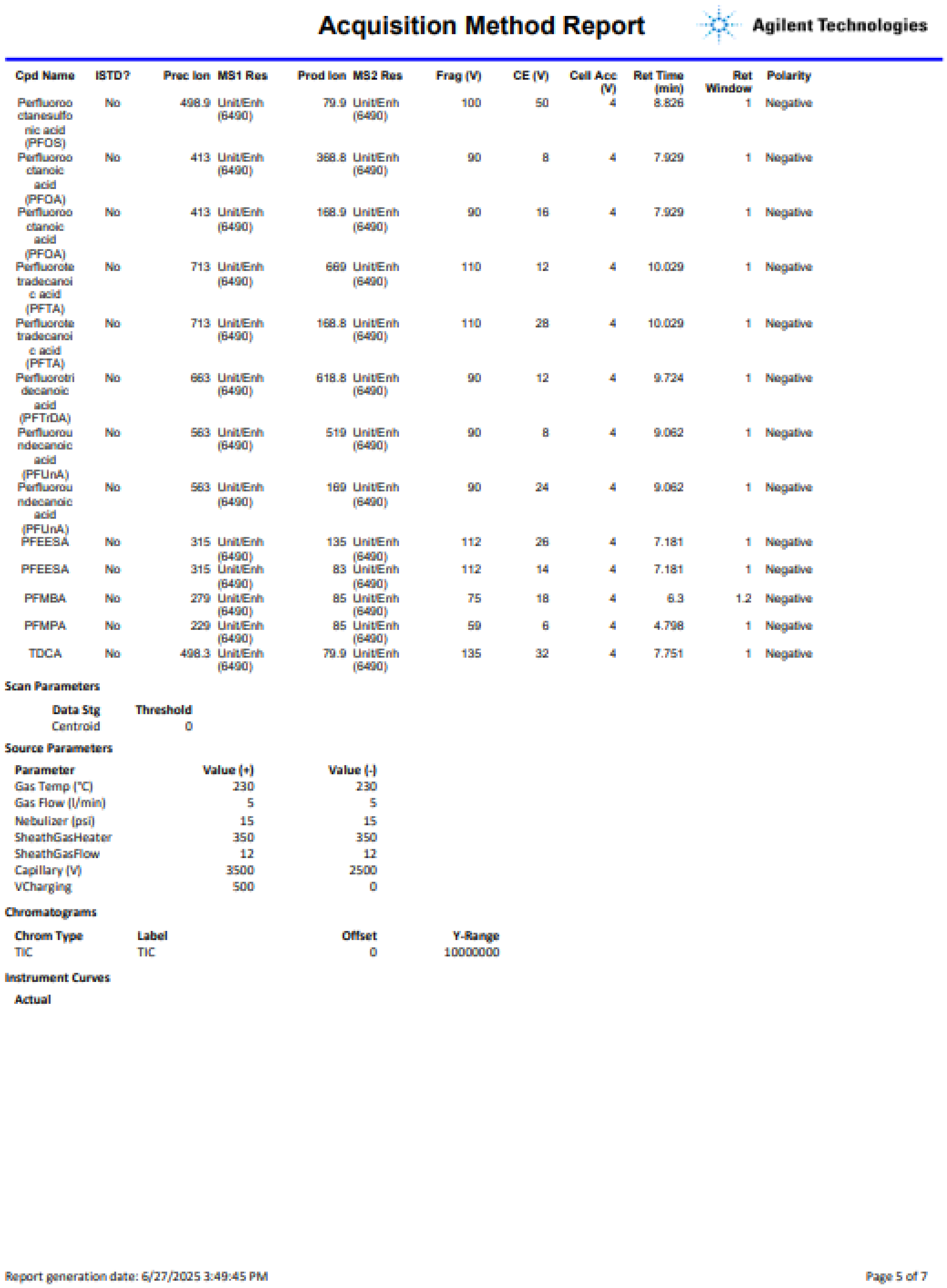

Acquisition Method Report

Agilent Technologies

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
Perfluorooctanesulfonic acid (PFOS)	No	498.9	Unit/Enh (6490)	79.9	Unit/Enh (6490)	100	50	4	8.826	1	Negative
Perfluorooctanoic acid (PFOA)	No	413	Unit/Enh (6490)	368.8	Unit/Enh (6490)	90	8	4	7.929	1	Negative
Perfluorooctanoic acid (PFOA)	No	413	Unit/Enh (6490)	168.9	Unit/Enh (6490)	90	16	4	7.929	1	Negative
Perfluorotetradecanoic acid (PFTA)	No	713	Unit/Enh (6490)	669	Unit/Enh (6490)	110	12	4	10.029	1	Negative
Perfluorotetradecanoic acid (PFTA)	No	713	Unit/Enh (6490)	168.8	Unit/Enh (6490)	110	28	4	10.029	1	Negative
Perfluorotridecanoic acid (PFTrDA)	No	663	Unit/Enh (6490)	618.8	Unit/Enh (6490)	90	12	4	9.724	1	Negative
Perfluoroundecanoic acid (PFUnA)	No	563	Unit/Enh (6490)	519	Unit/Enh (6490)	90	8	4	9.062	1	Negative
Perfluoroundecanoic acid (PFUnA)	No	563	Unit/Enh (6490)	169	Unit/Enh (6490)	90	24	4	9.062	1	Negative
PFEESA	No	315	Unit/Enh (6490)	135	Unit/Enh (6490)	112	26	4	7.181	1	Negative
PFEESA	No	315	Unit/Enh (6490)	83	Unit/Enh (6490)	112	14	4	7.181	1	Negative
PFMBA	No	279	Unit/Enh (6490)	85	Unit/Enh (6490)	75	18	4	6.3	1.2	Negative
PFMPA	No	229	Unit/Enh (6490)	85	Unit/Enh (6490)	59	6	4	4.798	1	Negative
TDCA	No	498.3	Unit/Enh (6490)	79.9	Unit/Enh (6490)	135	32	4	7.751	1	Negative

