REMEDIAL INVESTIGATION WORK PLAN

for

261 Walton Avenue
Bronx, New York

Prepared for:

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New York, NY 10022

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CERTIFICATION

I, Jason Hayes, certify that I am currently a Qualified Environmental Professional as defined in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 and that this Remedial Investigation Work Plan (RIWP) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation.



Jason J. Hayes, P.E., LEED^{AP}

1.0 INTRODUCTION

This Remedial Investigation Work Plan (RIWP) was prepared on behalf of Tuck-It-Away Associates, Deegan, LLC (the Requestor) for the property located at 261 Walton Avenue in the Mott Haven neighborhood of the Bronx, New York (the site). The Requestor is submitting this RIWP in conjunction with an Application to the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) to investigate and remediate the site.

The objective of the scope of work defined in this RIWP is to further investigate and characterize the nature and extent of environmental impacts at and emanating from the site and to provide sufficient information to evaluate remedial alternatives, as required. This RIWP was developed in accordance with the process and requirements identified in the NYSDEC Division of Environmental Remediation (DER)-10 *Technical Guidance for Site Investigation and Remediation* (May 2010) and the New York State Department of Health (NYSDOH) *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006, with updates).

2.0 SITE BACKGROUND

2.1 Site Description

The site is located at 261 Walton Avenue in the Mott Haven neighborhood of the Bronx, New York. The site is about 27,454 square feet (0.63 acres) in area and is identified on the Bronx Borough Tax Map as Block 2344, Lot 60. A site location map is provided as Figure 1 and details of the site are included in Figure 2.

The site is improved with a vacant six-story building and an asphalt-paved lot; numerous large metal storage containers are stacked on the asphalt-paved lot. The site is bound by an industrial/manufacturing building to the north, Walton Avenue followed by industrial buildings to the east, a gas station to the south, and Gerard Avenue followed by the Major Deegan Expressway to the west. The proposed development will include abatement and demolition of the existing building to prepare the site for investigation and remediation, and construction of an affordable residential building. A site plan is provided as Figure 2.

2.2 Surrounding Property Land Use

The site is in a mixed-use area with commercial, light industrial, and institutional uses nearby. The following is a summary of surrounding property usage:

Direction	Adjoining and Adjacent Properties			Surrounding Properties
	Block No.	Lot No.	Description	
North	2344	83	3-story industrial/manufacturing building	Light industrial/manufacturing and institutional buildings
East	NA	NA	Walton Avenue	Light industrial/manufacturing and commercial buildings
South	2344	52	BP Gas Station	Madison Avenue Bridge, Deegan Rock Memorial Park
West	NA	NA	Gerard Avenue	Major Deegan Expressway, light industrial/manufacturing buildings and Con Edison buildings

Public infrastructure (storm drains, sewers, and underground utility lines) exists within the streets surrounding the site.

Land use within a half-mile radius is urban and includes residential, light industrial, and commercial buildings and institutional facilities. The nearest ecological receptor is the Harlem River, which is located approximately 500 feet west of the site.

No schools or day care facilities are located on the site. Sensitive receptors, as defined in DER-10, within a half mile of the site include those listed below:

Number	Name (Approximate distance from site)	Address
1	Health Opportunities High School (0.08 miles north of the site)	350 Gerard Avenue Bronx, NY 10451
2	Community School for Social Justice (0.10 miles north of the site)	350 Gerard Avenue Bronx, NY 10451
3	Family Life Academy Charter School III (0.14 miles north of the site)	370 Gerard Avenue Bronx, NY 10451
4	P.S. 168 (0.2 miles east of the site)	339 Morris Avenue Bronx, NY 10451
5	Success Academy Bronx 1 Middle School (0.24 miles east of the site)	339 Morris Avenue Bronx, NY 10451
6	KIPP NYC College Prep High School (0.31 miles southeast of the site)	201 East 144th Street Bronx, NY 10451
7	Sunshine Learning Center (0.26 miles northeast of the site)	253 East 142nd Street Bronx, NY 10451
8	Global Community Charter School (0.28 miles northwest of the site)	2350 5th Avenue New York, NY 10037
9	Hostos Community Children's Center (0.28 miles north of the site)	475 Grand Concourse New York, NY 10039
10	Family Life Academy Charter School II (0.32 miles southeast of the site)	296 East 140th Street Bronx, NY 1454
11	The Jewish Board: Harlem Child Development Center (0.34 miles northwest of the site)	34 West 139th Street New York, NY 10037
12	Creciendo DayCare (0.35 miles east of the site)	281 East 143rd Street Apt. 12-F Bronx, NY 10451
13	Cuddly Bundles Childcare (0.38 miles north of the site)	137 East 150th Street Bronx, NY 10451
14	Democracy Prep Charter Middle School (0.39 miles northwest of the site)	2230 5th Avenue New York, NY 10037
15	Zeta Charter School Bronx 1 (0.41 miles southeast of the site)	222 Alexander Avenue Bronx, NY 10454
16	PS 18 John Peter Zenger (0.41 miles northeast of the site)	502 Morris Avenue Bronx, NY 10451
17	St. Mark the Evangelist School (0.42 miles northwest of the site)	55 West 138th Street New York, NY 10037
18	New York City Housing Authority's Lincoln Day Care Center	212 Madison Avenue New York, NY 10037

Number	Name (Approximate distance from site)	Address
	(0.42 miles west of the site)	
19	PS 49 Willis Avenue (0.46 miles southeast of the site)	383 East 139th Street Bronx, NY 10454
20	South Bronx Classical Charter School II (0.48 miles southeast of the site)	333 East 135th Street Bronx, NY 10454
21	The Laboratory School of Finance and Technology (0.49 miles east of the site)	360 East 145th Street Bronx, NY 10454

2.3 Site Physical Conditions

2.3.1 Topography

According to the 2013 United States Geological Survey (USGS) Central Park Quadrangle 7.5-minute Series Topographic Map, the site is at an elevation of approximately 25 feet above mean sea level (msl). The topography of the site slopes to the west, towards the Harlem River.

2.3.2 Site Geology

According to soil descriptions provided in the February 2012 Limited Phase II Environmental Site Assessment conducted by IVI Environmental, Inc. and the October 2017 Initial Geotechnical Investigation memorandum prepared by Langan Engineering, Environmental, Surveying, Landscape Architecture, and Geology, D.P.C. (Langan), historic fill was identified beneath the asphalt layer across the site to depths ranging from 6 inches to 5 feet below grade surface (bgs)[1]. The fill material, generally characterized as fine to medium sands, with varying amounts of silt, clay, gravel, and brick, is underlain by silty sands, clay and/or weathered bedrock, and bedrock. Bedrock was encountered at depths ranging from 10 inches to 9 feet bgs.

Based on a review of the "Bedrock and Engineering Geologic Maps of Bronx County and Parts of New York and Queens Counties, New York" by Charles A. Baskerville, et al. and the geotechnical investigation results, the bedrock underlying the site is the Manhattan Schist formation. The Manhattan Schist is a Lower Cambrian formation composed of sillimanite-muscovite-biotite-kyanite schist and gneiss.

[1] The October 2017 Initial Geotechnical Investigation included three borings and one temporary groundwater level observation well advanced within the asphalt-paved areas on site.

2.3.3 Hydrogeology

Groundwater flow is typically topographically influenced because shallow groundwater tends to originate in areas of topographic highs and flows toward areas of topographic lows, such as rivers, stream valleys, ponds, and wetlands. A broader, interconnected hydrogeologic network often governs groundwater flow at depth or in the bedrock aquifer. Groundwater depth and flow direction are also subject to hydrogeologic and anthropogenic variables such as precipitation, evaporation, extent of vegetative cover, coverage by impervious surfaces, and subsurface structures. Other factors influencing groundwater include depth to bedrock, the presence of anthropogenic fill, and variability in local geology and groundwater sources or sinks.

Based on the Langan's Initial Geotechnical Investigation memorandum, site groundwater observed at about 8 feet bgs represents a perched groundwater condition near top of bedrock.

2.3.4 Wetlands and Floodplain

Wetlands on and near the site were evaluated by reviewing the National Wetlands Inventory and NYSDEC regulated wetlands map. There are no wetlands on the site. According to the NYSDEC Tidal Wetlands Map 588-518 the Harlem River is mapped as a Littoral Zone (LZ) approximately 500 feet west of the site.

According to the Effective National Flood Insurance Rate map for the City of New York published by the Federal Emergency Management Agency (Community Panel No. 3604970083F), the site falls within Zone X, which is defined as having a 0.2% annual chance of flood.

2.4 Summary of Previous Environmental Investigations

Three previous environmental reports were reviewed in the preparation of this RIWP (See Appendix A).

- *December 13, 2011 Phase I Environmental Site Assessment (ESA), prepared by Airtek Environmental Corporation*
- *February 16, 2012 Limited Phase II ESA, prepared by IVI Environmental, Inc.*
- *June 8, 2015 ASTM E1528-14 Transaction Screen Environmental Site Assessment Report, prepared by LCS, Inc.*

To supplement these reports, data will be gathered during the Remedial Investigation (RI) proposed herein using appropriate sampling and analytical procedures as approved and conducted under the oversight of the NYSDEC and NYSDOH. The purpose of the RI will be to characterize the nature and extent of contamination at this site. Sufficient information will be collected to determine if contamination is migrating or emanating from the site, inform the qualitative human health exposure assessment, and support the positive or negative significant

threat determination. The conclusions of previous investigations may or may not be supported by the findings of this RI.

Phase I ESA, prepared by Airtek Environmental Corporation (December 13, 2011)

Airtek Environmental Corporation conducted a Phase I ESA on behalf of M & T Bank in accordance with ASTM E1527-13. The site was occupied and owned by Tuck-It-Away Associates and used for self-storage at the time of the assessment. The Phase I ESA identified the following Recognized Environmental Conditions (REC):

- Previous site use included an electrical specialties and lumber storage facility (1908); an automotive wrecking yard (1909-1965); a card and paper warehouse (1927-1956); a brick, lime and cement manufacturing company with a 550-gallon gasoline underground storage tank (1935); an automotive repair facility (1936-1976); and a furniture warehouse and showroom (1977-2007).

- Current and historical use of the adjoining and surrounding properties included the following:

    - The southern adjoining property was occupied by a piano factory and lumber storage facility (1908-1935) and then by a gasoline station (1951-present). The property is associated with two closed NYSDEC Spills (Nos. 9408104 and 0207682).

    - The northern adjoining property was used for furniture manufacturing, storage, and as a fur processing and dyeing facility with an associated paint shop (1935-1951).

    - The northeastern property across Walton Avenue was used as an automotive sales and service facility (1935 and 1977 - 2007), a gasoline station (1944 – 2002) and a car wash (1992 – 2011). The site is associated with an open NYSDEC Spill (No. 9909720).

    - The eastern adjoining property across Walton Avenue was used as an automotive gasoline station (1935) and plastics manufacturing facility (1947-1951).

- As part of the Lower Concourse Rezoning, dated May 8, 2009, the site was assigned an E-Designation (E-227) for hazardous materials and air quality (for fuel oil/natural gas restriction and exhaust stack location limitations).

Limited Phase II ESA, prepared by IVI Environmental, Inc. (February 16 2012)

IVI Environmental, Inc. conducted a Limited Phase II ESA in February 2012 to investigate the RECs identified in the Phase I ESA. The Limited Phase II ESA included a geophysical survey, advancement of ten soil borings and collection and laboratory analysis of eight soil samples from the asphalt-paved area on the site. The following summarizes the findings of the Limited Phase II ESA:

- Subsurface soils encountered during the investigation consisted of historic fill material and brown silty sands and clay. The historic fill was observed to depths varying between about 10 inches and 5 feet bgs. Historic fill was generally underlain by silty sands, clay, and weathered rock. Refusal, on presumed bedrock, was encountered in each of the ten borings at depths ranging from approximately 10 inches bgs in the northeastern part of the site to 9 feet bgs in the northwestern part of the site. Groundwater was not encountered in any of the soil borings.

- Petroleum impacts (i.e., visual, olfactory and/or photoionization detector [PID] readings) were not observed in the borings. Soil samples were collected from the bottom of each soil boring and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and Resource Conservation and Recovery Act (RCRA) metals.

- Soil sample results were compared to the NYSDEC Title 6 of the Official Compilation of New York Codes, Rules, and Regulations (NYCRR) Part 375 Unrestricted Use (UU) and Restricted Use Restricted Residential (RURR) Soil Cleanup Objectives (SCO). Analytes with detections above the UU SCOs are listed below, with those above the RURR SCOs shown in **bold**.

    - No VOCs were detected at concentrations above UU or RURR SCO.

    - SVOCs: **benzo(a)anthracene** (maximum concentration 8.3 milligrams per kilogram [mg/kg]), **benzo(a)pyrene** (maximum concentration 10 mg/kg), **benzo(b)fluoranthene** (maximum concentration 13 mg/kg), **benzo(k)fluoranthene** (maximum concentration 6.3 mg/kg), **chrysene** (maximum concentration 7.9 mg/kg), **dibenzo(a,h)anthracene** (maximum concentration 1.2 mg/kg) and **indeno(1,2,3-cd)pyrene** (maximum concentration 3.7 mg/kg).

    - Metals: barium (maximum concentration 386 mg/kg), **cadmium** (maximum concentration 6.9 mg/kg), **lead** (maximum concentration 8,440 mg/kg), mercury (maximum concentration 0.56 mg/kg) and silver (maximum concentration 3.69 mg/kg).

Figure 3 summarizes the detected soil concentrations from the Limited Phase II ESA.

ASTM E1528-14 Transaction Screen Environmental Site Assessment Report, prepared by LCS Inc. (June 8, 2015)

LCS Inc. conducted an ASTM 15-28-14 Transaction Screen Environmental Site Assessment Report for M&T Bank of New York to identify potential environmental concerns (PEC) for financing purposes. The site was occupied by Tuck-It-Away Self Storage at the time of the site inspection and the report identified the following PECs:

- Historic site use included an auto wrecking yard and auto repair facility. An associated 2012 investigation (the Limited Phase II ESA described above) identified metal and SVOCs at concentrations above Part 375 criteria in soil across the site.
- The site was assigned an E-Designation for hazardous materials and air quality.
- There were adjacent properties, including a south adjacent gasoline station, with the potential to impact subsurface conditions on the site.

2.5 Areas of Concern

Based on the site history and the findings of the previous studies, the areas of concerns (AOC) to be further investigated by this RI are shown on Figure 4 and described below.

AOC 1: Prior Site Use

Historical operations at the site include an electrical specialties and lumber storage facility (1908); an automotive wrecking yard (1909 – 1965); a brick, lime and cement manufacturing company with a 550-gallon gasoline underground storage tank (1935); and an automotive repair facility (1936 – 1976). The RI will evaluate whether releases of petroleum products or other hazardous substances associated with prior uses have adversely impacted soil, soil vapor and/or groundwater.

AOC 2: Historic Fill

Historic fill from unknown sources was identified on the site from below surface grade up to 5 feet bgs. Contaminants associated with historic fill, including SVOCs and metals, were identified in soil samples at concentrations exceeding the UU and/or RURR SCOs. The RI will evaluate the nature and extent of historic fill and the presence of SVOCs and metals above UU and/or RURR SCOs.

AOC 3: Off-site Current and Historical Use

Historical and current operations at adjoining and surrounding properties include a gasoline station (1951 – present) at the southern adjoining property, a gasoline station (1935) and plastics

manufacturing facility (1947 – 1951) at the eastern adjoining property, an auto service facility (1935 and 1977 – 2007) and a gasoline station (1944 – 2002) at the northeastern surrounding property, and a fur processing and dyeing facility (1935 – 1951) with an associated paint shop in 1935 at the northern adjoining property. The RI will evaluate whether releases of petroleum products or other hazardous substances associated with adjoining and surrounding property use have adversely impacted groundwater and/or soil vapor at the site.

3.0 SCOPE OF WORK

The objective of this RIWP is to investigate and characterize "the nature and extent of the contamination at and/or emanating from a brownfield site", per Environmental Conservation Law Article 27, Title 14 (Brownfield Cleanup Program). The field investigation will include the tasks summarized below. The rationale for each sampling location, in relation to the AOCs, and analytical parameters for each proposed sample are provided in Table 1. These tasks are discussed in more detail in the following sections.

Asbestos Abatement and Demolition of Existing Structures and Site Clearing

- Removal of stacked metal containers to allow for the investigation on the exterior portions of the RI
- Abate and demolish the existing self-storage building to allow for the safe implementation of the RI within the building footprint

Geophysical Survey

- Perform a geophysical survey to locate unidentified underground storage tanks (USTs) and underground structures and identify utilities in the vicinity of proposed sampling locations.

Soil Borings and Sampling

- Advance 19 soil borings to refusal/bedrock (assumed at a maximum of 9 feet bgs).
- Collect up to 41 soil samples (plus quality assurance/quality control |QA/QC| samples) to characterize the nature and extent of soil contamination.

Monitoring Well Installation and Sampling

- Install and develop up to 5 permanent monitoring wells.
- Collect one groundwater sample from each monitoring well for a total of 5 samples (plus QA/QC samples) for laboratory analysis to evaluate groundwater quality across the site.
- Survey and gauge monitoring wells to establish groundwater elevations and evaluate flow direction.

Soil Vapor and Ambient Air Sampling

- Install 7 soil vapor points to about 2 feet above the groundwater table, if encountered. If groundwater is not encountered the vapor points will be installed above the bedrock.
- Collect one vapor sample from each vapor point for a total of 7 samples for laboratory analysis to evaluate the nature of soil vapor across the site.
- Collect one outdoor ambient air sample as a QA/QC sample for laboratory analysis.

The investigation will be conducted in two phases. Phase 1 will include the borings, wells, and soil vapor points in the exterior portion of the site. Phase 2 will include the borings, wells and soil vapor sample points located within the footprint of the building and will be conducted after abatement and demolition of the building is complete. This RIWP was designed to allow for real-time decision making in the field. Additional soil, groundwater or soil vapor samples may be required:

(1) in the event unexpected soil and groundwater contamination is encountered in the field or exhibited by lab data; and

(2) to adequately characterize and delineate impacts related to AOCs in compliance with the BCP legislation, regulations and applicable investigation guidance documents (e.g., DER-10).

The NYSDEC and NYSDOH Project Managers will be consulted, as reasonable, to inform this decision-making process. In addition, modifications to the scope of work presented above may be required because of site operations, equipment or restrictions (not anticipated). All additions and modifications will be reflected in the Remedial Investigation Report (RIR).

The field investigation will be completed in accordance with NYSDEC DER-10 Guidance and the procedures specified in the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) included as Appendices B and C, respectively. A Community Air Monitoring Plan will be implemented during this investigation (See Section 3.10.2).