Scan Parameters

Data Stg	Threshold
Centroid	0

Source Parameters

Parameter	Value (+)	Value (-)
Gas Temp (°C)	230	230
Gas Flow (l/min)	5	5
Nebulizer (psi)	15	15
SheathGasHeater	350	350
SheathGasFlow	12	12
Capillary (V)	3500	2500
VCharging	500	0

Chromatograms

Chrom Type	Label	Offset	Y-Range
TIC	TIC	0	10000000

Instrument Curves

Actual

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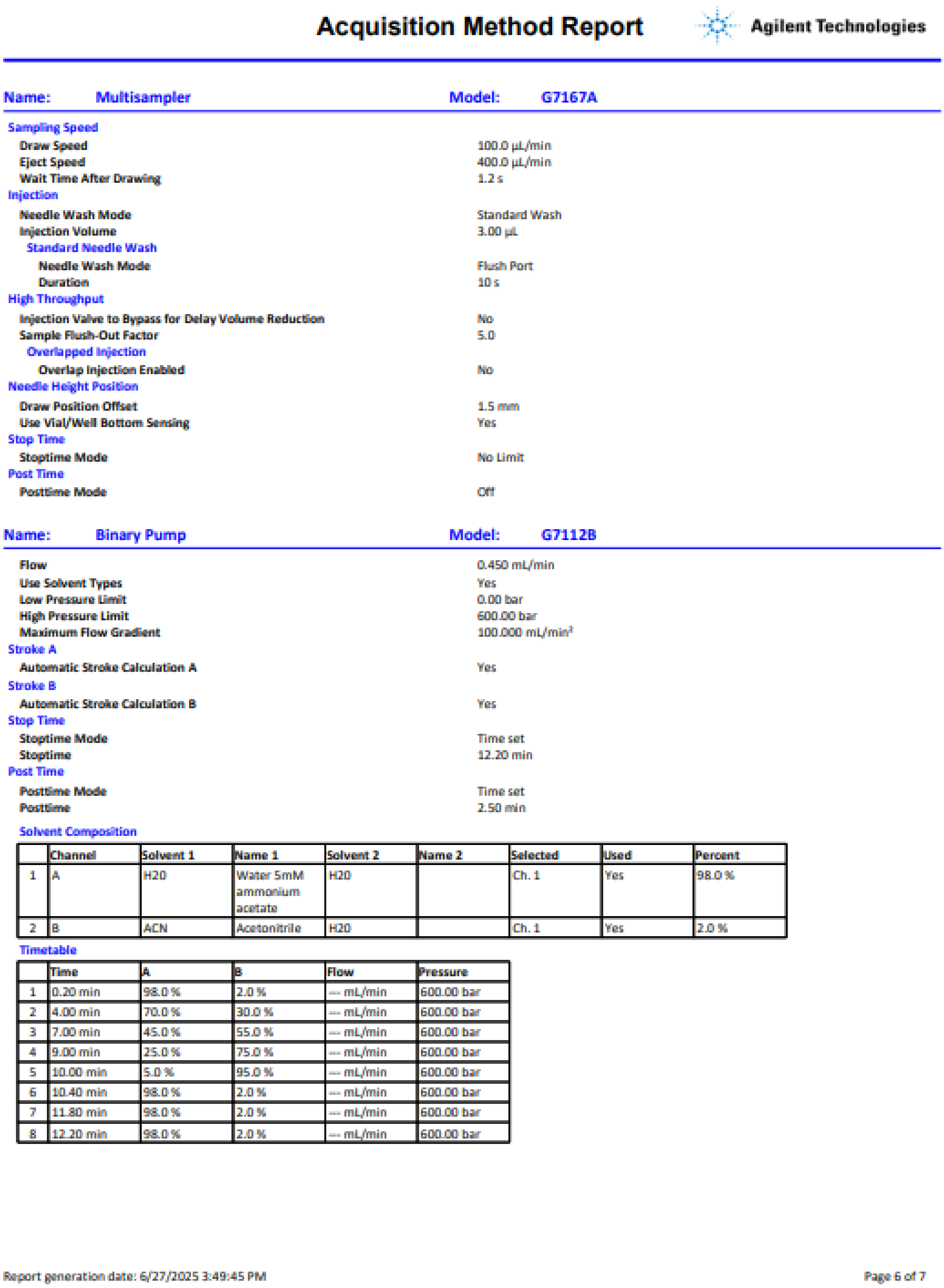