The names, contact information and roles of the principal personnel who will participate in the investigation — including NYSDEC/NYSDOH personnel, project managers, and subcontractors — are listed below. Resumes for Langan employees involved in the project are included in the QAPP (Appendix B).

Personnel	Investigation Role	Contact Information
Stuart Knoop Langan Engineering	Project Manager	Phone – 212-479-5461 Email – sknoop@Langan.com

Personnel	Investigation Role	Contact Information
Jason J. Hayes, P.E. Langan Engineering	Project Engineer	Phone – 212-479-5427 Email – jhayes@langan.com
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Tony Moffa, CHMM Langan Engineering	Langan Health & Safety Officer	Phone – 215-491-6500 Email – tmoffa@langan.com
Bill Bohrer Langan Engineering	Field Safety Officer	Phone – 410-984-3068 Email – wbohrer@langan.com
Mimi S. Raygorodetsky Langan Engineering	Quality Assurance Officer	Phone – 212-479-5441 Email – mraygorodetsky@langan.com
Steve Plofker AARCO Environmental	Drilling Contractor	Phone – 631-586-5900 Email – splofker@aarcoenvironmental.com
Ben Rao Alpha Analytical	Laboratory Contractor	Phone – 201-847-9100 Email – brao@alphalab.com
Marla Miller Langan Engineering	Program Quality Assurance Monitor/ Data Validator	Phone – 602-772-1839 Email – mmiller@langan.com
Hasan Ahmed NYSDEC	Project Manager	Phone – 718-482-6405 Email – hasan.ahmed@dec.ny.gov
Renata Ockerby NYSDOH	Project Manager	Phone – 518-402-7867 Email – renata.ockerby@health.ny.gov

3.1 Asbestos Abatement and Demolition

The stacked metal storage containers on the northern and western portions of the site were removed in July 2021 to allow for the investigation of the exterior portions of the RI.

Abatement of hazardous materials, including asbestos containing materials (ACM), lead based paint (LBP), and other universal waste and miscellaneous hazardous waste articles and demolition of the existing self-storage building will be implemented to prepare the site for the RI within the building footprint. ACM abatement will be implemented in accordance with New York State Department of Labor Policies and Procedures.

3.2 Geophysical Survey

We will coordinate with a geophysical contractor to clear subsurface testing locations of potential subsurface utilities and to locate any USTs. The geophysical survey will be completed using a collection of geophysical instruments, including electromagnetic and utility line locator instruments and ground-penetrating radar (GPR). The results of the survey may require relocating subsurface testing locations.

3.3 Soil Investigation

Soil Boring Installation

A drilling subcontractor will advance 19 soil borings (SB01 through SB19) to investigate the site and the AOCs identified in Section 2.5. Soil borings will terminate five feet below the groundwater interface if encountered or at bedrock, which is anticipated at about 9 feet bgs. A plan showing the proposed sample locations is included as Figure 4. Table 1 indicates the sample locations that are intended to investigate each AOC.

The soil borings will be advanced using direct-push drilling technology by an experienced environmental driller. The direct-push drill rig will be equipped with a closed-point Macro-Core® sampler or dual-tube sampling system to prevent the collapse of sidewall material as borings are advanced. A Langan field engineer, scientist or geologist will document the work, screen soil samples for environmental impacts, and collect representative environmental soil samples for laboratory analyses. Soil will be screened continuously to the boring termination depth for organic vapors with a photoionization detector (PID) equipped with a 10.6 electron volt (eV) bulb and for visual and olfactory evidence of environmental impacts (e.g., non-aqueous phase liquid [NAPL], staining, odor). Soil will be visually classified for color, grain size, texture, and moisture content, and will be recorded in a field log. Non-disposable, down-hole drilling equipment and sampling apparatus will be decontaminated between locations with Alconox® and water. Water used for decontamination and rinsate will be containerized into United Nations/Department of Transportation (UN/DOT)-approved 55-gallon drums, labeled, and staged for off-site disposal.

Soil Sampling and Analysis

Up to two grab soil samples will be collected for laboratory analysis from each soil boring:

- One soil sample will be collected from the shallow fill layer.
- One sample will be collected from the interval exhibiting the greatest degree of contamination, where observed (based on the presence of staining, odor, and/or PID readings above background). If no impacts are observed, the sample will be collected from above the groundwater interface, if groundwater is encountered. If groundwater is not encountered, the sample will be collected from the interval above refusal/bedrock.

The proposed soil samples are summarized in Table 1. Depending on the site conditions (e.g., historic fill and bedrock depth, presence/absence of impacts), the number of samples collected at each boring may vary.

The samples will be collected in laboratory-supplied containers and will be sealed, labeled, and placed in a chilled cooler (to attempt to maintain a temperature of about 4°C) for delivery to a

NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory. Soil samples will be analyzed using the latest USEPA methods as follows:

- Part 375 Target Compound List (TCL) VOCs by USEPA methods 8260C/5035
- Part 375 TCL SVOCs by USEPA method 8270D
- Part 375 Polychlorinated biphenyls (PCB) by USEPA method 8082A
- Part 375 Target Analyte List (TAL)/Part 375 List metals (including cyanide and hexavalent and trivalent chromium) by USEPA Methods 6010C/7471B/9010C/7196A
- Part 375 Pesticides and herbicides by USEPA methods 8081B and 8151A, respectively
- NYSDEC list for per- and poly-fluoroalkyl substances (PFAS) by USEPA method 537 Rev 1.15

Relevant QA/QC procedures to be followed are described in the QAPP in Appendix B.

3.4 Groundwater Investigation

Monitoring Well Installation

Five soil borings will be converted into permanent groundwater monitoring wells. A plan showing the proposed well locations is included as Figure 4. Table 1 indicates the monitoring wells that are intended to investigate each AOC. Monitoring well locations will be numbered in conjunction with their respective soil boring numbers and prefixed with "MW". Wells will be constructed across the observed water table. The wells will be constructed with 2-inch-diameter, threaded, flush-joint, polyvinyl chloride (PVC) casing and 0.01-inch-slot well screens. Clean sand (e.g., Morrie No. 1) will be used to fill the annulus around the screen and above the top of the screened interval. A bentonite seal will be installed above the sand and the remaining borehole annulus will be backfilled with drill cuttings with no evidence of petroleum impacts (i.e., staining, odors, or elevated PID readings) to within 12 inches of the surface and/or grouted to the surface with bentonite and cement slurry.

If petroleum impacted material is encountered at the top of the bedrock surface and perched groundwater is not encountered on top of bedrock, a bedrock well will be installed. The bedrock well will be installed into bedrock using an appropriate drill rig by advancing steel protective casing at least 5 feet into bedrock, grouting the annulus outside the casing within the borehole up to the ground surface, and coring another 5 feet into rock starting at the bottom of the casing. The targeted depth of the well will be about 10 feet below the bedrock surface. The bedrock monitoring well will be developed by surging with a surge block. Bedrock monitoring wells will be prefixed with "BRW".

After installation, the wells will be developed by surging using either a weighted bailer or surge block across the well screen and casing to agitate and remove fines. The bailer or surge block will be surged across the well screen in 2- to 3-foot increments for about two minutes per increment. After surging, the well will be purged via pumping until the water becomes visually clear. The well will then be allowed to stabilize for a minimum of one week.

Groundwater Sampling and Analysis

Before sampling, the headspace of each well will be monitored with a PID and the wells will be gauged and purged. Each well will be gauged with an interface probe to determine the depth to groundwater and thickness of any light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid DNAPL. If either is encountered, representative samples of the product will be collected for laboratory fingerprint analysis.

Groundwater samples will be collected about one week after the wells are installed and developed. The proposed groundwater samples are summarized in Table 1. One groundwater sample will be collected from each well in general accordance with NYSDEC DER-10 and USEPA's *Low Flow Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (EQASOP-GW4 Revised Sep. 2017)*. Before the groundwater samples are collected, wells will be gauged and then, provided no NAPL is present, continuously purged until groundwater quality parameters (pH, conductivity, turbidity, dissolved oxygen, temperature, and oxidation-reduction potential) stabilize, to the extent practical, in accordance with the USEPA low-flow guidance. A multi-parameter water quality system will be used to monitor the groundwater quality parameters during sampling. No groundwater samples will be collected from monitoring wells containing NAPL. Samples will be collected with a peristaltic pump (if possible) or equivalent and dedicated polyethylene tubing. The pump will be decontaminated with Alconox® and water between each sample location. Development and purge water will be containerized into UN/DOT-approved 55-gallon drums, labeled, and staged for off-site disposal.

The groundwater samples will be collected in laboratory-supplied containers and will be sealed, labeled, and placed in a chilled cooler (to attempt to maintain a temperature of about 4°C) for delivery to the laboratory. Groundwater samples will be analyzed using the latest USEPA methods as follows:

- TCL VOCs by USEPA method 8260C
- TCL SVOCs by USEPA method 8270D (including 1,4-dioxane by 8270 SIM isotope dilution)
- PCBs by USEPA method 8082A
- Metals (field-filtered and unfiltered) by USEPA method 6010C/7470

- Pesticides and herbicides by USEPA methods 8081B and 8151A, respectively
- Per- and poly-fluoroalkyl substances (PFAS) by USEPA method 537 Rev 1.15

QA/QC procedures to be followed are described in the QAPP in Appendix B.

3.5 Soil Vapor Investigation

Soil Vapor Point Installation

Seven soil vapor points will be installed using direct-push technology in accordance with the NYSDOH's *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006, with updates). A plan showing the proposed soil vapor point locations is included as Figure 4. Table 1 indicates the soil vapor points that are intended to investigate AOCs 1, 2 and 3. Soil vapor points will be installed by advancing a probe implant to about 2 feet above the groundwater table or if groundwater is not encountered, soil vapor probes will be installed above the bedrock.

The soil vapor collection points will consist of a 1.875-inch polyethylene implant with inert sample tubing (e.g., polyethylene or Teflon) and inert sample tubing only, respectively. The annulus (i.e., the sampling zone) around the soil vapor implant and tubing will be filled with a clean, coarse sand pack followed by a hydrated bentonite seal to surface grade. Hydrated bentonite will also be used to create a seal around the tubing at the surface of the soil vapor point.

Soil Vapor Sampling and Analysis

Samples will be collected in general accordance with the 2006 NYSDOH guidance. The proposed vapor samples are summarized in Table 1. Before collecting vapor samples, about three soil vapor point volumes (i.e., the volume of the sample implant and tubing) will be purged from each sample location at a rate of less than 0.2 liters per minute using a RAE Systems MultiRAE® meter set at a low flow setting. The purged soil vapor will be monitored for VOCs with the MultiRAE® during purging.

A helium tracer gas will be used in accordance with the NYSDOH protocols to serve as a QA/QC technique to document the integrity of each soil vapor point seal before and after sampling. The tracer gas will be introduced into a container, which will shroud the soil vapor point and seal. Helium will be measured from the sampling tube and inside the container. If the sample tubing contains more than 10% of the tracer gas concentration that was introduced into the container, then the seal will be considered compromised and will be enhanced or reconstructed to reduce outdoor air infiltration.

A log sheet for each soil vapor sample will be completed to record sample identification; date and time of sample collection; sampling depth; name of the field engineer, geologist or scientist

responsible for sampling; sampling methods and equipment; vapor purge volumes; volume of vapor extracted; flow rate; and vacuum of canisters before and after sample collection.

After the integrity of each seal is confirmed, soil vapor samples will be collected into laboratory-supplied batch-certified clean 2.7-liter Summa® canisters with calibrated flow controllers. Soil vapor samples will be collected over a 2-hour sampling period and analyzed for VOCs by USEPA Method TO-15.

Ambient Air Sampling

One ambient air sample will be collected at a height above the ground to represent the breathing zone (about 3 to 5 feet). The air sample will be collected over a 2-hour sampling period (concurrently with the soil vapor samples) and analyzed for VOCs by USEPA TO-15 to evaluate potential outdoor air interferences with sampling apparatus.

QA/QC procedures to be followed are described in the QAPP in Appendix B.

3.6 Sampling Contingency

Additional soil, groundwater, and soil vapor sampling locations may be completed, as needed, to evaluate unanticipated contamination and to horizontally and vertically delineate identified contamination (e.g., NAPL, VOCs, SVOCs, metals, or other analytes) based on field observations and analytical results. The objective of sampling contingency is to provide adequate delineation of AOCs during a single mobilization event, if possible. Off-site groundwater and soil vapor sampling may be completed as part of the human health exposure assessment if perimeter sampling indicates potential contaminant migration to off-site receptors. Adjoining properties are exclusively occupied by manufacturing/industrial and commercial tenants. The decision to complete additional sampling and delineation (including step-out distances and target-depth intervals) based on field observations and/or preliminary (non-validated) laboratory data will be made by Langan in consultation with NYSDEC and NYSDOH Project Managers, where appropriate. The location and number of any step-out soil borings and additional monitoring wells will be based on field observations and analytical data from adjacent borings and wells, site access and drilling considerations. Sampling depths and analyses will be contingent on findings.

3.7 Monitoring Well Survey

The location and elevation of groundwater monitoring wells (top of casing) will be surveyed. This data will be used in conjunction with synoptic groundwater well gauging data to prepare a groundwater elevation contour map and evaluate the direction of groundwater flow. The survey will be conducted relative to the NAVD88 by a NYS-licensed land surveyor. Elevations of the top of monitoring-well casings and protective well covers will be surveyed to the nearest 0.01 foot.

3.8 Data Management and Validation

Laboratory analyses of all samples collected as part the remedial investigation will be conducted by a NYSDOH ELAP-approved laboratory in accordance with USEPA SW-846 methods and NYSDEC Analytical Services Protocol (ASP) Category B deliverable format. Environmental data will be reported electronically using the database software application EQuIS as part of NYSDEC's Environmental Information Management System (EIMS) and/or e-mail. Data usability summary reports will be included as an appendix in the RIR.

QA/QC procedures required by the NYSDEC ASP and SW-846 methods, including initial and continuing instrument calibrations, standard compound spikes, surrogate compound spikes, and analysis of other samples (blanks, laboratory control samples, and matrix spikes/matrix spike duplicates), will be followed. The laboratory will provide sample bottles, which will be pre-cleaned and preserved in accordance with the SW-846 methods. Where there are differences in the SW-846 and NYSDEC ASP requirements, the NYSDEC ASP will take precedence.

Data validation will be performed in accordance with the USEPA validation guidelines for organic and inorganic data review. Validation will include the following:

- Verification of QC sample results (qualitative and quantitative)
- Verification of sample results (positive hits and non-detects
- Recalculation of 10 percent of all investigative) sample results
- Preparation of Data Usability Summary Reports (DUSR

The DUSRs will be prepared and reviewed by the Program Quality Assurance Monitor (PQAM). The DUSRs will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and COC procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method. A detailed assessment of each sample delivery group (SDG) will follow. Additional details on the DUSRs are provided in the QAPP in Appendix B.

The RI results will be reported to the NYSDEC using EQuIS in NYSDEC ASP Category B deliverable format and validated by the Data Validator identified in the QAPP.

3.9 Management of Investigation-Derived Waste

Soil cuttings will be returned to the borehole unless:

- Free product or grossly contaminated soil is present in the cuttings.
- The borehole has penetrated a confining layer.

- Backfilling the borehole with cuttings will create a significant path for vertical movement of contaminants. Soil additives (bentonite) may be added to the cuttings to reduce permeability.
- The soil cannot fit into the borehole.

Boreholes requiring disposal of drill cuttings will be filled with hydrated bentonite chips or clean sand and capped with asphalt or concrete. Soil cuttings and decontamination, well-development and purging fluids (together, investigation-derived waste [IDW]) will be containerized in properly labeled and sealed UN/DOT-approved 55-gallon drums and staged for future waste characterization and off-site disposal at a facility with a permit to accept the waste. The drums will be staged in a secure area on-site, pending receipt of laboratory data and off-site disposal to an appropriate facility. Spent disposable sampling equipment, including spoons, gloves, bags, and paper towels, will be double-bagged and disposed of as municipal trash in a dumpster or garbage can.

3.10 Air Monitoring

Worker and community air monitoring will be conducted during ground intrusive field activities. We will record air monitoring results in the field book during the investigation. Fugitive particulate (dust) generation that could affect site workers or the community is not expected for the following reasons:

- Most of the work area and the boring locations are paved with asphalt or concrete; therefore, vehicle movement will not generate dust.
- Intrusive work is limited to boring, soil vapor point and well installation, which does not generate large volumes of soil cuttings or dust.

3.10.1 Worker Air Monitoring

Air monitoring of the breathing zone will be performed periodically during drilling and sampling activities to document health and safety protection for the field team. Langan will monitor VOCs with a PID in accordance with the HASP. If air monitoring during intrusive operations identifies the presence of VOCs, we will follow the guidelines outlined in the HASP regarding action levels, permissible exposure, engineering controls, and personal protective equipment. If the VOC threshold action level is exceeded, work will cease and the work location will be evacuated. Monitoring will continue until the levels drops to permissible limits, at which point, work will resume with continued monitoring. If high levels persist, field activities will be halted and the work relocated to another area. If dust emissions are observed, work will stop and dust suppression measures (e.g., water spray) will be implemented.

3.10.2 Community Air Monitoring Plan

In addition to air monitoring in the workers' breathing zone, we will conduct community air monitoring in compliance with the NYSDOH Generic CAMP. Work may be conducted within 20 feet of potentially exposed individuals at adjoining properties; therefore, Special Requirements are included in the CAMP. The CAMP is included in Appendix D.

The CAMP will consist of continuous monitoring for VOCs and dust emissions during ground-intrusive activities (e.g., soil boring and monitoring-well installation). Baseline upwind and downwind concentrations will be measured prior to the start of each workday, and periodically thereafter, to establish background concentrations. VOCs and dust emissions will be monitored at the downwind perimeter of the work zone, which will be established at a point on the site where the general public or site employees may be present. VOC monitoring will be conducted with a PID equipped with a 10.6-eV lamp. VOC community air monitoring requirements will be conducted until it is determined that the site is not a source of organic vapors. Dust emissions will be monitored using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM10) and capable of averaging a period of 15 minutes (or less) for comparison to the airborne particulate action level (e.g., DustTrak).

Periodic monitoring for VOCs will be conducted during nonintrusive activities such as the collection of groundwater samples. Periodic monitoring may include obtaining measurements upon arrival at a location, when opening a monitoring-well cap, when bailing or purging a well, and upon departure from the location.

Daily field reports will include a summary of CAMP data, a figure displaying wind direction and location of CAMP stations. A summary of particulate matter/VOC exceedances and corrective actions taken will be reported to the NYSDEC and NYSDOH Project Managers within one business day.

3.11 Qualitative Human Health Exposure Assessment

A Qualitative Human Health Exposure Assessment will be conducted in accordance with Appendix 3B of the NYSDEC DER-10, *Technical Guidance for Site Investigation and Remediation*. The assessment will be submitted in the RIR.

4.0 REMEDIAL INVESTIGATION REPORT

After completion of the RI and receipt of analytical data, a RIR will be prepared. The report will include:

- A summary of the site history and previous investigations
- A description of site conditions and the remedial investigation
- Sampling methodology and field observations
- Presentation and evaluation of the results and findings
- Conclusions and recommendations for any further assessment, if warranted

The report will summarize the nature and extent of contamination at each area of concern and identify unacceptable exposure pathways (as determined through a Qualitative Human Health Exposure Assessment).

The report will include soil boring and well-construction logs, sampling logs, tabulated analytical results, figures, and laboratory-data packages. The tabulated analytical results will be organized in table format and include sample location; media sampled; sample depth; field/laboratory identification numbers; analytical results; and applicable Standards, Criteria, and Guidance (SCG) pertaining to the site and contaminants of concern for comparison. The soil and groundwater analytical results will be compared to the UU and RURR SCOs and NYSDEC SGVs for Class GA water, respectively. Soil vapor analytical data will be presented and evaluated in conjunction with soil and groundwater analytical data. The report will include scaled figures showing the locations of soil borings, monitoring wells, and soil vapor points, sample concentrations above SCGs for each media, groundwater-elevation contours and flow direction, and, if appropriate, groundwater-contaminant concentration contours.

5.0 SCHEDULE

The table below presents an anticipated schedule for the proposed remedial investigation and reporting. If the scheduled changes, it will be updated and submitted to the NYSDEC.

Estimated Project Schedule		2021												2022											
Item	Action	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	Removal of Metal Storage Containers																								
2	RI Scheduling and Mobilization																								
3	Implementation of RI Field Work on Exterior Portions of Site																								
4	Laboratory Analysis																								
5	Partial RIR Preparation																								
6	Asbestos Abatement and Building Demolition																								
7	Implementation of RI Field Work on Building Footprint																								
8	Laboratory Analysis																								
9	Data Validation																								
10	RIR Prepration																								

TABLES

Table 1
Proposed Sample Summary

261 Walton Avenue
Bronx, NY 10451
Langan Project No. 17061701

No.	Sample Name	Type	Location	Rationale	Depth	Analysis
SOIL						
1	SB01_depth	Grab	SB01	Investigate AOC 1, 2 & 3	Historic Fill	TCL VOCs, TCL SVOCs, pesticides, herbicides, PCBs, TAL metals including hexavalent and trivalent chromium, cyanide, PFAS, and 1,4-dioxane.
2	SB01_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
3	SB02_2-3	Grab	SB02	Investigate AOCs 1, 2 & 3 and to Delineate Lead impacts	2-3 feet below grade	
4	SB02_3-4				3-4 feet below grade	
5	SB02_4-5				4-5 feet below grade	
6	SB03_depth	Grab	SB03	Investigate AOC 1, 2 & 3	Historic Fill	
7	SB03_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
8	SB04_depth	Grab	SB04	Investigate AOCs 1, 2 & 3	Historic Fill	
9	SB04_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
10	SB05_depth	Grab	SB05	Investigate AOC 1, 2 & 3	Historic Fill	
11	SB05_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
12	SB06_depth	Grab	SB06	Investigate AOCs 1, 2, & 3	Historic Fill	
13	SB06_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
14	SB07_depth	Grab	SB07	Investigate AOCs 1, 2, & 3	Historic Fill	
15	SB07_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
16	SB08_depth	Grab	SB08	Investigate AOCs 1, 2, & 3	Historic Fill	
17	SB08_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
18	SB09_depth	Grab	SB09	Investigate AOC 1, 2 & 3	Historic Fill	
19	SB09_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	

Notes are on Page 3.

Table 1
Proposed Sample Summary

261 Walton Avenue
Bronx, NY 10451
Langan Project No. 17061701

No.	Sample Name	Type	Location	Rationale	Depth	Analysis
SOIL						
20	SB10_2-3	Grab	SB10	Investigate AOCs 1, 2, & 3 and to Delineate lead impacts	2-3 feet below grade	TCL VOCs, TCL SVOCs, pesticides, herbicides, PCBs, TAL metals including hexavalent and trivalent chromium, cyanide, PFAS, and 1,4-dioxane.
21	SB10_3-4				3-4 feet below grade	
22	SB10_4-5				4-5 feet below grade	
23	SB11_2-3	Grab	SB11	Investigate AOCs 1, 2, & 3 and to Delineate lead impacts	2-3 feet below grade	
24	SB11_3-4				3-4 feet below grade	
25	SB11_4-5				4-5 feet below grade	
26	SB12_depth	Grab	SB12	Investigate AOCs 1, 2 & 3	Historic Fill	
27	SB12_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
28	SB13_depth	Grab	SB13	Investigate AOCs 1, 2 & 3	Historic Fill	
29	SB13_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
30	SB14_depth	Grab	SB14	Investigate AOCs 1, 2 & 3	Historic Fill	
31	SB14_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
32	SB15_depth	Grab	SB15	Investigate AOCs 1, 2 & 3	Historic Fill	
33	SB15_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
34	SB16_depth	Grab	SB16	Investigate AOCs 1, 2 & 3	Historic Fill	
35	SB16_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
36	SB17_depth	Grab	SB17	Investigate AOCs 1, 2 & 3	Historic Fill	
37	SB17_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
38	SB18_depth	Grab	SB18	Investigate AOCs 1, 2 & 3	Historic Fill	
39	SB18_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
40	SB19_depth	Grab	SB19	Investigate AOCs 1, 2 & 3	Historic Fill	
41	SB19_depth				Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
QA/QC SOIL						
42	SBDUP01_date	Duplicate	TBD	QA/QC	TBD	TCL VOCs, TCL SVOCs, pesticides, herbicides, PCBs, TAL metals including hexavalent and trivalent chromium, cyanide, PFAS, and 1,4-dioxane.
43	SBDUP02_date	Duplicate	TBD			
44	MS/MSD-SS01_date	MS/MSD	TBD			
45	MS/MSD-SS02_date	MS/MSD	TBD		Greatest degree of impacts, if encountered. Otherwise, groundwater interface if encountered or above bedrock	
46	SBEB01_date	Equipment Blank	TBD		NA	
47	SBEB02_date	Equipment Blank	TBD		NA	
48	SBTB01_date	Trip Blank	NA		NA	TCL VOCs
49	SBTB02_date	Trip Blank	NA		NA	
50	SBTB03_date	Trip Blank	NA		NA	

Notes are on Page 3.

Table 1
Proposed Sample Summary

261 Walton Avenue
Bronx, NY 10451
Langan Project No. 17061701

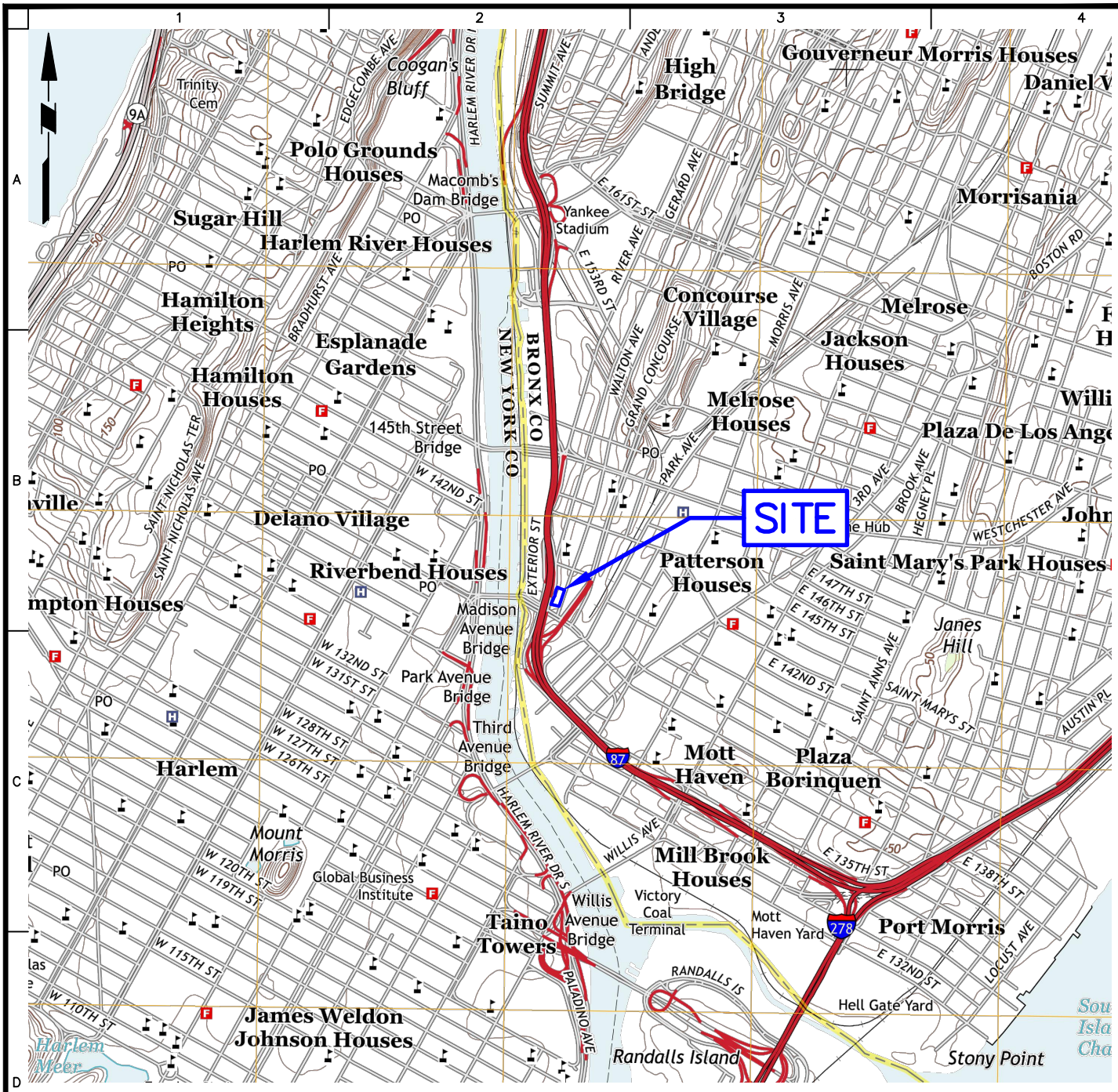
No.	Sample Name	Type	Location	Rationale	Depth	Analysis
GROUNDWATER						
1	MW01_date	Grab	MW01	Investigate AOCs 1, 2 & 3	middle of observed water column	TCL VOCs, TCL SVOCs, 1,4 Dioxane, Pesticides, Herbicides, PCBs, Cyanide, TAL Metals including hexavalent and trivalent chromium (total and dissolved [field filtered]), and PFAS.
2	MW02_date		MW02	Investigate AOCs 1 & 2	middle of observed water column	
3	MW03_date		MW03	Investigate AOCs 1 & 2	middle of observed water column	
4	MW04_date		MW04	Investigate AOCs 1, 2 & 3	middle of observed water column	
5	MW17_date		MW17	Investigate AOCs 1, 2 & 3	middle of observed water column	
6	GWDUP01_date	Duplicate	TBD	QA/QC	middle of observed water column	
7	MS/MSD-GW01_date	MS/MSD	TBD		middle of observed water column	
8	GWEB01_date	Equipment Blank	TBD		NA	
9	GWTB01_date	Trip Blank	NA			TCL VOC
SOIL VAPOR						
1	SV01_date	Grab	SV01	Investigate AOCs 1 & 3	Anticipated depth of proposed foundation footings, if known at the time of the investigation, or to about 2 feet above the groundwater table	TO-15
2	SV02_date		SV02			
3	SV03_date		SV03			
4	SV04_date		SV04			
5	SV05_date		SV05			
6	SV06_date		SV06			
7	SV07_date		SV07			
8	AA01_date	Field Blank	TBD	QA/QC	NA	

Notes:

Area of Concern (AOC) 1 - Historical Site Use
AOC 2 - Historic Fill
AOC 3 - Off-site Current and Historic Use

1. TBD = To be determined in the field
2. VOC = Volatile organic compounds
3. SVOC = Semivolatile organic compounds
4. PCBs = Polychlorinated biphenyls
5. TCL = Target compound list
6. TAL = Target analyte list
7. PFAS = per- and poly-fluoroalkyl substances
8. QA/QC = Quality assurance/quality control
9. NA = Not applicable

FIGURES



NOTES:

1. BASE MAP REFERENCED FROM THE UNITED STATE GEOLOGICAL SURVEY 7.5 MINUTE SERIES CENTRAL PARK QUADRANGLE, DATED 2013
2. ALL LOCATIONS APPROXIMATE

WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

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Project
261 WALTON AVENUE
BLOCK No. 2344, LOT No. 60
BRONX NEW YORK

Figure Title
SITE LOCATION MAP

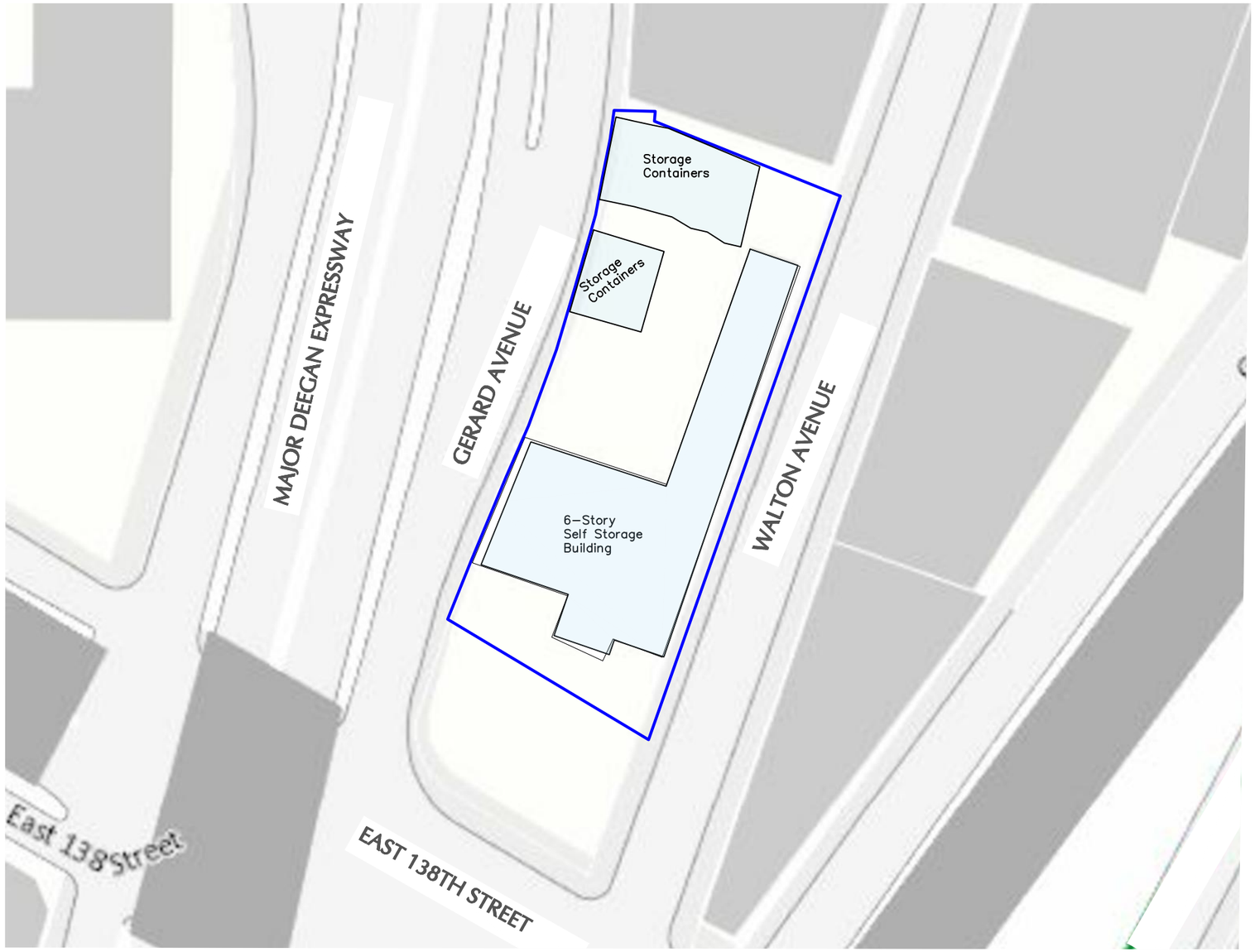
Project No.	170601701
Date	10/29/2019
Drawn By	KW
Checked By	JL

Figure No. 1

Sheet 1 of 4

© 2018 Langan

Filename: \\langan.com\data\NYC\data7\170601701\Project Data\CAD\01\SheetFiles\Environmental\RIWP\Figure 1 - Site Location Map.dwg Date: 2/19/2020 Time: 10:53 User: kwexler Style Table: Langan.stb Layout: ANSIA-BP



LEGEND:

APPROXIMATE SITE BOUNDARY

APPROXIMATE BUILDING AND STORAGE CONTAINER LOCATIONS

NOTES:

1. BASE MAP REFERENCED FROM NEW YORK CITY DEPARTMENT OF CITY PLANNING OPEN ACCESSIBLE SPACE INFORMATION SYSTEM (OASIS) MAP, ACCESSED ON JANUARY 29, 2020.
2. ALL BOUNDARIES ARE APPROXIMATE.