Acquisition Method Report

Name: **Multisampler** **Model:** **G7167A**

Sampling Speed	
Draw Speed	100.0 µL/min
Eject Speed	400.0 µL/min
Wait Time After Drawing	1.2 s
Injection	
Needle Wash Mode	Standard Wash
Injection Volume	3.00 µL
Standard Needle Wash	
Needle Wash Mode	Flush Port
Duration	10 s
High Throughput	
Injection Valve to Bypass for Delay Volume Reduction	No
Sample Flush-Out Factor	5.0
Overlapped Injection	
Overlap Injection Enabled	No
Needle Height Position	
Draw Position Offset	1.5 mm
Use Vial/Well Bottom Sensing	Yes
Stop Time	
Stoptime Mode	No Limit
Post Time	
Posttime Mode	Off

Name: **Binary Pump** **Model:** **G7112B**

Flow	0.450 mL/min
Use Solvent Types	Yes
Low Pressure Limit	0.00 bar
High Pressure Limit	600.00 bar
Maximum Flow Gradient	100.000 mL/min²
Stroke A	
Automatic Stroke Calculation A	Yes
Stroke B	
Automatic Stroke Calculation B	Yes
Stop Time	
Stoptime Mode	Time set
Stoptime	12.20 min
Post Time	
Posttime Mode	Time set
Posttime	2.50 min

Solvent Composition

	Channel	Solvent 1	Name 1	Solvent 2	Name 2	Selected	Used	Percent
1	A	H20	Water 5mM ammonium acetate	H20		Ch. 1	Yes	98.0 %
2	B	ACN	Acetonitrile	H20		Ch. 1	Yes	2.0 %

Timetable

	Time	A	B	Flow	Pressure
1	0.20 min	98.0 %	2.0 %	--- mL/min	600.00 bar
2	4.00 min	70.0 %	30.0 %	--- mL/min	600.00 bar
3	7.00 min	45.0 %	55.0 %	--- mL/min	600.00 bar
4	9.00 min	25.0 %	75.0 %	--- mL/min	600.00 bar
5	10.00 min	5.0 %	95.0 %	--- mL/min	600.00 bar
6	10.40 min	98.0 %	2.0 %	--- mL/min	600.00 bar
7	11.80 min	98.0 %	2.0 %	--- mL/min	600.00 bar
8	12.20 min	98.0 %	2.0 %	--- mL/min	600.00 bar

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Acquisition Method Report

Agilent Technologies

Name: Column Comp. **Model:** G7116A

Valve Position	Position 1 (Port 1 -> 1')
Position Switch After Run	Do not switch
Left Temperature Control	
Temperature Control Mode	Temperature Set
Temperature	40.0 °C
Enable Analysis Left Temperature	
Enable Analysis Left Temperature On	No
Right Temperature Control	
Right temperature Control Mode	Temperature Set
Right temperature	40.0 °C
Enable Analysis Right Temperature	
Enable Analysis Right Temperature On	No
Enforce column for run	
Enforce column for run enabled	No
Stop Time	
Stoptime Mode	As pump/injector
Post Time	
Posttime Mode	Off
Timetable	

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Appendix C - Analyte/EIS Internal Standard Associations

Analyte/EIS	**Internal Standard**
PFBA	^{13}C4-PFBA
PFPeA	^{13}C5-PFPeA
PFHxA	^{13}C5-PFHxA
PFHpA	^{13}C4-PFHpA
PFOA	^{13}C8-PFOA
PFNA	^{13}C9-PFNA
PFDA	^{13}C6-PFDA
PFUnA	^{13}C7-PFUnDA
PFDoA	^{13}C2-PFDoA
PFTrDA	^{13}C2-PFTeDA
PFTA	^{13}C2-PFTeDA
PFBS	^{13}C3-PFBS
PFPeS	^{13}C3-PFHxS
PFHxS	^{13}C3-PFHxS
PFHpS	^{13}C8-PFOS
PFOS	^{13}C8-PFOS
PFNS	^{13}C8-PFOS
PFDS	^{13}C8-PFOS
PFDoS	^{13}C8-PFOS
4:2 FTS	^{13}C2-4:2 FTS
6:2 FTS	^{13}C2-6:2 FTS
8:2 FTS	^{13}C2-8:2 FTS
PFOSA	^{13}C8-PFOSA
NMeFOSA	D3-NMeFOSA
NEtFOSA	D5-NEtFOSA
NMeFOSAA	D3-NMeFOSAA
NEtFOSAA	D5-NEtFOSAA
NMeFOSE	D7-NMeFOSE
NEtFOSE	D9-NEtFOSE
HFPO-DA	^{13}C3-HFPO-DA