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60 0 30 60
SCALE IN FEET

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Project
261 WALTON AVENUE
BLOCK No. 2344, LOT No. 60
BRONX NEW YORK

Figure Title
SITE PLAN

Project No. 170601701
Date 1/29/2020
Drawn By KW
Checked By JL

Figure No. 2
Figure 2 of 4

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Filename: \\langan.com\data\NYC\data7\170601701\Project Data\CAD\01\SheetFiles\Environmental\RIWP\Figure 2 - Site Plan.dwg Date: 2/19/2020 Time: 17:04 User: kwexler Style Table: Langan.stb Layout: ANSIB-BL



Sample ID	B-4
Sample Date	1/24/2012
Sample Depth (feet bgs)	9
VOCs (mg/kg)	ND
Inorganics (mg/kg)	NE
SVOCs (mg/kg)	ND

Sample ID	B-7
Sample Date	1/24/2012
Sample Depth (feet bgs)	4
VOCs (mg/kg)	ND
Inorganics (mg/kg)	
Lead	**494**
Mercury	**0.3**
SVOCs (mg/kg)	
Benz(a)anthracene	**1.1**
Benzo(b)fluoranthene	**1.1**
Chrysene	**1.1**

Sample ID	B-8
Sample Date	1/24/2012
Sample Depth (feet bgs)	3.5
VOCs (mg/kg)	ND
Inorganics (mg/kg)	
Cadmium	**6.9**
Lead	**8440**
Mercury	**0.56**
Silver	**3.69**
SVOCs (mg/kg)	
Benz(a)anthracene	**1.9**
Benzo(a)pyrene	**1.8**
Benzo(b)fluoranthene	**2.6**
Benzo(k)fluoranthene	**0.87**
Chrysene	**2.2**

Sample ID	B-10
Sample Date	1/24/2012
Sample Depth (feet bgs)	4
VOCs (mg/kg)	ND
Inorganics (mg/kg)	NA
SVOCs (mg/kg)	ND

Sample ID	B-3
Sample Date	1/24/2012
Sample Depth (feet bgs)	1.5
VOCs (mg/kg)	ND
Inorganics (mg/kg)	
Lead	**106**
Mercury	**0.4**
SVOCs (mg/kg)	
Benz(a)anthracene	**8.3**
Benzo(a)pyrene	**10**
Benzo(b)fluoranthene	**13**
Benzo(k)fluoranthene	**6.3**
Chrysene	**7.9**
Dibenz(a,h)anthracene	**1.2**
Indeno(1,2,3-cd)pyrene	**3.7**

Sample ID	B-5
Sample Date	1/24/2012
Sample Depth (feet bgs)	3.5
VOCs (mg/kg)	NE
Inorganics (mg/kg)	
Barium	**386**
Cadmium	**4.9**
Lead	**311**
Mercury	**0.29**
SVOCs (mg/kg)	NE

Sample ID	B-6
Sample Date	1/24/2012
Sample Depth (feet bgs)	4
VOCs (mg/kg)	ND
Inorganics (mg/kg)	NE
SVOCs (mg/kg)	NE

Sample ID	B-9
Sample Date	1/24/2012
Sample Depth (feet bgs)	6
VOCs (mg/kg)	ND
Inorganics (mg/kg)	NA
SVOCs (mg/kg)	ND

LEGEND:

SITE BOUNDARY

IVI LIMITED PHASE II SOIL BORING LOCATION

Analyte	NYSDEC Part 375 Unrestricted Use SCOs	NYSDEC Part 375 Restricted Use Restricted-Residential SCOs
SVOCs (mg/kg)		
Benz(a)anthracene	1	1
Benzo(a)pyrene	1	1
Benzo(b)fluoranthene	1	1
Benzo(k)fluoranthene	0.8	3.9
Chrysene	1	3.9
Dibenz(a,h)anthracene	0.33	0.33
Indeno(1,2,3-cd)pyrene	0.5	0.5
Inorganics (mg/kg)		
Barium	350	400
Cadmium	2.5	4.3
Lead	63	400
Mercury	0.18	0.81
Silver	2	180

NOTES:

1. BASE MAP REFERENCED FROM IVI ENVIRONMENTAL LIMITED PHASE II ENVIRONMENTAL SITE ASSESSMENT REPORT, DATED FEBRUARY 16, 2012.
2. ALL BOUNDARIES ARE APPROXIMATE.
3. SOIL SAMPLE ANALYTICAL RESULTS ARE COMPARED TO TITLE 6 OF THE OFFICIAL COMPILATION OF NEW YORK CODES, RULES, AND REGULATIONS (NYCRR) UNRESTRICTED USE (UU) AND RESTRICTED USE RESTRICTED - RESIDENTIAL (RURR) SOIL CLEANUP OBJECTIVES (SCOs).
4. ONLY COMPOUNDS EXCEEDING COMPARISON CRITERIA ARE SHOWN.
5. RESULTS ABOVE THE PART 375 UU SCOs ARE BOLDED.
6. RESULTS ABOVE THE PART 375 RURR SCOs ARE SHADED.
7. VOCs = VOLATILE ORGANIC COMPOUNDS
8. SVOCs = SEMIVOLATILE ORGANIC COMPOUNDS
9. mg/kg = MILLIGRAMS PER KILOGRAM
10. ND = ANALYTE NOT DETECTED
11. NE = ANALYTE CONCENTRATIONS DID NOT EXCEED SCOs
12. NA = ANALYTE NOT ANALYZED
13. UST = UNDERGROUND STORAGE TANK
14. BGS = BELOW GRADE SURFACE

WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

100 0 20 100
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BLOCK No. 2344, LOT No. 60
BRONX NEW YORK

Figure Title
PREVIOUS SOIL SAMPLE LOCATIONS AND ANALYTICAL RESULTS MAP

Project No. 170601701
Date 11/5/2019
Drawn By KW
Checked By JL

Figure No. 3
Figure 3 of 4

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Filename: \\langan.com\data\NYC\data7\170601701\Project Data\CAD\01\SheetFiles\Environmental\RIWP\Figure 3 - Previous Soil Sample Analytical Results Map.dwg Date: 2/19/2020 Time: 11:51 User: kwexler Style Table: Langan.stb Layout: ANSIB-BL



LEGEND:

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE BUILDING LOCATIONS
- B-1 — PREVIOUS SOIL BORING LOCATION (IVI ENVIRONMENTAL, 2012)
- SB05 — PROPOSED SOIL BORING LOCATION
- SB01/MW01/SV01 — PROPOSED SOIL BORING/MONITORING WELL/SOIL VAPOR POINT LOCATION
- SB12/SV12 — PROPOSED SOIL BORING/SOIL VAPOR POINT LOCATION
- SV05 — PROPOSED SOIL VAPOR POINT LOCATION
- APPROXIMATE LOCATION OF HISTORICAL UST DOCUMENTED
- AOC 1, 2, & 3: HISTORICAL SITE USE, HISTORIC FILL, AND CURRENT AND HISTORICAL OFF–SITE USE

NOTES:

1. BASE MAP REFERENCED FROM NEW YORK CITY DEPARTMENT OF CITY PLANNING OPEN ACCESSIBLE SPACE INFORMATION SYSTEM (OASIS) MAP, ACCESSED ON JANUARY 29, 2020.
2. ALL LOCATIONS ARE APPROXIMATE.
3. SB = SOIL BORING
4. MW = MONITORING WELL
5. SV = SOIL VAPOR
6. AOC = AREA OF CONCERN
7. UST= UNDERGROUND STORAGE TANK

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Figure Title: PROPOSED REMEDIAL INVESTIGATION SAMPLE LOCATION PLAN

Project No. 170601701
Date 1/29/2020
Drawn By KW
Checked By JL

Figure No. 4
Figure 4 of 4

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Filename: \\langan.com\data\NYC\data7\170601701\Project Data\CAD\01\SheetFiles\Environmental\RIWP\Figure 4 - Proposed Sample Location Plan.dwg Date: 8/5/2021 Time: 13:29 User: jyanowitz Style Table: Langan.stb Layout: ANSIB-BL

Appendix A

PREVIOUS ENVIRONMENTAL REPORTS

Appendix B

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

261 Walton Avenue
BRONX, NY 10451

Prepared for:

Tuck-It-Away Associates – Deegan, LLC
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September 30, 2021
Langan Project No. 170480801

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) for the proposed remedial investigation (RI) was completed on behalf of Tuck-It-Away Associates – Deegan, LLC, pursuant to the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) for the site at 261 Walton Avenue, Bronx, New York (the site). Tuck-It-Away Associates – Deegan, LLC, selected Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, DPC (Langan) to complete the RI. The objective of the RI is to investigate and characterize the nature and extent of environmental impacts at the site and emanating from the site and to provide sufficient information to evaluate remedial alternatives, as required. Additional site information and data collected previously by Langan is provided in the Remedial Investigation Work Plan (RIWP).

This QAPP specifies analytical methods to be used to ensure that data from the proposed Remedial Investigation (RI) at the site are precise, accurate, representative, comparable, and complete.

1.2 PROJECT OBJECTIVES

The objective of the RI is to investigate and characterize the nature and extent of on-site and off-site environmental impacts associated with areas of concern (AOC). This QAPP addresses sampling and analytical methods that may be necessary in support of the RI. These objectives were established in order to meet standards that will protect public health and the environment for the site.

1.3 SCOPE OF WORK

The field investigation will include the tasks listed below to supplement the data and findings of previous investigations, and is described in detail in the RIWP. All RI work will be overseen by Langan. The proposed RI consists of the following:

- Completion of a geophysical survey;
- Advancement of soil borings to evaluate potential subsurface impacts from the identified areas of concerns and historical site uses;
- Installation of monitoring wells;
- Completion of a monitoring well survey;
- Installation of soil vapor points;
- Collection and chemical analysis of soil, groundwater, soil vapor, and ambient air samples;
- Implementation of a community air monitoring plan (CAMP); and
- A qualitative assessment of potential exposure pathways based on the investigation findings.

1.3.1 SUMMARY OF PROPOSED FIELD SAMPLING ACTIVITIES

Soil Boring Installation and Soil Sampling

A geophysical subcontractor will clear subsurface testing locations of potential subsurface utilities and to locate any underground storage tanks (USTs). The geophysical survey will be completed using a collection of geophysical instruments, including electromagnetic and utility line locator instruments and ground-penetrating radar (GPR). The results of the survey may require relocating subsurface testing locations.

Soil Boring Installation and Soil Sampling

A drilling subcontractor will advance 15 soil borings (SB01 through SB15) to investigate the site and the AOCs identified in Section 2.5. Soil borings will terminate at the groundwater interface if encountered or at bedrock, which is anticipated at about 9 feet bgs. Six of the soil borings (SB through SB) will be used to horizontally and vertically delineate lead impacts detected in the 3- to 4-foot sample collected from soil boring B-8. A plan showing the proposed sample locations is included as Figure 4. Table 1 indicates the sample locations that are intended to investigate each AOC.

The soil borings will be advanced using direct-push drilling technology by an experienced environmental driller. The direct-push drill rig will be equipped with a closed-point Macro-Core® sampler or dual-tube sampling system to prevent the collapse of sidewall material as borings are advanced. A Langan field engineer, scientist or geologist will document the work, screen soil samples for environmental impacts, and collect representative environmental soil samples for laboratory analyses. Soil will be screened continuously to the boring termination depth for organic vapors with a photoionization detector (PID) equipped with a 10.6 electron volt (eV) bulb and for visual and olfactory evidence of environmental impacts (e.g., NAPL, staining, odor). Soil will be visually classified for color, grain size, texture, and moisture content, and will be recorded in a field log. Nondisposable, down-hole drilling equipment and sampling apparatus will be decontaminated between locations with Alconox® and water. Water used for decontamination and rinsate will be containerized into United Nations/Department of Transportation (UN/DOT)-approved 55-gallon drums, labeled, and staged for off-site disposal.

Per- and poly-fluoroalkyl substances (PFAS) analysis will be performed according to USEPA Method 537 Modified with a maximum reporting limit of 0.5 micrograms per kilogram (ug/kg). 1,4-Dioxane analysis will be performed according to USEPA Method 8270 with a reporting limit of 0.1 milligram per kilogram (mg/kg).

Monitoring Well Installation and Groundwater Sampling

A total of four permanent groundwater monitoring wells will be installed during the investigation. Fourteen of the thirty-two soil borings will be converted into monitoring wells. Wells will be constructed across the observed water table. The wells will be constructed with 2-inch diameter, threaded, flush-joint, polyvinyl chloride (PVC) casing and 0.01-inch slot screens. Clean sand will be used to fill the annulus around the screen up to approximately two feet above the top of the screened interval. A two-foot bentonite seal will be installed above the sand, and the borehole annulus will be grouted to the surface with bentonite/cement slurry. After installation, wells will be developed by surging either a weighted bailer or surge block across the well screen/casing to agitate and remove fines.

After installation, the wells will be developed by surging using either a weighted bailer or surge block across the well screen and casing to agitate and remove fines. The bailer or surge block will be surged across the well screen in 2- to 3-foot increments for about two minutes per increment. After surging, the well will be purged via pumping until the water becomes visually clear. The well will then be allowed to stabilize for a minimum of one week.

Before sampling, the headspace of each well will be monitored with a PID and the wells will be gauged and purged. Dedicated tubing will be used at each well, and the interface probe and any sampling apparatus will be decontaminated between locations with Alconox® and water.

One groundwater sample will be collected from each newly-installed well in general accordance with NYSDEC DER-10 and United States Environmental Protection Agency's (USEPA) *Low Flow Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells*. Groundwater samples will be collected about one week after new wells are installed. No groundwater samples will be collected from monitoring wells containing NAPL.

Per- and poly-fluoroalkyl substances (PFAS) and 1,4-Dioxane will be sampled in accordance with the protocol outlined in Attachments A and B. PFAS analysis will be performed according to USEPA Method 537 Modified with a reporting limit of 2 nanograms per liter (ng/L). 1,4-Dioxane analysis will be performed according to USEPA Method 8270 SIM with a reporting limit of 0.35 ug/L.

Soil Vapor and Ambient Air Sampling

Seven soil vapor points will be installed using direct-push technology in accordance with the NYSDOH's *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). Soil vapor points will be installed by advancing a 1.875-inch polyethylene implant with tubing to the anticipated depth of proposed foundation footings, if known at the time of the investigation, or to 2 feet above the groundwater table. Samples will be collected in general accordance with the NYSDOH guidance. Before collecting vapor samples, a minimum of three vapor probe volumes (i.e., the volume of the sample implant and tubing) will be purged from each sample point at a rate

of less than 0.2 liters per minute using a RAE Systems MultiRAE® meter. An ambient air sample will be collected concurrently with the soil vapor sample at a height above the ground to represent the breathing zone (about 3 to 5 feet). Soil vapor and ambient air samples will be collected into laboratory-supplied batch-certified clean 2.7- or 6-liter Summa® canisters with calibrated flow controllers for an 2-hour sampling period.

A dust and organic vapor control and monitoring plan will be implemented during investigation activities. A table summarizing the sampling plan as outlined in the RIWP is included in Table 1.1.

1.4 DATA QUALITY OBJECTIVES AND PROCESS

The quality assurance and quality control objectives for all measurement data include:

- **Precision** – an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal QC duplicates and matrix spike duplicates.
- **Accuracy** – a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. Sampling accuracy will be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.
- **Representativeness** – expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness will be determined by assessing a number of investigation procedures, including chain of custody, decontamination, and analysis of field blanks and trip blanks.
- **Completeness** – the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested.
- **Comparability** – expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured using several procedures, including standard methods for sampling and analysis, instrument calibrations, using standard reporting units and reporting formats, and data validation.

- **Sensitivity** - the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection.

Each of the above objectives is discussed in detail in Section 3.

TABLE 1.1
Analytical Methods / Quality Assurance Summary Table

SOIL

	Quantity (1)	Analysis (2, 3, 4)
Soil Samples	36	TCL VOCs, TCL SVOCs, pesticides, PCBs, herbicides, and TAL metals (including all 6 NYCRR Part 375 compounds), TCLP – Lead, PFAS, and 1,4-Dioxane
Duplicate Soil Samples	1 (one per 20 soil samples)	
Soil Matrix Spike/Matrix Spike Duplicate	1 (one per 20 soil samples)	

GROUNDWATER

	Quantity (5)	Analysis (2, 3, 4, 6)
Groundwater Samples	4	TCL VOCs, TCL SVOCs, pesticides, PCBs, herbicides, TAL metals (including all 6 NYCRR Part 375 compounds), PFAS, and 1,4-Dioxane
Duplicate Groundwater Samples	1 (one per 20 groundwater samples)	
Groundwater Matrix Spike/Matrix Spike Duplicate	1 (one per 20 groundwater samples)	

SOIL VAPOR

	Quantity	Analysis (2)
Soil Vapor / Ambient Air Samples	7	TO-15 VOCs
Duplicate Soil Vapor Samples	1 (one per 20 soil vapor samples)	

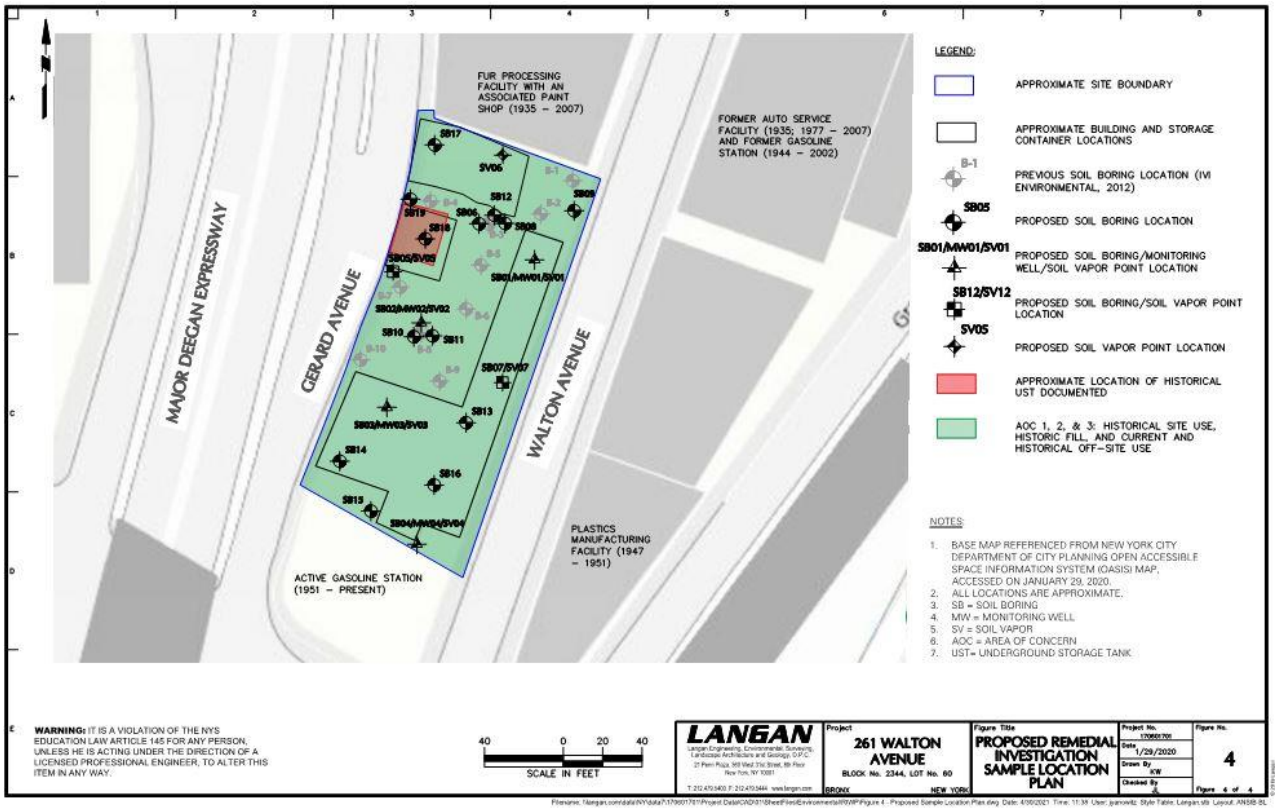
FIELD AND TRIP BLANKS

	Quantity	Analysis (2)
Soil Equipment Blanks	1 (one per 20 soil samples)	TCL VOCs, TCL SVOCs, pesticides, PCBs, herbicides, and TAL metals (including all 6 NYCRR Part 375 compounds)
Groundwater Equipment Blanks	1 (one per 20 groundwater samples)	
Trip Blanks	One per shipment of soil and groundwater samples for VOC analysis	TCL VOCs

Notes
1) Up to three soil samples are proposed for collection at each of proposed soil borings.
2) For details regarding sample containerization, volume requirements, preservation, and holding times for water, soil, and soil vapor samples, refer to tables 4.1, 4.2, and 4.3, respectively.
3) For analytical methods and reporting limits, see Table 7.1.
4) For detailed information on matrix spike and matrix spike duplicate analysis for groundwater and soil samples, see tables 3.1 and 3.2, respectively.
5) Additional samples may be collected based on encountered field conditions.
6) Groundwater samples and the duplicate groundwater sample will also be analyzed for PFAS and 1,4-Dioxane

PFAS = per- and poly-fluoroalkyl substances (PFAS)
VOCs = volatile organic compounds
SVOCs = semivolatile organic compounds
PCBs = polychlorinated biphenyls
TCL = target compound list
TAL = target analyte list
NA = not applicable
6 NYCRR = Title 6 of the New York Codes, Rules and Regulations

Figure 1.1 Soil, Groundwater, Soil Vapor, and Ambient Air Sample Locations Map



2.0 PROJECT ORGANIZATION

The execution of the RIWP will be overseen by Langan on behalf of Tuck-It-Away Associates – Deegan, LLC. Langan will collect media samples and will subcontract with a qualified driller and an Environmental Laboratory Approval Program (ELAP)-certified laboratory. Langan will also perform the data analysis, evaluation, and reporting tasks.

The analytical services will be performed by Alpha Analytical Laboratories, Inc. of Mansfield, MA, New York State Department of Health (NYSDOH) ELAP certification number 11148. Data validation services will be performed by Marla Miller; resume attached (Attachment C).

Key contacts for this project are as follows:

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Langan Project Manager:	Mr. Stuart Knoop Telephone: (212) 479-5461
Qualified Environmental Professional (QEP):	Jason J. Hayes, P.E Telephone: (212) 479-5427
Langan Quality Assurance Officer (QAO):	Mr. William Bohrer Telephone: (212) 479-5533
Data Validator:	Ms. Marla Miller Telephone: (602) 772-1839
Laboratory Representatives:	Alpha Analytical Laboratories, Inc. Mr. Ben Rao Telephone: (201) 847-9100

3.0 QUALITY ASSURANCE OBJECTIVES FOR COLLECTION OF DATA

3.1 INTRODUCTION

The quality assurance and quality control objectives for all data include precision, accuracy, representativeness, completeness, comparability, and sensitivity. These objectives are defined in following subsections. They are formulated to meet the requirements of the USEPA SW-846. The

laboratory will aim to achieve low reporting limits for all analytical methods. The analytical methods and their Contract Required Quantification Limits (CRQLs) are given in Section 7.

3.2 PRECISION

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing coded duplicate samples (labeled so that the laboratory does not recognize them as duplicates) for the same parameters, and then, during data validation (Section 8), calculating the RPD for duplicate sample results.

Analytical precision will be determined by the laboratory by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates. The formula for calculating RPD is as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD	=	Relative Percent Difference.
V1, V2	=	The two values to be compared.
$\|V1 - V2\|$	=	The absolute value of the difference between the two values.
$(V1 + V2)/2$	=	The average of the two values.

The data quality objectives for analytical precision, calculated as the RPD between duplicate analyses, are presented in Tables 3.1 and 3.2.

TABLE 3.1
QUALITY CONTROL LIMITS FOR WATER SAMPLES

			Laboratory Accuracy and Precision				
Analytical Parameters	**Analytical Method (a)**	**Matrix Spike (MS) Compounds**	**MS/MSD (b) % Recovery**	**MS/MSD RPD l**	**LCS (d) % Recovery**	**Surrogate Compounds**	**Surrogate % Recovery**
VOCs (e)	8260	1,1-Dichloroethane	61-145	-	NA	Toluene-d8	88-110
		Trichloroethene	71-120	-	NA	Bromofluorobenzene	86-115
		Benzene	76-127	-	NA	1,2-Dichloroethane-d4	76-114
		Toluene	76-125	-	NA		
		Chlorobenzene	75-130	-	NA		
SVOCs (f)	8270	Phenol	12-110	-	NA	Nitrobenzene-d5	35-114
		2-Chlorophenol	27-123	-	NA	2-Fluorobiphenyl	43-116
		1,4-Dichlorobenzene	36-97	-	NA	Terphenyl-d14	33-141
		N-Nitroso-di-n-propylamine	41-116	-	NA	Phenol-d5	10-110
		1,2,4-Trichlorobenzene	39-98	-	NA	2-Fluorophenol	21-110
		4-Chloro-3-methylphenol	23-97	-	NA	2,4,6-Tribromophenol	10-123
		Acenaphthene	46-118	-	NA	2-Chlorophenol-d4	33-110 (g)
		4-Nitrophenol	10-80	-	NA	1,2-Dichlorobenzene-d4	16-110 (g)
		2,4-Dinitrotoluene	24-96	-	NA		
		Pentachlorophenol	9-103	-	NA		
		Pyrene	26-127	-	NA		
Inorganics (i)	6010,7470/7471,7841,9010, OIA-1677	Inorganic Analyte	75-125 (j)	- (k)	80-120	NA	NA

(a) Analytical Methods: USEPA SW-846, 3rd edition, Revision 1, November 1990; any subsequent revisions shall supersede this information
(b) Matrix Spike/Matrix Spike Duplicate
(c) Relative Percent Difference
(d) Laboratory Control Sample
(e) TCL VOCs plus library search
(f) TCL SVOCs plus library search
(g) Limits are advisory only
(i) Target Analyte List Inorganics (metals)
(j)Matrix spike only
(k) Laboratory duplicate RPD
NA - Not Applicable

TABLE 3.2
QUALITY CONTROL LIMITS FOR SOIL SAMPLES

Laboratory Accuracy and Precision

Analytical Parameter	Analytical Method (a)	Matrix Spike (MS) Compounds	MS/MSD (b) % Recovery	MS/MSD RPD (c)	LCS (d) % Recovery	Surrogate Compounds	Surrogate % Recovery
VOCs (e)	8260	1,1-Dichloroethane	59-172	22	NA	Toluene-d8	84-138
		Trichloroethene	62-137	24	NA	Bromofluorobenzene	59-113
		Benzene	66-142	21	NA	1,2-Dichloroethane-d4	70-121
		Toluene	59-139	21	NA		
		Chlorobenzene	60-133	21	NA		
SVOCs (f)	8270	Phenol	26-90	35	NA	Nitrobenzene-d5	23-120
		2-Chlorophenol	25-102	50	NA	2-Fluorobiphenyl	30-115
		1,4-Dichlorobenzene	28-104	27	NA	Terphenyl-d14	18-137
		N-Nitroso-di-n-propylamine	41-126	38	NA	Phenol-d5	24-113
		1,2,4-Trichlorobenzene	38-107	23	NA	2-Fluorophenol	25-121
		4-Chloro-3-methylphenol	26-103	33	NA	2,4,6-Tribromophenol	19-122
		Acenaphthene	31-137	19	NA	2-Chlorophenol-d4	20-130 (g)
		4-Nitrophenol	11-114	50	NA	1,2-Dichlorobenzene-d4	20-130 (g)
		2,4-Dinitrotoluene	28-89	47	NA		
		Pentachlorophenol	17-109	47	NA		
		Pyrene	35-142	36	NA		
Inorganics (i)	6010, 7470/7471, 7841, 9010	Inorganic Analyte	75-125 (j)	20 (k)	80-120	NA	NA
PCBs (h)	8082	PCBs (Aroclor 1260)	50-128	50	NA	Tetrachlorometaxylene	24-154
						Decachlorobiphenyl	25-159

(a) Analytical Methods: USEPA SW-846, 3rd edition, Revision 1, November 1990, any subsequent revisions shall supersede this information
(b) Matrix Spike/Matrix Spike Duplicate
(c) Relative Percent Difference
(d) Laboratory Control Sample
(e) TCL VOCs plus library search
(f) TCL SVOCs plus library search
(g) Limits are advisory only
(h) PCBs
(i) Target Analyte List Inorganics (metals and cyanide)
(j) Matrix spike only
(k) Laboratory duplicate RPD
NA - Not Applicable

3.3 ACCURACY

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material, and is expressed as the percent of the known quantity, which is recovered or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes, which are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise." Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike). The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

- %R = Percent recovery.
- SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.
- SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.
- SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for each parameter are presented in Tables 3.1 and 3.2.

3.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter, which is most concerned with the proper design of the sampling program (USEPA, 1987). Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the Field Sampling Plan. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank, duplicate and Chain-of-custody procedures are presented in Sections 4 and 5.

3.5 COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid (USEPA, 1987). The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

$$\%C = \frac{V}{T} \times 100$$

where:

%C = Percent completeness.

V = Number of measurements judged valid.
T = Total number of measurements.

3.6 COMPATABILITY

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of all analytical standards and/or source materials to the USEPA or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all users of either the data or the conclusions drawn from them will be able to judge the comparability of the data and conclusions.

3.7 SENSITIVITY

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection and QC acceptance limits that meet established performance criteria. Concurrently, the project manager will select the level of data assessment to ensure that only data meeting the project data quality objectives are used in decision-making.

Field equipment will be used that can achieve the required levels of detection for analytical measurements in the field. In addition, the field sampling staff will collect and submit full volumes of samples as required by the laboratory for analysis, whenever possible. Full volume aliquots will help ensure achievement of the required limits of detection and allow for reanalysis if necessary. The concentration of the lowest level check standard in a multi-point calibration curve will represent the reporting limit.

Analytical methods and quality assurance parameters associated with the sampling program are presented in Table 1.1. The frequency of associated equipment blanks and duplicate samples will be based on the recommendations listed in DER-10 and as described in Table 1.1.

Site-specific MS and MSD samples will be prepared and analyzed by the analytical laboratory by spiking an aliquot of submitted sample volume with analytes of interest. Additional sample volume is not required by the laboratory for this purpose. An MS/MSD analysis will be analyzed at a rate of 1 out of every 20 samples, or one per analytical batch. MS/MSD samples are only required for soil and groundwater samples.

4.0 SAMPLING PROGRAM

4.1 INTRODUCTION

Soil and groundwater sampling will be conducted in accordance with the established NYSDEC protocols contained in DER-10. Air sampling will be conducted in accordance with the established NYSDOH protocols contained in the *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). The following sections describe procedures to be followed for specific tasks.

4.2 SAMPLE NOMENCLATURE

The sample nomenclature system was devised such that the following objectives can be attained (see Attachment D):

- Sorting of data by matrix;
- Sorting of data by depth;
- Maintenance of consistency (filed, laboratory, and database sample numbers);
- Accommodation of all project-specific requirements; and
- Accommodation of laboratory sample number length constraints (maximum 20 characters).

4.3 SAMPLE CONTAINER PREPARATION AND SAMPLE PRESERVATION

Sample containers will be properly washed and decontaminated prior to their use by either the analytical laboratory or the container vendor to the specifications required by the USEPA. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. The containers will be labeled and the appropriate preservatives will be added. The types of containers are shown in Tables 4.1 and 4.2.

Food and beverages will be prohibited near sampling equipment. Additionally, no cosmetics, moisturizers, hand cream, sun screen or clothing material containing Gore-Tex™ or Tyvek® will be worn during sampling. Each grab PFAS soil sample will be collected into one 8-ounce HDPE container. Soil 1,4-Dioxane samples will be collected in 4 ounce jars.

Samples shall be preserved according to the preservation techniques given in Tables 4.1 and 4.2. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles should be placed on ice in the shipping cooler, cooled to 4°C with ice in Ziploc® bags (or equivalent), and delivered to the laboratory within 48 hours of collection. Chain-of-custody procedures are described in Section 5.

4.4 PFAS SPECIAL CONSIDERATIONS AND TARGET ANALYTE LIST

Special considerations applying to the collection of soil and groundwater samples for PFAS analysis to prevent cross-contamination include the following;

- Field equipment will no contain Teflon®
- All sampling material will be made from stainless, HDPE, acetate or silicon
- No waterproof field books will be used
- No plastic clipboards, binders, or spiral hard cover notebooks will be used
- No adhesives will be used
- No sharpies or permanent markers will be used; ball point pens are acceptable
- Aluminum foil will not be used
- PFAS samples will be kept in a separate cooler from other sampling containers
- Coolers will be filled only with regular ice

PFAS sampling protocols are provided in Attachments A and B.

DER has developed a PFAS target analyte list. At minimum, the laboratory will report the following PFAS target compounds:

Group	Analyte Name	Abbreviation	CAS #
Perfluoroalkyl carboxylates	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	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4

Group	Analyte Name	Abbreviation	CAS #
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

4.5 SAMPLE HOLDING TIMES

The sample holding times for organic and inorganic parameters are given in Tables 4.1 and 4.2 and must be in accordance with the USEPA requirements for each method. The USEPA technical holding times must be strictly adhered to by the laboratory. Any holding time exceedances must be reported to Langan.

4.6 FIELD QC SAMPLES

To assess cross-contamination and effectiveness of equipment decontamination, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include:

a. **Trip Blanks** - A trip blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of a 40-ml vials containing distilled, deionized water, which accompanies the other water sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for Part 375 volatiles analysis. The trip blank will be analyzed for volatile organic compounds to assess any contamination from sampling and transport, and internal laboratory procedures.

b. **Equipment Blanks** - Equipment blanks will be collected for quality assurance purposes at a rate of one per 20 investigative samples per matrix (soil and groundwater only). Equipment blanks will be obtained by pouring laboratory-demonstrated analyte-free water on or through a decontaminated sampling device following use and implementation of decontamination protocols. The water will be collected off of the sampling device into a laboratory-provided sample container for analysis. Equipment blank samples will be analyzed for the complete list of analytes on the day of sampling.

c. **PFAS Equipment Blanks** – A PFAS equipment blank will be prepared each day that PFAS sampling occurs. PFAS equipment blanks will be obtained by pouring laboratory-demonstrated analyte-free water on or throughout a decontaminated sampling device following use and implementation of decontamination protocols. The water will be collected off of the sampling device into a laboratory-provided HDPE sample container for analysis. The PFAS equipment blank will be analyzed for PFAS via USEPA Method 537 Modified.

The duplicates will include:

a. **Coded Field Duplicate** - To determine the representativeness of the sampling methods, coded field duplicates will be collected at a minimum frequency of one per 20 field samples for each matrix (soil, groundwater, and soil vapor). The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise.

b. **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples (soil and groundwater). These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and RPDs are given in Tables 3.1 and 3.2.

4.7 DECONTAMINATION PROCEDURES

Decontamination procedures will be used for non-dedicated sampling equipment. Decontamination of field personnel is discussed in the site-specific HASP. Field sampling equipment that is to be reused will be decontaminated in the field in accordance with the following procedures:

1. Laboratory-grade glassware detergent and tap water scrub to remove visual contamination
2. Generous tap water rinse
3. Distilled/de-ionized water rinse

Non-dedicated equipment used for PFAS sampling will be rinsed using a three bucket rinse procedure. An about three-gallon solution of decontamination fluid consisting of Alconox® or Citranox® and de-ionized water will be prepared in a five-gallon bucket for the first equipment rinse. A second five-gallon bucket will be filled with about three gallons of de-ionized water for the second rinse. A third five-gallon bucket will be filled with about three gallons of water for the final rinse. Powderless nitrile gloves will be donned during the handling of sampling equipment and containers.

The Safety Data Sheets of detergents used in decontamination procedures will be reviewed to ensure fluoro-surfactants and 1,4-dioxane are not listed as ingredients. Laboratory-verified PFAS-free water will be used as the final rinse during decontamination of sampling equipment.

4.8 RESIDUALS MANAGEMENT

Debris (e.g., paper, plastic and disposable PPE) will be collected in plastic garbage bags and disposed of as non-hazardous industrial waste. Debris is expected to be transported to a local municipal landfill for disposal. Drill cuttings will be placed back in the borehole from which it was sampled unless the soil is grossly-contaminated. If gross contamination is observed, soil will be collected and stored in Department of Transportation (DOT)-approved 55-gallon drums in a designated storage area at the site. Grossly-contaminated drill cuttings contained in drums will be stored in a designated storage area at the site and will be analyzed, characterized and disposed off-site in accordance with applicable federal and state regulations.

Residual fluids (such as purge water) will be collected and stored in DOT-approved (or equivalent) 55-gallon drums in a designated storage area at the site. The residual fluids will be analyzed, characterized and disposed off-site in accordance with applicable federal and state regulations. Residual fluids such as decontamination water may be discharged to the ground surface; however, if gross contamination is observed, the residual fluids will be collected, stored, and transported similar purge water or other residual fluids.

TABLE 4.1
WATER SAMPLE CONTAINERIZATION, PRESERVATION, AND HOLDING TIMES

Analysis	Bottle Type	Preservation (a)	Holding Time (b)
VOCs	40 mL glass VOA vials w/ Teflon-lined cap	HCl pH<2, Cool to 4°C	14 days
SVOCs	1000 mL glass w/ Teflon-lined cap	Cool to 4°C	7 days*
PCBs	1000 mL glass w/ Teflon-lined cap	Cool to 4°C	7 days**
Metals	1000 mL plastic bottle	HNO_3 to pH < 2 Cool to 4°C	180 days, except mercury (28 days)
1,4-Dioxane	1000 mL glass w/ Teflon-lined cap	Cool to 4°C	7 days**
PFAS	250 mL HDPE bottles	Cool to 4°C	14 days

(a) All samples to be preserved in ice during collection and transport. Select samples preserved with hydrochloric acid (HCl) and nitric acid (HNO_3) as noted.

(b) Days from date of sample collection.

* Continuous liquid-liquid extraction is the required extraction for water samples for SVOCs. Continuous liquid-liquid extraction and concentration of water samples for SVOC analysis completed within 7 days from the date of sample collection. Extracts of water samples must be analyzed within 40 days of extraction.