Appendix C - Analyte/EIS Internal Standard Associations	
Analyte/EIS	**Internal Standard**
ADONA	^{13}C3-HFPO-DA
9-Cl-PF3ONS	^{13}C3-HFPO-DA
11-Cl-PF3OUDS	^{13}C3-HFPO-DA
3:3 FTCA	^{13}C5-PFPeA
5:3 FTCA	^{13}C5-PFHxA
7:3 FTCA	^{13}C5-PFHxA
PFEESA	^{13}C5-PFHxA
PFMPA	^{13}C5-PFPeA
PFMBA	^{13}C5-PFPeA
NFDHA	^{13}C5-PFHxA
^{13}C4-PFBA	^{13}C3-PFBA
^{13}C5-PFPeA	^{13}C2-PFHxA
^{13}C5-PFHxA	^{13}C2-PFHxA
^{13}C4-PFHpA	^{13}C2-PFHxA
^{13}C8-PFOA	^{13}C4-PFOA
^{13}C9-PFNA	^{13}C5-PFNA
^{13}C6-PFDA	^{13}C2-PFDA
^{13}C7-PFUnDA	^{13}C2-PFDA
^{13}C2-PFDoA	^{13}C2-PFDA
^{13}C2-PFTeDA	^{13}C2-PFDA
^{13}C3-PFBS	^{18}O2-PFHxS
^{13}C3-PFHxS	^{18}O2-PFHxS
^{13}C8-PFOS	^{13}C4-PFOS
^{13}C2-4:2 FTS	^{18}O2-PFHxS
^{13}C2-6:2 FTS	^{18}O2-PFHxS
^{13}C2-8:2 FTS	^{18}O2-PFHxS
^{13}C8-PFOSA	^{13}C4-PFOS
D3-NMeFOSA	^{13}C4-PFOS
D5-NEtFOSA	^{13}C4-PFOS
D3-NMeFOSAA	^{13}C4-PFOS
D5-NEtFOSAA	^{13}C4-PFOS

Appendix C - Analyte/EIS Internal Standard Associations	
Analyte/EIS	**Internal Standard**
D7-NMeFOSE	^{13}C4-PFOS
D9-NEtFOSE	^{13}C4-PFOS
^{13}C3-HFPO-DA	^{13}C2-PFHxA

Appendix D – Corrective Action Summary

EPA 1633A Ref. Method Section	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
Section 10.0	Mass Calibration	Annually and on as-needed basis	Manufacturer-specific instructions and acceptance criteria	Instrument maintenance may be required. Trouble shoot and repeat Mass Calibration.
Section 10.1.7	Mass Calibration Verification	After mass calibration	Manufacturer-specific acceptance criteria	Repeat Mass Calibration
Section 10.3	Initial Calibration (ICAL)	Prior to sample analysis. At least 6 levels, 5 must be within the quantification range. (7 calibration standards for non-linear models.)	% RSD ≤ 20 or % RSE ≤ 20	Correct problem then repeat ICAL
Section 10.3	ICV	After ICAL	± 30% Diff	Correct problem and verify second source standard; rerun second source verification for failed analyte(s). If fails, correct problem and repeat initial calibration.
Sections 7.3.1 & 9.4	Extracted Internal Standard (EIS)	Added to all CAL standards, batch QC and field samples	See Tables 6 (aqueous) and 7 (solids)	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis.
Section 7.3.2	Non- extracted Internal Standards (NIS)	Added to all CAL standards, batch QC and field samples	RTs: ± 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial daily CCV. All field samples and QC samples recoveries must be 50-200% of the daily opening CCV. For DOD, Areas: >30% of the average area of the calibration standards.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis.

Appendix D – Corrective Action Summary

EPA 1633A Ref. Method Section	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
Sections 7.3.4, 10.3.1, & 13.3	Instrument Sensitivity Check (ISC)	Daily, prior to analysis	All analyte concentrations must be within ±30% of their true values. Signal-to-noise ratio of the ISC must be ≥3:1 for analytes with secondary transitions and ≥10:1 for analytes without secondary transitions.	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
Section 14.3	Continuing Calibration Verification (CCV)	At the beginning and every 10 samples	±30% Diff	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
Sections 9.13, 9.5, & 14.7	Method Blank (MB)	One per preparation batch (maximum of 20 field samples)	No targets at concentration greater than the higher of: 1) The ML of each analyte. -or- 2) 1/3 the regulatory compliance limit. -or- 3) 1/10 the concentration in the sample.	Determine source on background: If instrumental reanalyze all affected samples using a fresh aliquot of each extract. If traced to extraction batch samples affected by the blank must be re-extracted and analyzed.
Section 14.5	Laboratory Control Sample (LCS)/ Ongoing Precision Recovery (OPR)	One per preparation batch (maximum of 20 field samples)	For all sample matrices, see LIMS for criteria.	Re-analyze to confirm failures and re-extract associated batch if failures persist.
Section 11.0	Limit of Quantitation Verification (LLOPR)/(LCS_LL)	One per preparation batch (maximum of 20 field samples)	For all sample matrices, see LIMS for criteria.	Re-analyze to confirm failures and re-extract associated batch if failures persist.
Sections 9.9 & 11.0	Matrix Spike (MS)	One per preparation batch (maximum of 20 field samples)	For all sample matrices, see LIMS for criteria.	Evaluate data to determine if the there is a matrix effect or analytical error