** Procedures for extraction and concentration of water samples for PCBs must be completed within 7 days from the date of sample collection. Extracts of water samples must be analyzed within 40 days of extraction.

TABLE 4.2
SOIL SAMPLE
CONTAINERIZATION, PRESERVATION AND HOLDING TIMES

Analysis	Bottle Type	Preservation [a]	Holding Time [b]
VOCs	40 mL glass VOA vials or 5-g Encore samplers	Cool to 4°C, MeOH (VOA vials)	14 days*
SVOCs	Wide-mouth glass w/ Teflon lined cap	Cool to 4°C	14 days*
Metals	Wide-mouth plastic or glass	Cool to 4°C	180 days, except mercury (28 days)
PCBs	Wide-mouth glass w/ Teflon-lined cap	Cool to 4°C	14 days**
Herbicides	Wide-mouth glass w/ Teflon-lined cap	Cool to 4°C	14 days**
Cyanide, Total	Wide-mouth glass w/ Teflon-lined cap	Cool to 4°C	14 days
Hexavalent Chromium	Wide-mouth glass w/ Teflon-lined cap	Cool to 4°C	30 Days
1,4-Dioxane	40 mL glass VOA vials or 5-g Encore samplers	Cool to 4°C MeOH (VOA vials)	14 days *
PFAS	8-oz HDPE bottles	Cool to 4°C	28 days

(a) All samples to be preserved in ice during collection and transport. Samples collected for VOC analysis in VOA vials are preserved with methanol (MeOH).

(b) Days from date of sample collection.

* Samples collected for VOC analysis using Encore samplers must be analyzed within 48 hours unless frozen. Samples frozen within 48 hours can be analyzed up to 14 days from the date of sample collection.

* Soxhlet or sonication procedures for extraction and concentration of soil/waste samples for SVOCs must be completed within 14 days from the date of sample collection. Extracts of soil samples must be analyzed within 40 days of extraction.

** Procedures for extraction and concentration of soil/waste samples for PCBs and herbicides must be completed within 14 days from the date of sample collection. Extracts of soil samples must be analyzed within 40 days of extraction.

TABLE 4.3
SOIL VAPOR, INDOOR AIR, AND AMBIENT AIR SAMPLES
CONTAINERIZATION PRESENTATION AND HOLDING TIMES

Analysis	Bottle Type	Preservation	Holding Time [(a)]
VOCs	Summa Canister	None	30 days

(a) Days from date of sample collection.

* Summa canisters will be batch-certified by the analytical laboratory.

5.0 SAMPLE SHIPMENT, TRACKING AND CUSTODY

5.1 INTRODUCTION

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the Chain-of-custody (COC) and transfer of samples will be trained as to the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity is provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is shown in Figure 5.1. A sample is considered to be in a person's custody if the sample is:

- In his/her possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with custody seals so that no one can tamper with it after having been in physical custody; or
- In a secured area, restricted to authorized personnel.

5.2 PACKAGING

Air samples canisters can be stored and transported without additional packaging. Soil and groundwater sample containers will be placed in plastic coolers. Ice in Ziploc® bags (or equivalent) will be placed around sample containers. Cushioning material will be added around the sample containers if necessary. COCs and other paperwork will be placed in a Ziploc® bag (or equivalent) and placed inside the cooler. The cooler will be taped closed and custody seals will be affixed to one side of the cooler at a minimum. If the samples are being shipped by an express delivery company (e.g. FedEx) then laboratory address labels will be placed on top of the cooler

5.3 SHIPPING

Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below.

- All environmental samples will be transported to the laboratory by a laboratory-provided courier under the chain-of-custody protocols.

Prior notice will be provided to the laboratory regarding when to expect shipped samples. If the number, type or date of shipment changes due to site constraints or program changes, the laboratory will be informed.

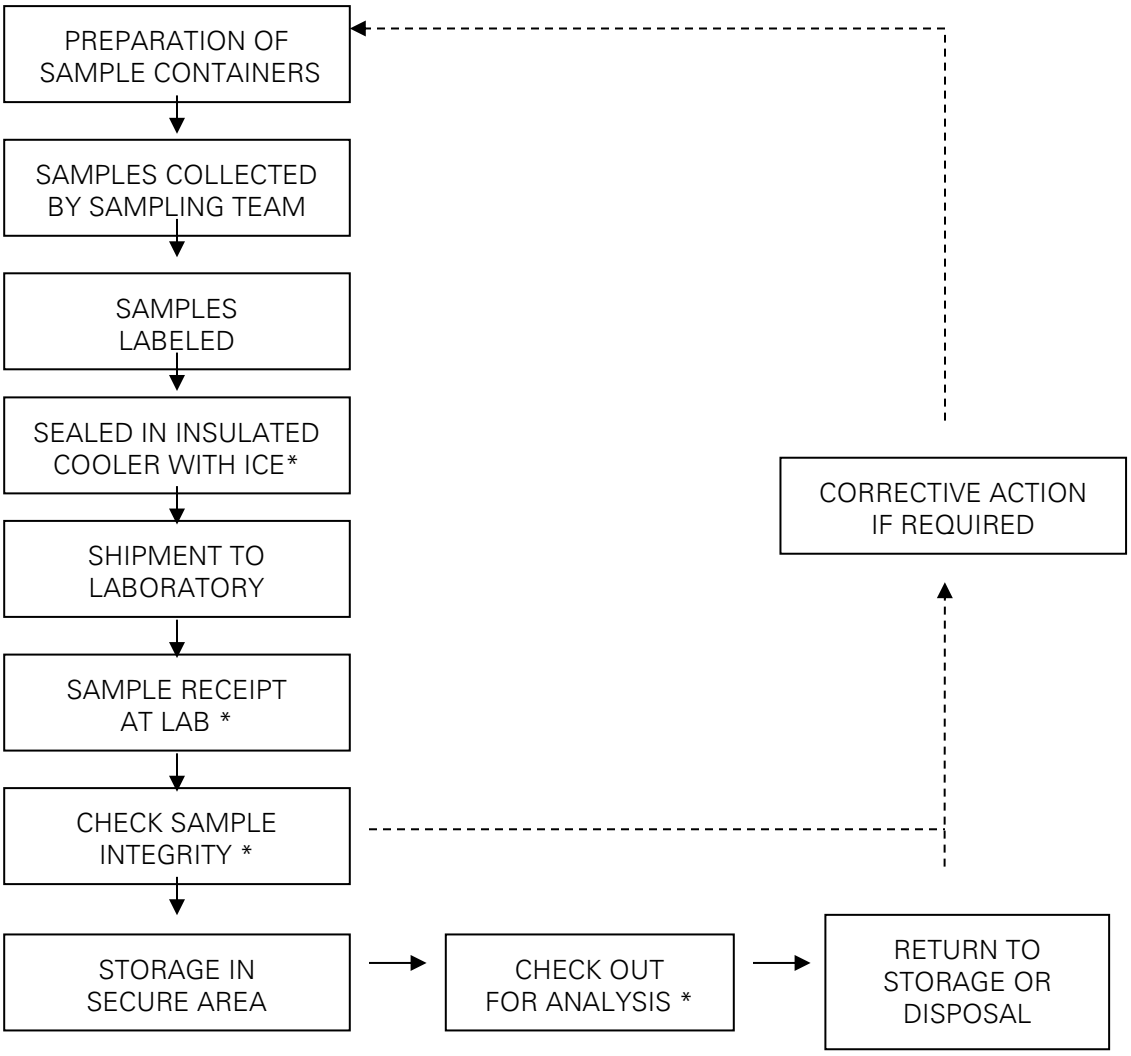
5.4 FIELD SAMPLE CUSTODY

A COC record (Figure 5.2 or similar) accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Triplicate copies of the COC must be completed for each sample set collected.

The COC lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The COC also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample.

The *REMARKS* space on the COC is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first *RELINQUISHED BY* space. The sampler will also write the method of shipment, the shipping cooler identification number, and the shipper airbill number on the top of the COC.

Figure 5.1 Sample Custody



* REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

Figure 5.2 Sample Chain-of-Custody Form

ALPHA ANALYTICAL LABORATORIES

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

NEW YORK CHAIN OF CUSTODY

Page of

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Date Rec'd in Lab

ALPHA Job #

Client Information

Client:
Address:
Phone:
Fax:
Email:

Project Information

Project Name:
Project Location:
Project #
(Use Project name as Project #)
Project Manager:
ALPHAQuote #:

Turn-Around Time

Standard
Rush (only if pre approved)
Due Date:
# of Days:

Deliverables

ASP-A
EQuIS (1 File)
Other
ASP-B
EQuIS (4 File)

Regulatory Requirement

NY TOGS
AWQ Standards
NY Restricted Use
NY Unrestricted Use
NYC Sewer Discharge
NY Part 375
NY CP-51
Other

Billing Information

Same as Client Info
PO #

Disposal Site Information

Please identify below location of applicable disposal facilities.
Disposal Facility:
NJ
NY
Other:

These samples have been previously analyzed by Alpha
Other project specific requirements/comments:

Please specify Metals or TAL.

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS	Sample Filtration	Total Bottles
							☐ Done ☐ Lab to do Preservation ☐ Lab to do (Please Specify below)	

Mistakes will be crossed out with a single line in ink and initialed by the author.

One copy of the COC is retained by sampling personnel (notations identifying blind duplicate samples will be added to this copy of the COC, but not the others that will go to the laboratory) and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will not be analyzed.

5.5 LABORATORY SAMPLE CUSTODY

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original COC documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.
- The samples will be stored in a secured area at a temperature of approximately 4°C until analyses commence.

- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

6.0 CALIBRATION PROCEDURES

6.1 FIELD INSTRUMENTS

A PID will be used during the sampling activities to evaluate work zone action levels, collect pre- and post-sample readings for air samples, screen soil samples, and collect monitoring well headspace readings. Field calibration and/or field checking of the PID will be the responsibility of the field team leader and will be accomplished by following the procedures outlined in the operating manual for the instrument. At a minimum, field calibration and/or field equipment checking will be performed once daily, prior to use. Field calibration will be documented in the field notebook. Entries made into the logbook regarding the status of field equipment will include the following information:

- Date and time of calibration
- Type of equipment serviced and identification number (such as serial number)
- Reference standard used for calibration
- Calibration and/or maintenance procedure used
- Other pertinent information

A water quality meter (Horiba U-52 or similar) will be used during purging and sampling of groundwater to measure pH, specific conductance, temperature, dissolved oxygen, turbidity and oxidation-reduction-potential (ORP) every five minutes. Water-quality meters should be calibrated and the results documented before use each day using standardized field calibration procedures and calibration checks.

Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent utilization. The equipment will be properly tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated to the manufacturer's specifications by qualified personnel. Equipment that cannot be repaired will be replaced.

Off-site calibration and maintenance of field instruments will be conducted as appropriate throughout the duration of project activities. All field instrumentation, sampling equipment and accessories will be maintained in accordance with the manufacturer's recommendations and specifications and established field equipment practice. Off-site calibration and maintenance will be performed by qualified personnel. A logbook will be kept to document that established calibration and maintenance procedures were followed. Documentation will include both scheduled and unscheduled maintenance.

6.2 LABORATORY INSTRUMENTS

The laboratory will follow all calibration procedures and schedules as specified in the sections of the USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods given in Section 7.

7.0 ANALYTICAL PROCEDURES

7.1 INTRODUCTION

Samples will be analyzed according to the USEPA SW-846 "Test Methods for Evaluating Solid Waste," November 1986, 3rd edition and subsequent updates. The methods for the laboratory analysis of soil, water, and air samples and the quantitation limits presented in Table 7.1.

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
	VOCs			
1	Methylene chloride	8260C/5035	0.01	0.00165
2	1,1-Dichloroethane	8260C/5035	0.0015	0.00027
3	Chloroform	8260C/5035	0.0015	0.00037
4	Carbon tetrachloride	8260C/5035	0.001	0.000345
5	1,2-Dichloropropane	8260C/5035	0.0035	0.000228
6	Dibromochloromethane	8260C/5035	0.001	0.000176
7	1,1,2-Trichloroethane	8260C/5035	0.0015	0.000313
8	Tetrachloroethene	8260C/5035	0.001	0.000302
9	Chlorobenzene	8260C/5035	0.001	0.000348
10	Trichlorofluoromethane	8260C/5035	0.005	0.000417
11	1,2-Dichloroethane	8260C/5035	0.001	0.000246
12	1,1,1-Trichloroethane	8260C/5035	0.001	0.00035
13	Bromodichloromethane	8260C/5035	0.001	0.000308
14	trans-1,3-Dichloropropene	8260C/5035	0.001	0.000208
15	cis-1,3-Dichloropropene	8260C/5035	0.001	0.000231
16	1,3-Dichloropropene, Total	8260C/5035	0.001	0.000208
17	1,1-Dichloropropene	8260C/5035	0.005	0.000328
18	Bromoform	8260C/5035	0.004	0.000237
19	1,1,2,2-Tetrachloroethane	8260C/5035	0.001	0.000298
20	Benzene	8260C/5035	0.001	0.000193
21	Toluene	8260C/5035	0.0015	0.000195
22	Ethylbenzene	8260C/5035	0.001	0.00017
23	Chloromethane	8260C/5035	0.005	0.000436
24	Bromomethane	8260C/5035	0.002	0.000338
25	Vinyl chloride	8260C/5035	0.002	0.000315
26	Chloroethane	8260C/5035	0.002	0.000316
27	1,1-Dichloroethene	8260C/5035	0.001	0.000372
28	trans-1,2-Dichloroethene	8260C/5035	0.0015	0.000241
29	Trichloroethene	8260C/5035	0.001	0.000302

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
30	1,2-Dichlorobenzene	8260C/5035	0.005	0.000182
31	1,3-Dichlorobenzene	8260C/5035	0.005	0.000218
32	1,4-Dichlorobenzene	8260C/5035	0.005	0.000182
33	Methyl tert butyl ether	8260C/5035	0.002	0.000153
34	p/m-Xylene	8260C/5035	0.002	0.000351
35	o-Xylene	8260C/5035	0.002	0.000338
36	Xylene (Total)	8260C/5035	0.002	0.000338
37	cis-1,2-Dichloroethene	8260C/5035	0.001	0.000342
38	1,2-Dichloroethene (total)	8260C/5035	0.001	0.000241
39	Dibromomethane	8260C/5035	0.01	0.000239
40	Styrene	8260C/5035	0.002	0.000401
41	Dichlorodifluoromethane	8260C/5035	0.01	0.0005
42	Acetone	8260C/5035	0.01	0.00229
43	Carbon disulfide	8260C/5035	0.01	0.0011
44	2-Butanone	8260C/5035	0.01	0.00069
45	Vinyl acetate	8260C/5035	0.01	0.000153
46	4-Methyl-2-pentanone	8260C/5035	0.01	0.000244
47	1,2,3-Trichloropropane	8260C/5035	0.01	0.000177
48	2-Hexanone	8260C/5035	0.01	0.000666
49	Bromochloromethane	8260C/5035	0.005	0.000357
50	2,2-Dichloropropane	8260C/5035	0.005	0.00045
51	1,2-Dibromoethane	8260C/5035	0.004	0.000199
52	1,3-Dichloropropane	8260C/5035	0.005	0.000183
53	1,1,1,2-Tetrachloroethane	8260C/5035	0.001	0.000318
54	Bromobenzene	8260C/5035	0.005	0.000219
55	n-Butylbenzene	8260C/5035	0.001	0.000228
56	sec-Butylbenzene	8260C/5035	0.001	0.000217
57	tert-Butylbenzene	8260C/5035	0.005	0.000247
58	o-Chlorotoluene	8260C/5035	0.005	0.000221
59	p-Chlorotoluene	8260C/5035	0.005	0.000183
60	1,2-Dibromo-3-chloropropane	8260C/5035	0.005	0.000396
61	Hexachlorobutadiene	8260C/5035	0.005	0.000348
62	Isopropylbenzene	8260C/5035	0.001	0.000194
63	p-Isopropyltoluene	8260C/5035	0.001	0.000202
64	Naphthalene	8260C/5035	0.005	0.000138
65	Acrylonitrile	8260C/5035	0.01	0.000514
66	n-Propylbenzene	8260C/5035	0.001	0.000215

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
67	1,2,3-Trichlorobenzene	8260C/5035	0.005	0.000251
68	1,2,4-Trichlorobenzene	8260C/5035	0.005	0.000215
69	1,3,5-Trimethylbenzene	8260C/5035	0.005	0.000161
70	1,2,4-Trimethylbenzene	8260C/5035	0.005	0.000186
71	1,4-Dioxane	8260C/5035	0.04	0.0144
72	1,4-Diethylbenzene	8260C/5035	0.004	0.004
73	4-Ethyltoluene	8260C/5035	0.004	0.000234
74	1,2,4,5-Tetramethylbenzene	8260C/5035	0.004	0.000156
75	Ethyl ether	8260C/5035	0.005	0.00026
76	trans-1,4-Dichloro-2-butene	8260C/5035	0.005	0.000392
	SVOCs			
1	Acenaphthene	8270D	0.1332	0.0172494
2	1,2,4-Trichlorobenzene	8270D	0.1665	0.0190476
3	Hexachlorobenzene	8270D	0.0999	0.018648
4	Bis(2-chloroethyl)ether	8270D	0.14985	0.0225774
5	2-Chloronaphthalene	8270D	0.1665	0.0165168
6	1,2-Dichlorobenzene	8270D	0.1665	0.0299034
7	1,3-Dichlorobenzene	8270D	0.1665	0.028638
8	1,4-Dichlorobenzene	8270D	0.1665	0.0290709
9	3,3'-Dichlorobenzidine	8270D	0.1665	0.044289
10	2,4-Dinitrotoluene	8270D	0.1665	0.0333
11	2,6-Dinitrotoluene	8270D	0.1665	0.0285714
12	Fluoranthene	8270D	0.0999	0.0191142
13	4-Chlorophenyl phenyl ether	8270D	0.1665	0.0178155
14	4-Bromophenyl phenyl ether	8270D	0.1665	0.0254079
15	Bis(2-chloroisopropyl)ether	8270D	0.1998	0.0284382
16	Bis(2-chloroethoxy)methane	8270D	0.17982	0.0166833
17	Hexachlorobutadiene	8270D	0.1665	0.0243756
18	Hexachlorocyclopentadiene	8270D	0.47619	0.150849
19	Hexachloroethane	8270D	0.1332	0.0269397
20	Isophorone	8270D	0.14985	0.0216117
21	Naphthalene	8270D	0.1665	0.0202797
22	Nitrobenzene	8270D	0.14985	0.024642
23	NitrosoDiPhenylAmine(NDPA)/DPA	8270D	0.1332	0.0189477
24	n-Nitrosodi-n-propylamine	8270D	0.1665	0.0257076
25	Bis(2-Ethylhexyl)phthalate	8270D	0.1665	0.057609