Appendix D – Corrective Action Summary

EPA 1633A Ref. Method Section	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
Sections 9.9 & 11.0	Matrix Spike Duplicate (MSD)	One per preparation batch (maximum of 20 field samples)	For all sample matrices, see LIMS for criteria.	Evaluate data to determine if there is a matrix effect or analytical error

Note: all section references refer to sections in the EPA 1633A Reference Method, not this SOP.

Appendix E - Valid Analysis Sequence Example and Corrective Actions

Injection #	Control	Acceptance Criteria	Corrective Action
1	Instrument Blank/Continuing Calibration Blank (IB/CCB)	Concentration of each analyte must be < MDL	Correct problem and reanalyze all affected samples using a fresh aliquot of each extract.
2	Instrument Sensitivity Check (ISC)	Signal-to-noise ratio of the ISC must be ≤ 3:1 for analytes with secondary transitions and ≤ 10:1 for analytes without secondary transitions. All analyte concentrations must be within ± 30% of their true values	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
3	Continuing Calibration Verification (CCV)	± 30% Diff	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
4	Qualitative Identification Standards (QIS)	Confirmed acquisition and RT of known branched isomers.	Reset scan windows and reanalyze sequence.
5	Instrument Blank/Continuing Calibration Blank (IB/CCB)	Concentration of each analyte must be < MDL	Correct problem and reanalyze all affected samples using a fresh aliquot of each extract.
6	Method Blank (MB)	No targets at concentration greater than the higher of: 1. The PQL of each analyte. -or- 2. 1/3 the regulatory compliance limit. -or- 3. 1/10 the concentration in the sample.	Determine source on background: If instrumental, reanalyze all affected samples using a fresh aliquot of each extract If traced to extraction batch, samples affected by the blank must be re-extracted and analyzed
7	Low-level Laboratory Control Sample (LCS_LL)	For all sample matrices, see LIMS for criteria.	Correct the problem, re-prepare, extract, and clean up the sample batch and repeat the ongoing precision and recovery test.

Appendix E - Valid Analysis Sequence Example and Corrective Actions			
Injection #	**Control**	**Acceptance Criteria**	**Corrective Action**
8	Laboratory Control Sample (LCS)	For all sample matrices, see LIMS for criteria.	Correct the problem, re-prepare, extract, and clean up the sample batch and repeat the ongoing precision and recovery test.
9	Bile Salts Standard (BSS)	Verify TDCA does not coelute with any of the target analytes, EIS, or NIS standards. Analytical conditions must be set to allow a separation of at least 1 minute between the bile salts and PFOS.	Adjust chromatographic conditions and perform Initial Demonstration of Capability.
10-11	Matrix Spike/Matrix Spike Duplicate or Sample Duplicate (MS/MSD or MS/DUP) (Optional)	For all sample matrices, see LIMS for criteria.	Evaluate data to determine if there is a matrix effect or analytical error
12-22	Field Samples (10 or fewer)	For all sample matrices, see LIMS for criteria.	Evaluate data to determine if the there is a matrix effect or analytical error.
23	Continuing Calibration Verification (CCV)	± 30% Diff	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
24	Instrument Blank/Continuing Calibration Blank (IB/CCB)	Concentration of each analyte must be < MDL.	Correct problem and reanalyze all affected samples using a fresh aliquot of each extract.
25-35	Field Samples (10 or fewer)	For all sample matrices, see LIMS for criteria.	Evaluate data to determine if the there is a matrix effect or analytical error

Appendix E - Valid Analysis Sequence Example and Corrective Actions			
Injection #	**Control**	**Acceptance Criteria**	**Corrective Action**
36	Continuing Calibration Verification (CCV)	± 30% Diff	Perform instrument maintenance and/or recalibrate to correct the problem. Reanalyze all affected samples using a fresh aliquot of each extract.
37	Instrument Blank/Continuing Calibration Blank (IB/CCB)	Concentration of each analyte must be < MDL	Correct problem and reanalyze all affected samples using a fresh aliquot of each extract.

Appendix F – Concentrations of Analytes/EIS/NIS in Purchased Standards

Vendor/Catalog Number	Analyte/EIS/NIS Name	Concentration as Acids (ng/mL)
Wellington PFAC-MXH	PFBA - Perfluorobutanoic acid	4000
Wellington PFAC-MXH	PFPeA - Perfluoropentanoic acid	2000
Wellington PFAC-MXH	PFHxA - Perfluorohexanoic acid	1000
Wellington PFAC-MXH	PFHpA - Perfluoroheptanoic acid	1000
Wellington PFAC-MXH	PFOA - Perfluorooctanoic acid	1000
Wellington PFAC-MXH	PFNA - Perfluorononanoic acid	1000
Wellington PFAC-MXH	PFDA - Perfluorodecanoic acid	1000
Wellington PFAC-MXH	PFUnA - Perfluoroundecanoic acid	1000
Wellington PFAC-MXH	PFDoA - Perfluorododecanoic acid	1000
Wellington PFAC-MXH	PFTrDA - Perfluorotridecanoic acid	1000
Wellington PFAC-MXH	PFTA - Perfluorotetradecanoic acid	1000
Wellington PFAC-MXH	PFBS - Perfluorobutane sulfonic acid	887
Wellington PFAC-MXH	PFPeS - Perfluoropentane sulfonic acid	941
Wellington PFAC-MXH	PFHxS - Perfluorohexane sulfonic acid (linear/branched)	914
Wellington PFAC-MXH	PFHpS - Perfluoroheptane sulfonic acid	953
Wellington PFAC-MXH	PFOS - Perfluorooctane sulfonic acid (linear/branched)	928
Wellington PFAC-MXH	PFNS - Perfluorononane sulfonic acid	962
Wellington PFAC-MXH	PFDS - Perfluorodecane sulfonic acid	965
Wellington PFAC-MXH	4:2 FTS - 4:2 Fluorotelomer sulfonic acid	3750
Wellington PFAC-MXH	6:2 FTS - 6:2 Fluorotelomer sulfonic acid	3800
Wellington PFAC-MXH	8:2 FTS - 8:2 Fluorotelomer sulfonic acid	3840
Wellington PFAC-MXH	FOSA - Perfluorooctane sulfonamide	1000
Wellington PFAC-MXH	N-MeFOSAA - N-Methyl perfluorooctane sulfonamidoacetic acid (linear/branched)	1000
Wellington PFAC-MXH	N-EtFOSAA - N-Ethylperfluorooctane sulfonamidoacetic acid (linear/branched)	1000
Wellington PFAC-MXF	HFPO-DA (GenX) - Hexafluoropropylene oxide dimer acid	2000
Wellington PFAC-MXF	ADONA - 4,8-Dioxa-3H-perfluorononanoic acid	1890
Wellington PFAC-MXF	9Cl-PF3ONS - 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	1870
Wellington PFAC-MXF	11Cl-PF3OUnDS - 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	1890
Wellington PFAC-MXG	PFEESA - Perfluoro(2-ethoxyethane)sulfonic acid	1780
Wellington PFAC-MXG	PFMPA - Perfluoro-3-methoxypropanoic acid	2000
Wellington PFAC-MXG	PFMBA - Perfluoro-4-methoxybutanoic acid	2000
Wellington PFAC-MXJ	3:3 FTCA - 2H,2H,3H,3H-Perfluorohexanoic acid	4000
Wellington PFAC-MXJ	5:3 FTCA - 2H,2H,3H,3H-Perfluorooctanoic acid	20000
Wellington PFAC-MXJ	7:3 FTCA - 2H,2H,3H,3H-Perfluorodecanoic acid	20000
Wellington PFAC-MXH	PFDoS - Perfluoro-1-dodecanesulfonic acid	970
Wellington PFAC-MXI	N-MeFOSA - N-methylperfluoro-1-octanesulfonamide	1000
Wellington PFAC-MXI	N-EtFOSA - N-ethylperfluoro-1-octanesulfonamide	1000
Wellington PFAC-MXI	N-MeFOSE - 2-(N-methylperfluoro-1-octanesulfonamide)-ethanol	10000
Wellington PFAC-MXI	N-EtFOSE - 2-(N-ethylperfluoro-1-octanesulfonamide)-ethanol	10000
Wellington PFAC-MXG	NFDHA - Nonafluoro-3,6-dioxaheptanoic acid	2000
Absolute 65735	PFBA - Perfluorobutanoic acid	2000
Absolute 65735	PFPeA - Perfluoropentanoic acid	2000
Absolute 65735	PFHxA - Perfluorohexanoic acid	2000
Absolute 65735	PFHpA - Perfluoroheptanoic acid	2000
Absolute 65735	PFOA - Perfluorooctanoic acid	2000
Absolute 65735	PFNA - Perfluorononanoic acid	2000
Absolute 65735	PFDA - Perfluorodecanoic acid	2000