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
26	Butyl benzyl phthalate	8270D	0.1665	0.041958
27	Di-n-butylphthalate	8270D	0.1665	0.0315684
28	Di-n-octylphthalate	8270D	0.1665	0.05661
29	Diethyl phthalate	8270D	0.1665	0.0154179
30	Dimethyl phthalate	8270D	0.1665	0.034965
31	Benzo(a)anthracene	8270D	0.0999	0.0187479
32	Benzo(a)pyrene	8270D	0.1332	0.040626
33	Benzo(b)fluoranthene	8270D	0.0999	0.0280386
34	Benzo(k)fluoranthene	8270D	0.0999	0.02664
35	Chrysene	8270D	0.0999	0.017316
36	Acenaphthylene	8270D	0.1332	0.0257076
37	Anthracene	8270D	0.0999	0.0324675
38	Benzo(ghi)perylene	8270D	0.1332	0.0195804
39	Fluorene	8270D	0.1665	0.0161838
40	Phenanthrene	8270D	0.0999	0.0202464
41	Dibenzo(a,h)anthracene	8270D	0.0999	0.0192474
42	Indeno(1,2,3-cd)Pyrene	8270D	0.1332	0.0232101
43	Pyrene	8270D	0.0999	0.0165501
44	Biphenyl	8270D	0.37962	0.038628
45	4-Chloroaniline	8270D	0.1665	0.030303
46	2-Nitroaniline	8270D	0.1665	0.0321012
47	3-Nitroaniline	8270D	0.1665	0.0314019
48	4-Nitroaniline	8270D	0.1665	0.068931
49	Dibenzofuran	8270D	0.1665	0.0157509
50	2-Methylnaphthalene	8270D	0.1998	0.0201132
51	Acetophenone	8270D	0.1665	0.0206127
52	2,4,6-Trichlorophenol	8270D	0.0999	0.0315684
53	P-Chloro-M-Cresol	8270D	0.1665	0.0248085
54	2-Chlorophenol	8270D	0.1665	0.0196803
55	2,4-Dichlorophenol	8270D	0.14985	0.0267732
56	2,4-Dimethylphenol	8270D	0.1665	0.054945
57	2-Nitrophenol	8270D	0.35964	0.062604
58	4-Nitrophenol	8270D	0.2331	0.067932
59	2,4-Dinitrophenol	8270D	0.7992	0.077589
60	4,6-Dinitro-o-cresol	8270D	0.4329	0.07992
61	Pentachlorophenol	8270D	0.1332	0.03663
62	Phenol	8270D	0.1665	0.0251415

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
63	2-Methylphenol	8270D	0.1665	0.0258075
64	3-Methylphenol/4-Methylphenol	8270D	0.23976	0.0260739
65	2,4,5-Trichlorophenol	8270D	0.1665	0.0319014
66	Benzoic Acid	8270D	0.53946	0.168498
67	Benzyl Alcohol	8270D	0.1665	0.050949
68	Carbazole	8270D	0.1665	0.0161838
	Pesticides			
1	Delta-BHC	8081B	0.007992	0.0015651
2	Lindane	8081B	0.00333	0.00148851
3	Alpha-BHC	8081B	0.00333	0.00094572
4	Beta-BHC	8081B	0.007992	0.0030303
5	Heptachlor	8081B	0.003996	0.00179154
6	Aldrin	8081B	0.007992	0.00281385
7	Heptachlor epoxide	8081B	0.014985	0.0044955
8	Endrin	8081B	0.00333	0.0013653
9	Endrin aldehyde	8081B	0.00999	0.0034965
10	Endrin ketone	8081B	0.007992	0.00205794
11	Dieldrin	8081B	0.004995	0.0024975
12	4,4'-DDE	8081B	0.007992	0.00184815
13	4,4'-DDD	8081B	0.007992	0.00285048
14	4,4'-DDT	8081B	0.014985	0.0064269
15	Endosulfan I	8081B	0.007992	0.00188811
16	Endosulfan II	8081B	0.007992	0.00267066
17	Endosulfan sulfate	8081B	0.00333	0.00152181
18	Methoxychlor	8081B	0.014985	0.004662
19	Toxaphene	8081B	0.14985	0.041958
20	cis-Chlordane	8081B	0.00999	0.00278388
21	trans-Chlordane	8081B	0.00999	0.00263736
22	Chlordane	8081B	0.064935	0.0264735
	Herbicides			
1	2,4,5-TP (Silvex)	8151A	0.1665	0.0044289
	PCBs			
1	Aroclor 1016	8082A	0.0335	0.0026465
2	Aroclor 1221	8082A	0.0335	0.0030887

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
3	Aroclor 1232	8082A	0.0335	0.0039262
4	Aroclor 1242	8082A	0.0335	0.0041004
5	Aroclor 1248	8082A	0.0335	0.0028274
6	Aroclor 1254	8082A	0.0335	0.0027537
7	Aroclor 1260	8082A	0.0335	0.0025527
8	Aroclor 1262	8082A	0.0335	0.0016616
9	Aroclor 1268	8082A	0.0335	0.0048575
10	PCBs, Total	8082A	0.0335	0.0016616
	Metals			
1	Aluminum, Total	6010C	4	1.08
2	Antimony, Total	6010C	2	0.152
3	Arsenic, Total	6010C	0.4	0.0832
4	Barium, Total	6010C	0.4	0.0696
5	Beryllium, Total	6010C	0.2	0.0132
6	Cadmium, Total	6010C	0.4	0.0392
7	Calcium, Total	6010C	4	1.4
8	Chromium, Total	6010C	0.4	0.0384
9	Cobalt, Total	6010C	0.8	0.0664
10	Copper, Total	6010C	0.4	0.1032
11	Iron, Total	6010C	2	0.3612
12	Lead, Total	6010C	2	0.1072
13	Magnesium, Total	6010C	4	0.616
14	Manganese, Total	6010C	0.4	0.0636
15	Mercury	7471B	0.08	0.016896
16	Nickel, Total	6010C	1	0.0968
17	Potassium, Total	6010C	100	5.76
18	Selenium, Total	6010C	0.8	0.1032
19	Silver, Total	6010C	0.4	0.1132
20	Sodium, Total	6010C	80	1.26
21	Thallium, Total	6010C	0.8	0.126
22	Vanadium, Total	6010C	0.4	0.0812
23	Zinc, Total	6010C	2	0.1172
	General Chemistry			
1	Cyanide	9010C	0.8	0.16
2	Hexavalent Chromium	7196A	1	0.166

TABLE 7.1
PROJECT QUANTITATION LIMITS - SOIL

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (mg/kg)**	**MDL(mg/kg)**
3	Trivalent Chromium	7196	0.8	0.8
	PFAS		**RL (µg/kg)**	**MDL (µg/kg)**
1	Perfluorohexanoic acid (PFHxA)	537 Rev 1.15	0.5	0.0525
2	Perfluoroheptanoic acid (PFHpA)	537 Rev 1.15	0.5	0.0451
3	Perfluorooctanoic acid (PFOA)	537 Rev 1.15	0.5	0.0419
4	Perfluorononanoic acid (PFNA)	537 Rev 1.15	0.5	0.075
5	Perfluorodecanoic acid (PFDA)	537 Rev 1.15	0.5	0.067
6	Perfluoroundecanoic acid (PFUnA)	537 Rev 1.15	0.5	0.0468
7	Perfluorododecanoic acid (PFDoA)	537 Rev 1.15	0.5	0.07
8	Perfluorotridecanoic Acid (PFTrDA)	537 Rev 1.15	0.5	0.2045
9	Perfluorotetradecanoic acid (PFTA)	537 Rev 1.15	0.5	0.054
10	Perfluorobutanesulfonic acid (PFBS)	537 Rev 1.15	0.5	0.039
11	Perfluorohexanesulfonic acid (PFHxS)	537 Rev 1.15	0.5	0.0605
12	Perfluorooctanesulfonic acid (PFOS)	537 Rev 1.15	0.5	0.13
13	Perfluorodecanesulfonic Acid (PFDS)	537 Rev 1.15	0.5	0.153
14	Perfluorobutanoic Acid (PFBA)	537 Rev 1.15	0.5	0.0227
15	Perfluoropentanoic Acid (PFPeA)	537 Rev 1.15	0.5	0.046
16	Perfluoroheptane Sulfonic Acid (PFHpS)	537 Rev 1.15	0.5	0.1365
17	1H,1H,2H,2H-Perfluorooctane Sulfonate (6:2 FTS)	537 Rev 1.15	0.5	0.1795
18	1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 FTS)	537 Rev 1.15	0.5	0.287
19	Perfluorooctanesulfonamide (FOSA)	537 Rev 1.15	0.5	0.098
20	N-methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)	537 Rev 1.15	0.5	0.2015
21	N-ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)	537 Rev 1.15	0.5	0.0845

Notes:
1) RL = Reporting Limit
2) MDL = Method Detection Limit
3) RL and MDL values were supplied by Alpha Analytical Laboratories
4) RL and MDL values are estimated and may vary depending on instruments
5) mg/kg = milligram per kilogram

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
	VOCs			
1	Methylene chloride	8260C	2.5	0.7
2	1,1-Dichloroethane	8260C	5	0.7
3	Chloroform	8260C	2.5	0.7
4	Carbon tetrachloride	8260C	5	0.134
5	1,2-Dichloropropane	8260C	5	0.133
6	Dibromochloromethane	8260C	5	0.149
7	1,1,2-Trichloroethane	8260C	5	0.5
8	Tetrachloroethene	8260C	5	0.181
9	Chlorobenzene	8260C	5	0.7
10	Trichlorofluoromethane	8260C	5	0.7
11	1,2-Dichloroethane	8260C	2.5	0.132
12	1,1,1-Trichloroethane	8260C	2.5	0.7
13	Bromodichloromethane	8260C	2	0.192
14	trans-1,3-Dichloropropene	8260C	2.5	0.164
15	cis-1,3-Dichloropropene	8260C	2.5	0.144
16	1,3-Dichloropropene, Total	8260C	2.5	0.144
17	1,1-Dichloropropene	8260C	2.5	0.7
18	Bromoform	8260C	2.5	0.65
19	1,1,2,2-Tetrachloroethane	8260C	2.5	0.144
20	Benzene	8260C	2.5	0.159
21	Toluene	8260C	2.5	0.7
22	Ethylbenzene	8260C	2.5	0.7
23	Chloromethane	8260C	2.5	0.7
24	Bromomethane	8260C	2.5	0.7
25	Vinyl chloride	8260C	2.5	0.0699
26	Chloroethane	8260C	2.5	0.7
27	1,1-Dichloroethene	8260C	2.5	0.142
28	trans-1,2-Dichloroethene	8260C	2.5	0.7
29	Trichloroethene	8260C	2.5	0.175
30	1,2-Dichlorobenzene	8260C	2.5	0.7
31	1,3-Dichlorobenzene	8260C	250	0.7
32	1,4-Dichlorobenzene	8260C	2	0.7
33	Methyl tert butyl ether	8260C	2	0.7
34	p/m-Xylene	8260C	2	0.7
35	o-Xylene	8260C	2.5	0.7
36	Xylene (Total)	8260C	2.5	0.7

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
37	cis-1,2-Dichloroethene	8260C	2.5	0.7
38	1,2-Dichloroethene (total)	8260C	2.5	0.7
39	Dibromomethane	8260C	5	1
40	1,2,3-Trichloropropane	8260C	2.5	0.7
41	Acrylonitrile	8260C	5	1.5
42	Styrene	8260C	2.5	0.7
43	Dichlorodifluoromethane	8260C	5	1
44	Acetone	8260C	5	1.46
45	Carbon disulfide	8260C	5	1
46	2-Butanone	8260C	5	1.94
47	Vinyl acetate	8260C	5	1
48	4-Methyl-2-pentanone	8260C	5	1
49	2-Hexanone	8260C	5	1
50	Bromochloromethane	8260C	2.5	0.7
51	2,2-Dichloropropane	8260C	2.5	0.7
52	1,2-Dibromoethane	8260C	2	0.65
53	1,3-Dichloropropane	8260C	2.5	0.7
54	1,1,1,2-Tetrachloroethane	8260C	2.5	0.7
55	Bromobenzene	8260C	2.5	0.7
56	n-Butylbenzene	8260C	2.5	0.7
57	sec-Butylbenzene	8260C	2.5	0.7
58	tert-Butylbenzene	8260C	2.5	0.7
59	o-Chlorotoluene	8260C	2.5	0.7
60	p-Chlorotoluene	8260C	2.5	0.7
61	1,2-Dibromo-3-chloropropane	8260C	2.5	0.7
62	Hexachlorobutadiene	8260C	2.5	0.7
63	Isopropylbenzene	8260C	2.5	0.7
64	p-Isopropyltoluene	8260C	2.5	0.7
65	Naphthalene	8260C	2.5	0.7
66	n-Propylbenzene	8260C	2.5	0.7
67	1,2,3-Trichlorobenzene	8260C	2.5	0.7
68	1,2,4-Trichlorobenzene	8260C	2.5	0.7
69	1,3,5-Trimethylbenzene	8260C	2.5	0.7
70	1,2,4-Trimethylbenzene	8260C	2.5	0.7
71	1,4-Dioxane	8270 SIM Isotope Dilution	0.15	0.075
72	1,4-Diethylbenzene	8260C	2	0.7

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
73	4-Ethyltoluene	8260C	2	0.7
74	1,2,4,5-Tetramethylbenzene	8260C	2	0.65
75	Ethyl ether	8260C	2.5	0.7
76	trans-1,4-Dichloro-2-butene	8260C	2.5	0.7
	SVOCs			
1	Acenaphthene	8270D	2	0.591
2	1,2,4-Trichlorobenzene	8270D	5	0.661
3	Hexachlorobenzene	8270D	2	0.579
4	Bis(2-chloroethyl)ether	8270D	2	0.669
5	2-Chloronaphthalene	8270D	2	0.64
6	1,2-Dichlorobenzene	8270D	2	0.732
7	1,3-Dichlorobenzene	8270D	2	0.732
8	1,4-Dichlorobenzene	8270D	2	0.708
9	3,3'-Dichlorobenzidine	8270D	5	1.39
10	2,4-Dinitrotoluene	8270D	5	0.845
11	2,6-Dinitrotoluene	8270D	5	1.12
12	Fluoranthene	8270D	2	0.568
13	4-Chlorophenyl phenyl ether	8270D	2	0.625
14	4-Bromophenyl phenyl ether	8270D	2	0.731
15	Bis(2-chloroisopropyl)ether	8270D	2	0.696
16	Bis(2-chloroethoxy)methane	8270D	5	0.626
17	Hexachlorobutadiene	8270D	2	0.658
18	Hexachlorocyclopentadiene	8270D	20	7.84
19	Hexachloroethane	8270D	2	0.682
20	Isophorone	8270D	5	0.601
21	Naphthalene	8270D	2	0.68
22	Nitrobenzene	8270D	2	0.753
23	NitrosoDiPhenylAmine(NDPA)/DPA	8270D	2	0.644
24	n-Nitrosodi-n-propylamine	8270D	5	0.7
25	Bis(2-Ethylhexyl)phthalate	8270D	3	0.91
26	Butyl benzyl phthalate	8270D	5	1.26
27	Di-n-butylphthalate	8270D	5	0.689
28	Di-n-octylphthalate	8270D	5	1.14
29	Diethyl phthalate	8270D	5	0.628
30	Dimethyl phthalate	8270D	5	0.65
31	Benzo(a)anthracene	8270D	2	0.61

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
32	Benzo(a)pyrene	8270D	2	0.539
33	Benzo(b)fluoranthene	8270D	2	0.635
34	Benzo(k)fluoranthene	8270D	2	0.597
35	Chrysene	8270D	2	0.543
36	Acenaphthylene	8270D	2	0.658
37	Anthracene	8270D	2	0.645
38	Benzo(ghi)perylene	8270D	2	0.611
39	Fluorene	8270D	2	0.619
40	Phenanthrene	8270D	2	0.613
41	Dibenzo(a,h)anthracene	8270D	2	0.548
42	Indeno(1,2,3-cd)Pyrene	8270D	2	0.707
43	Pyrene	8270D	2	0.569
44	Biphenyl	8270D	2	0.757
45	4-Chloroaniline	8270D	5	0.632
46	2-Nitroaniline	8270D	5	1.14
47	3-Nitroaniline	8270D	5	1.14
48	4-Nitroaniline	8270D	5	1.3
49	Dibenzofuran	8270D	2	0.656
50	2-Methylnaphthalene	8270D	2	0.72
51	Acetophenone	8270D	5	0.847
52	2,4,6-Trichlorophenol	8270D	5	0.681
53	P-Chloro-M-Cresol	8270D	2	0.617
54	2-Chlorophenol	8270D	2	0.631
55	2,4-Dichlorophenol	8270D	5	0.769
56	2,4-Dimethylphenol	8270D	5	1.64
57	2-Nitrophenol	8270D	10	1.52
58	4-Nitrophenol	8270D	10	1.77
59	2,4-Dinitrophenol	8270D	20	5.47
60	4,6-Dinitro-o-cresol	8270D	10	2.1
61	Pentachlorophenol	8270D	10	3.43
62	Phenol	8270D	5	1.89
63	2-Methylphenol	8270D	5	1.02
64	3-Methylphenol/4-Methylphenol	8270D	5	1.11
65	2,4,5-Trichlorophenol	8270D	5	0.715
66	Benzoic Acid	8270D	50	12.9
67	Benzyl Alcohol	8270D	2	0.725
68	Carbazole	8270D	2	0.627

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
69	1,4-Dioxane	8270 SIM Isotope Dilution	0.15	0.075
	Pesticides			
1	Delta-BHC	8081B	0.02	0.00467
2	Lindane	8081B	0.02	0.00434
3	Alpha-BHC	8081B	0.02	0.00439
4	Beta-BHC	8081B	0.02	0.0056
5	Heptachlor	8081B	0.02	0.0031
6	Aldrin	8081B	0.02	0.00216
7	Heptachlor epoxide	8081B	0.02	0.00415
8	Endrin	8081B	0.04	0.00429
9	Endrin aldehyde	8081B	0.04	0.0081
10	Endrin ketone	8081B	0.04	0.00477
11	Dieldrin	8081B	0.04	0.00429
12	4,4'-DDE	8081B	0.04	0.00381
13	4,4'-DDD	8081B	0.04	0.00464
14	4,4'-DDT	8081B	0.04	0.00432
15	Endosulfan I	8081B	0.02	0.00345
16	Endosulfan II	8081B	0.04	0.00519
17	Endosulfan sulfate	8081B	0.04	0.00481
18	Methoxychlor	8081B	0.2	0.00684
19	Toxaphene	8081B	0.2	0.063
20	cis-Chlordane	8081B	0.02	0.00666
21	trans-Chlordane	8081B	0.02	0.00627
22	Chlordane	8081B	0.2	0.0463
	Herbicides			
1	2,4,5-TP (Silvex)	8151A	2	0.539
	PCBs			
1	Aroclor 1016	8082A	0.083	0.05478
2	Aroclor 1221	8082A	0.083	0.05312
3	Aroclor 1232	8082A	0.083	0.03071
4	Aroclor 1242	8082A	0.083	0.05976
5	Aroclor 1248	8082A	0.083	0.05063
6	Aroclor 1254	8082A	0.083	0.03403
7	Aroclor 1260	8082A	0.083	0.03154