Appendix F – Concentrations of Analytes/EIS/NIS in Purchased Standards

Vendor/Catalog Number	Analyte/EIS/NIS Name	Concentration as Acids (ng/mL)
Absolute 65735	PFUnA - Perfluoroundecanoic acid	2000
Absolute 65735	PFDoA - Perfluorododecanoic acid	2000
Absolute 65735	PFTrDA - Perfluorotridecanoic acid	2000
Absolute 65735	PFTA - Perfluorotetradecanoic acid	2000
Absolute 65735	PFBS - Perfluorobutane sulfonic acid	2000
Absolute 65735	PFPeS - Perfluoropentane sulfonic acid	2000
Absolute 65735	PFHxS - Perfluorohexane sulfonic acid (linear/branched)	2000
Absolute 65735	PFHpS - Perfluoroheptane sulfonic acid	2000
Absolute 65735	PFOS - Perfluorooctane sulfonic acid (linear/branched)	2000
Absolute 65735	PFNS - Perfluorononane sulfonic acid	2000
Absolute 65735	PFDS - Perfluorodecane sulfonic acid	2000
Absolute 65735	4:2 FTS - 4:2 Fluorotelomer sulfonic acid	2000
Absolute 65735	6:2 FTS - 6:2 Fluorotelomer sulfonic acid	2000
Absolute 65735	8:2 FTS - 8:2 Fluorotelomer sulfonic acid	2000
Absolute 65735	FOSA - Perfluorooctane sulfonamide	2000
Absolute 65735	N-MeFOSAA - N-Methyl perfluorooctane sulfonamidoacetic acid (linear/branched)	2000
Absolute 65735	N-EtFOSAA - N-Ethylperfluorooctane sulfonamidoacetic acid (linear/branched)	2000
Absolute 65735	HFPO-DA (GenX) - Hexafluoropropylene oxide dimer acid	2000
Absolute 65735	ADONA - 4,8-Dioxa-3H-perfluorononanoic acid	2000
Absolute 65735	9Cl-PF3ONS - 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	2000
Absolute 65735	11Cl-PF3OUnDS - 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	2000
Absolute 65735	PFEESA - Perfluoro(2-ethoxyethane)sulfonic acid	2000
Absolute 65735	PFMPA - Perfluoro-3-methoxypropanoic acid	2000
Absolute 65735	PFMBA - Perfluoro-4-methoxybutanoic acid	2000
Absolute 65735	3:3 FTCA - 2H,2H,3H,3H-Perfluorohexanoic acid	2000
Absolute 65735	5:3 FTCA - 2H,2H,3H,3H-Perfluorooctanoic acid	2000
Absolute 65735	7:3 FTCA - 2H,2H,3H,3H-Perfluorodecanoic acid	2000
Absolute 65735	PFDoS - Perfluoro-1-dodecanesulfonic acid	2000
Absolute 65735	N-MeFOSA - N-methylperfluoro-1-octanesulfonamide	2000
Absolute 65735	N-EtFOSA - N-ethylperfluoro-1-octanesulfonamide	2000
Absolute 65735	N-MeFOSE - 2-(N-methylperfluoro-1-octanesulfonamide)-ethanol	2000
Absolute 65735	N-EtFOSE - 2-(N-ethylperfluoro-1-octanesulfonamide)-ethanol	2000
Absolute 65735	NFDHA - Nonafluoro-3,6-dioxaheptanoic acid	2000
MPFAC-HIF-ES	13C4-PFBA	2000
MPFAC-HIF-ES	13C5-PFPeA	1000
MPFAC-HIF-ES	13C5-PFHxA	500
MPFAC-HIF-ES	13C4-PFHpA	500
MPFAC-HIF-ES	13C8-PFOA	500
MPFAC-HIF-ES	13C9-PFNA	250
MPFAC-HIF-ES	13C6-PFDA	250
MPFAC-HIF-ES	13C7-PFUnDA	250
MPFAC-HIF-ES	13C2-PFDoA	250
MPFAC-HIF-ES	13C2-PFTeDA	250
MPFAC-HIF-ES	13C3-PFBS	466
MPFAC-HIF-ES	13C3-PFHxS	474
MPFAC-HIF-ES	13C8-PFOS	479
MPFAC-HIF-ES	13C2-4:2 FTS	938
MPFAC-HIF-ES	13C2-6:2 FTS	951

Appendix F – Concentrations of Analytes/EIS/NIS in Purchased Standards

Vendor/Catalog Number	Analyte/EIS/NIS Name	Concentration as Acids (ng/mL)
MPFAC-HIF-ES	13C2-8:2 FTS	960
MPFAC-HIF-ES	13C8-PFOSA	500
MPFAC-HIF-ES	D3-NMeFOSA	500
MPFAC-HIF-ES	D5-NEtFOSA	500
MPFAC-HIF-ES	D3-NMeFOSAA	1000
MPFAC-HIF-ES	D5-NEtFOSAA	1000
MPFAC-HIF-ES	D7-NMeFOSE	5000
MPFAC-HIF-ES	D9-NEtFOSE	5000
MPFAC-HIF-ES	13C3-HFPO-DA	2000
MPFAC-HIF-IS	13C3-PFBA	1000
MPFAC-HIF-IS	13C2-PFHxA	500
MPFAC-HIF-IS	13C4-PFOA	500
MPFAC-HIF-IS	13C5-PFNA	250
MPFAC-HIF-IS	13C2-PFDA	250
MPFAC-HIF-IS	18O2-PFHxS	474
MPFAC-HIF-IS	13C4-PFOS	479

Appendix G
Calculating Relative Standard Error (RSE)

https://nelac-institute.org/docs/comm/emmec/Calculating%20RSE.pdf

Calculating Relative Standard Error (RSE)

April 6, 2017

To calculate RSE you need to know:

1. The true concentration of each calibration standard. This is x_i
2. The measured concentration of each calibration standard. This is x'_i
3. The number of standard levels in the curve. This is n
4. The type of curve (average, linear or quadratic) the type of curve determines the value of p. For an average curve, p=1, for linear p=2 and quadratic p=3

1. Calculate the measured result –the true concentration / the true concentration for each level, then square the results.
$$\left[\frac{x'_i - x_i}{x_i}\right]^2$$
2. Divide each value determined in (1.) by n-p. For example if there are 5 calibration levels and the curve type is linear, 5=2 = 3 so divide each value by 3.
$$\frac{\left[\frac{x'_i - x_i}{x_i}\right]^2}{n-p}$$
3. Add all the values determined in (2.) together
$$\sum_{i=1}^{n}\frac{\left[\frac{x'_i - x_i}{x_i}\right]^2}{n-p}$$
4. Take the square root of the value determined in (3.)
$$\sqrt{\sum_{i=1}^{n}\frac{\left[\frac{x'_i - x_i}{x_i}\right]^2}{n-p}}$$
5. Multiply the result obtained in (4.) by 100% to obtain the RSE.
$$\%RSE = 100\times\sqrt{\sum_{i=1}^{n}\frac{\left[\frac{x'_i - x_i}{x_i}\right]^2}{n-p}}$$

<u>Notes</u>

Units do not matter so long as all of the calibration levels and results are in the same units

Weighting does not matter (the value of p for a linear curve is 2 whether weighted or not)

Appendix H
PromoChrom Automated Extraction System Parameters

Solvent 1: Methanol
Solvent 2: DI water
Solvent 3: 0.3 M Formic Acid in Water
Solvent 4: 1:1 0.1 M Formic Acid:Methanol
Solvent 5: 1% NH4OH in Methanol

"Clean System" (Prior to Sample Extraction and Following Sample Extraction/Elution):

Action	Inlet 1	Inlet 2 (ratio)	Flow	Volume
Clean	Solvent 1	Air (20%)	30	5.0
Add Samp W2	Sample	-	10	4.5
Clean	Solvent 2	Air (20%)	30	5.0
Add Samp W2	Sample	-	10	4.5
Clean	Solvent 1	Air (20%)	30	5.0
Add Samp W2	Sample	-	10	5.0
Add Samp W2	Sample	-	10	9.0

Note: This procedure may be updated as needed to reduce carryover and particulate matter clogging by adding additional Clean/Add Samp W2 steps within the procedure.

Conditioning/Sample Loading/Elution (Upside-Down Loading):

Action	Inlet 1	Inlet 2 (ratio)	Flow	Volume
Elute W2	Solvent 5	-	8	15.0
Elute W1	Solvent 3	-	8	5.0
Add Samp W1	Sample	-	5	285
Rinse	Solvent 2	Air (20%)	70	2.5
Add Samp W1	Sample	-	5	5.0
Rinse	Solvent 2	Air (20%)	70	5.0
Add Samp W1	Sample	-	5	5.0
Rinse	Solvent 2	Air (20%)	70	5.0
Add Samp W1	Sample	-	5	5.0
Shake	-	-	Time Based	20 s
Rinse	Solvent 4	Air (20%)	70	1.3
Add Samp W1	Sample	-	5	3.0
Rinse	Solvent 4	Air (20%)	70	5.0
Add Samp W2	Sample	-	5	5.0
Shake	-	-	Time based	20 s
Air-Purge R	Air	-	5	3.0
Add Samp W2	Sample	-	5	5.0
Blow N2	-	-	Time based	1 min
Rinse	Solvent 5	Air (20%)	70	1.3
Collect 1	Sample	-	5	3.0
Rinse	Solvent 5	Air (20%)	70	5.0
Collect 1	Sample	-	5	5.0
Shake	-	-	Time based	10 s
Collect 1	Sample	-	5	5.0

Note: Add Samp W1 volume in the 3rd row can be altered depending on the container size.

Conditioning/Sample Loading/Elution (Upright Loading):

Action	Inlet 1	Inlet 2 (ratio)	Flow	Volume
Elute W2	Solvent 5	-	8	15.0
Elute W1	Solvent 3	-	8	5.0
Add Samp W1	Sample	-	5	285
Rinse	Solvent 2	-	10	10.0
Air-Purge R	Air	-	10	3.0
Add Samp W1	Sample	-	5	15.0
Rinse	Solvent 4	-	70	5.0
Air-Purge R	Air	-	10	3.0
Add Samp W2	Sample	-	5	10
Blow N2	-	-	Time based	1 min
Rinse	Solvent 5	-	70	5.0
Air-Purge R	Air	-	10	3.0
Collect 1	Sample	-	5	10.0

Note: Add Samp W1 volume in the 3rd row can be altered depending on the container size.