TABLE 7.1
PROJECT QUANTITATION LIMITS - GROUNDWATER

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (ug/L)**	**MDL(ug/L)**
8	Aroclor 1262	8082A	0.083	0.02905
9	Aroclor 1268	8082A	0.083	0.03735
10	PCBs, Total	8082A	0.083	0.02905
	Metals			
1	Aluminum, Total	6010C	0.00001	0.00000327
2	Antimony, Total	6010C	0.000004	0.000000429
3	Arsenic, Total	6010C	0.0000005	0.000000165
4	Barium, Total	6010C	0.0000005	0.000000173
5	Beryllium, Total	6010C	0.0000005	0.000000107
6	Cadmium, Total	6010C	0.0000002	0.0000000599
7	Calcium, Total	6010C	0.0001	0.0000394
8	Chromium, Total	6010C	0.000001	0.000000178
9	Cobalt, Total	6010C	0.0000005	0.000000163
10	Copper, Total	6010C	0.000001	0.000000384
11	Iron, Total	6010C	0.00005	0.0000191
12	Lead, Total	6010C	0.000001	0.000000343
13	Magnesium, Total	6010C	0.00007	0.0000242
14	Manganese, Total	6010C	0.000001	0.00000044
15	Mercury	7040A	0.0000002	0.000000066
16	Nickel, Total	6010C	0.000002	0.000000556
17	Potassium, Total	6010C	0.0001	0.0000309
18	Selenium, Total	6010C	0.000005	0.00000173
19	Silver, Total	6010C	0.0000004	0.000000163
20	Sodium, Total	6010C	0.0001	0.0000293
21	Thallium, Total	6010C	0.0000005	0.000000143
22	Vanadium, Total	6010C	0.000005	0.00000157
23	Zinc, Total	6010C	0.00001	0.00000341
	General Chemistry			
1	Cyanide	9010C/9012A	0.00001	0.000003
2	Hexavalent Chromium	7196A	0.000005	0.0000018
3	Trivalent Chromium	7196	0.00001	0.00001

			Estimated Quantitation Limits (Groundwater)	
	Compound	**Method**	**RL (ng/L)**	**MDL (ng/L)**
	PFAS			

			Estimated Quantitation Limits (Groundwater)	
	Compound	**Method**	**RL (ng/L)**	**MDL (ng/L)**
1	Perfluorohexanoic acid (PFHxA)	537 Rev 1.15	2	0.1264
2	Perfluoroheptanoic acid (PFHpA)	537 Rev 1.15	2	0.0924
3	Perfluorooctanoic acid (PFOA)	537 Rev 1.15	2	0.0504
4	Perfluorononanoic acid (PFNA)	537 Rev 1.15	2	0.1008
5	Perfluorodecanoic acid (PFDA)	537 Rev 1.15	2	0.1904
6	Perfluoroundecanoic acid (PFUdA)	537 Rev 1.15	2	0.1912
7	Perfluorododecanoic acid (PFDoA)	537 Rev 1.15	2	0.0916
8	Perfluorotridecanoic Acid (PRTrDA)	537 Rev 1.15	2	0.0904
9	Perfluorotetradecanoic acid (PFTA)	537 Rev 1.15	2	0.072
10	Perfluorobutanesulfonic acid (PFBS)	537 Rev 1.15	2	0.11
11	Perfluorohexanesulfonic acid (PFHxS)	537 Rev 1.15	2	0.1076
12	Perfluorooctanesulfonic acid (PFOS)	537 Rev 1.15	2	0.1116
13	Perfluorodecanesulfonic Acid (PFDS)	537 Rev 1.15	2	0.2224
14	Perfluorobutanoic Acid (PFBA)	537 Rev 1.15	2	0.1312
15	Perfluoropentanoic Acid (PFPeA)	537 Rev 1.15	2	0.0856
16	Perfluoroheptane Sulfonic Acid (PFHpS)	537 Rev 1.15	2	0.1552
17	1H,1H,2H,2H-Perfluorooctane Sulfonate (6:2 FTS)	537 Rev 1.15	2	0.194
18	1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 FTS)	537 Rev 1.15	2	0.2908
19	Perfluorooctanesulfonamide (FOSA)	537 Rev 1.15	2	0.2268
20	N-methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)	537 Rev 1.15	2	0.2504
21	N-ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)	537 Rev 1.15	2	0.3728

Notes:
1) RL = Reporting Limit
2) MDL = Method Detection Limit
3) RL and MDL values were supplied by Alpha Analytical Laboratories
4) RL and MDL values are estimated and may vary depending on instruments
5) µg/L = micrograms per liter
6) ng/L = nanograms per liter

TABLE 7.1
PROJECT QUANTITATION LIMITS – AIR

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (µg/m^3)**	**MDL(µg/m^3)**
	VOCs			
1	1,1,1,2-Tetrachloroethane	TO-15	1.37	0.38
2	1,1,1-Trichloroethane	TO-15	1.09	0.31
3	1,1,2,2-Tetrachloroethane	TO-15	1.37	0.38

TABLE 7.1
PROJECT QUANTITATION LIMITS – AIR

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (µg/m^3)**	**MDL(µg/m^3)**
4	1,1,2-Trichloro-1,2,2-Trifluoroethane	TO-15	1.53	0.39
5	1,1,2-Trichloroethane	TO-15	1.09	0.36
6	1,1-Dichloroethane	TO-15	0.81	0.31
7	1,1-Dichloroethene	TO-15	0.79	0.22
8	1,1-Dichloropropene	TO-15	0.91	0.32
9	1,2,3-Trichlorobenzene	TO-15	1.48	0.32
10	1,2,3-Trichloropropane	TO-15	1.21	0.46
11	1,2,3-Trimethylbenzene	TO-15	0.98	0.37
12	1,2,4,5-Tetramethylbenzene	TO-15	1.1	0.44
13	1,2,4-Trichlorobenzene	TO-15	1.48	0.45
14	1,2,4-Trimethylbenzene	TO-15	0.98	0.34
15	1,2-Dibromo-3-chloropropane	TO-15	1.93	0.72
16	1,2-Dibromoethane	TO-15	1.54	0.6
17	1,2-Dichloro-1,1,2,2-tetrafluoroethane	TO-15	1.4	0.29
18	1,2-Dichlorobenzene	TO-15	1.2	0.37
19	1,2-Dichloroethane	TO-15	0.81	0.22
20	1,2-Dichloroethene (total)	TO-15	0.79	0.23
21	1,2-Dichloropropane	TO-15	0.92	0.32
22	1,3,5-Trimethylbenzene	TO-15	0.98	0.29
23	1,3-Butadiene	TO-15	0.44	0.18
24	1,3-Dichlorobenzene	TO-15	1.2	0.38
25	1,3-Dichloropropane	TO-15	0.92	0.36
26	1,3-Dichloropropene, Total	TO-15	0.91	0.31
27	1,4-Dichlorobenzene	TO-15	1.2	0.25
28	1,4-Dioxane	TO-15	0.72	0.28
29	1-Methylnaphthalene	TO-15	5.82	1.66
30	2,2,4-Trimethylpentane	TO-15	0.93	0.31
31	2,2-Dichloropropane	TO-15	0.92	0.27
32	2-Butanone	TO-15	1.47	0.15
33	2-Ethylthiophene	TO-15	0.92	0.26
34	2-Hexanone	TO-15	0.82	0.25
35	2-Methylnaphthalene	TO-15	5.82	0.16
36	2-Methylthiophene	TO-15	0.8	0.32
37	3-Chloropropene	TO-15	0.63	0.25
38	3-Methylthiophene	TO-15	0.8	0.27
39	4-Ethyltoluene	TO-15	0.98	0.38
40	4-Methyl-2-pentanone	TO-15	2.05	0.25

TABLE 7.1
PROJECT QUANTITATION LIMITS – AIR

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (µg/m^3)**	**MDL(µg/m^3)**
41	Acetaldehyde	TO-15	4.5	0.99
42	Acetone	TO-15	2.38	0.64
43	Acetonitrile	TO-15	0.34	0.13
44	Acrolein	TO-15	1.15	0.26
45	Acrylonitrile	TO-15	1.09	0.17
46	Benzene	TO-15	0.64	0.17
47	Benzothiophene	TO-15	2.74	0.26
48	Benzyl chloride	TO-15	1.04	0.33
49	Bromobenzene	TO-15	0.79	0.31
50	Bromodichloromethane	TO-15	1.34	0.44
51	Bromoform	TO-15	2.07	0.54
52	Bromomethane	TO-15	0.78	0.27
53	Butane	TO-15	0.48	0.11
54	Butyl Acetate	TO-15	2.38	0.54
55	Carbon disulfide	TO-15	0.62	0.11
56	Carbon tetrachloride	TO-15	1.26	0.3
57	Chlorobenzene	TO-15	0.92	0.36
58	Chlorodifluoromethane	TO-15	0.71	0.22
59	Chloroethane	TO-15	0.53	0.2
60	Chloroform	TO-15	0.98	0.22
61	Chloromethane	TO-15	0.41	0.2
62	cis-1,2-Dichloroethene	TO-15	0.79	0.23
63	cis-1,3-Dichloropropene	TO-15	0.91	0.34
64	Cyclohexane	TO-15	0.69	0.23
65	Decane (C10)	TO-15	1.16	0.28
66	Dibromochloromethane	TO-15	1.7	0.64
67	Dibromomethane	TO-15	1.42	0.34
68	Dichlorodifluoromethane	TO-15	0.99	0.23
69	Dichlorofluoromethane	TO-15	0.84	0.24
70	Dodecane (C12)	TO-15	1.39	0.39
71	Ethyl Acetate	TO-15	1.8	0.47
72	Ethyl Alcohol	TO-15	4.71	1.02
73	Ethyl ether	TO-15	0.61	0.18
74	Ethylbenzene	TO-15	0.87	0.24
75	Ethyl-Tert-Butyl-Ether	TO-15	0.84	0.22
76	Heptane	TO-15	0.82	0.23
77	Hexachlorobutadiene	TO-15	2.13	0.78

TABLE 7.1
PROJECT QUANTITATION LIMITS – AIR

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (µg/m^3)**	**MDL(µg/m^3)**
78	Indane	TO-15	0.97	0.38
79	Indene	TO-15	0.95	0.29
80	iso-Propyl Alcohol	TO-15	1.23	0.28
81	Isopropyl Ether	TO-15	0.84	0.27
82	Isopropylbenzene	TO-15	0.98	0.21
83	Methanol	TO-15	6.55	0.96
84	Methyl Methacrylate	TO-15	2.05	0.61
85	Methyl tert butyl ether	TO-15	0.72	0.16
86	Methylene chloride	TO-15	1.74	0.65
87	Naphthalene	TO-15	1.05	0.23
88	n-Butylbenzene	TO-15	1.1	0.35
89	n-Heptane	TO-15	0.82	0.23
90	n-Hexane	TO-15	0.7	0.18
91	Nonane (C9)	TO-15	1.05	0.34
92	n-Propylbenzene	TO-15	0.98	0.27
93	o-Chlorotoluene	TO-15	1.04	0.25
94	Octane	TO-15	0.93	0.2
95	o-Xylene	TO-15	0.87	0.27
96	p/m-Xylene	TO-15	1.74	0.6
97	p-Chlorotoluene	TO-15	1.04	0.4
98	Pentane	TO-15	0.59	0.14
99	p-Isopropyltoluene	TO-15	1.1	0.33
100	Propane	TO-15	0.9	0.21
101	Propylene	TO-15	0.86	0.16
102	sec-Butylbenzene	TO-15	1.1	0.4
103	Styrene	TO-15	0.85	0.34
104	tert-Butyl Alcohol	TO-15	1.52	0.18
105	tert-Butylbenzene	TO-15	1.1	0.22
106	Tertiary-Amyl Methyl Ether	TO-15	0.84	0.33
107	Tetrachloroethene	TO-15	1.36	0.51
108	Tetrahydrofuran	TO-15	1.47	0.18
109	Thiophene	TO-15	0.69	0.18
110	Toluene	TO-15	0.75	0.24
111	Total HC As Hexane	TO-15	39.34	0.2
112	Total VOCs As Toluene	TO-15	37.69	0.24
113	trans-1,2-Dichloroethene	TO-15	0.79	0.29
114	trans-1,3-Dichloropropene	TO-15	0.91	0.31

TABLE 7.1
PROJECT QUANTITATION LIMITS – AIR

			Estimated Quantitation Limits	
	Compound	**Method**	**RL (µg/m^3)**	**MDL(µg/m^3)**
115	Trichloroethene	TO-15	1.07	0.38
116	Trichlorofluoromethane	TO-15	1.12	0.23
117	Undecane	TO-15	1.28	0.34
118	Vinyl acetate	TO-15	3.52	0.2
119	Vinyl bromide	TO-15	0.87	0.31
120	Vinyl chloride	TO-15	0.51	0.14
121	Xylene (Total)	TO-15	0.87	0.27

Notes:
1) RL = Reporting Limit
2) MDL = Method Detection Limit
3) RL and MDL values were supplied by Alpha Analytical Laboratories
4) RL and MDL values are estimated and may vary depending on instrument
5) ppbV = parts per billion volume

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 INTRODUCTION

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in the USEPA SW-846 appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

8.2 DATA REDUCTION

The Analytical Services Protocol (ASP) Category B data packages and an electronic data deliverable (EDD) will be provided by the laboratory after receipt of a complete sample delivery group. The Project Manager will immediately arrange for archiving the results and preparation of result tables. These tables will form the database for assessment of the site contamination condition.

Each EDD deliverable must be formatted using a Microsoft Windows operating system and the NYSDEC data deliverable format for EQuIS. To avoid transcription errors, data will be loaded directly into the ASCII format from the laboratory information management system (LIMS). If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. All EDDs must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Project Manager will maintain close contact with the QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review is completed, the Project Manager may direct others to initiate and finalize the analytical data assessment.

8.3 DATA VALIDATION

Data validation will be performed in accordance with the USEPA Region 2 SOPs for data validation and USEPA's National Functional Guidelines for Organic and Inorganic Data Review. Tier 1 data validation (the equivalent of USEPA's Stage 2A validation) will be performed to evaluate data quality. Tier 1 data validation is based on completeness and compliance checks of sample-related QC results including:

- Holding times;
- Sample preservation;
- Blank results (method, trip, and field blanks);
- Surrogate recovery compounds and extracted internal standards (as applicable);
- LCS and LCSD recoveries and RPDs;
- MS and MSD recoveries and RPDs;
- Laboratory duplicate RPDs; and
- Field duplicate RPDs

A DUSR will be prepared by the data validator and reviewed by the Quality Assurance Manager before issuance. The DUSR will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected. The associated number indicates the approximate sample concentration necessary to be detected significantly greater than the level of the highest associated blank;
- "UJ" - Not detected. Quantitation limit may be inaccurate or imprecise;
- "J" - Analyte is present. Reported value may be associated with a higher level of uncertainty than is normally expected with the analytical method
- "R" – Unreliable result; data is rejected or unusable. Analyte may or may not be present in the sample; and
- No Flag - Result accepted without qualification.

9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

9.1 QUALITY ASSURANCE BATCHING

Each set of samples will be analyzed concurrently with calibration standards, method blanks, matrix spikes (MS), matrix spike duplicates (MSD) or laboratory duplicates, and QC check samples (if required by the protocol). The MS/MSD samples will be designated by the field personnel. If no MS/MSD samples were designated, the laboratory will contact the Langan Project Manager for corrective action.

9.2 CALIBRATION STANDARDS AND SURROGATES

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the USEPA or NIST, or other similar program. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or more frequently, based upon data indicating deterioration.

9.3 ORGANIC BLANKS AND MATRIX SPIKE

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives." The blank water can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing $KMnO_4$. The matrix spike is generated by addition of surrogate standard to each sample.

9.4 TRIP AND EQUIPMENT BLANKS

Trip blanks and equipment blanks will be utilized in accordance with the specifications in Section 4. These blanks will be analyzed to provide a check on sample bottle preparation and evaluate the effectiveness of field decontamination procedures.

10.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

10.1 INTRODUCTION

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the QAO. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

10.2 SYSTEM AUDITS

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or at the request of the Project Manager, additional audits may occur.

10.3 PERFORMANCE AUDITS

The laboratory may be required to conduct an analysis of Performance Evaluation samples or provide proof that Performance Evaluation samples submitted by the USEPA or a state agency were analyzed within the past twelve months.

10.4 FORMAL AUDITS

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements were developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged, and documented through audit findings, which are attached to

and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions will be reviewed and approved by the QAO. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

11.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

11.1 PREVENTIVE MAINTENANCE PROCEDURES

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

A list of critical spare parts will be established by the operator. These spare parts will be available for use in order to reduce the downtime. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory.

11.2 SCHEDULES

Written procedures will establish the schedule for servicing critical items to minimize the downtime of the measurement system. Rental equipment subcontractors and the laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Required service will be performed by qualified personnel.

11.3 RECORDS

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories. The QAO may audit these records to verify complete adherence to these procedures.

12.0 CORRECTIVE ACTION

12.1 INTRODUCTION

The following procedures were established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

12.2 PROCEDURE DESCRIPTION

When a significant condition adverse to quality is noted at site or laboratory, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and laboratory management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA SW-846, and subsequent updates, or by the NYSDEC ASP.

Project management and staff, such as field investigation teams and laboratory groups, will monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites or laboratory. Activities ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Project Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 12.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

FIGURE 12.1

CORRECTIVE ACTION REQUEST
Number: _____ Date: _____
TO: _____ You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _____
CONDITION:
REFERENCE DOCUMENTS:
RECOMMENDED CORRECTIVE ACTIONS:
_____ _____ _____ _____ _____ _____ Originator Date Approval Date Approval Date
RESPONSE
CAUSE OF CONDITION
CORRECTIVE ACTION (A) RESOLUTION (B) PREVENTION (C) AFFECTED DOCUMENTS
C.A. FOLLOWUP: CORRECTIVE ACTION VERIFIED BY: _____ DATE:_____

13.0 REFERENCES

NYSDEC. Division of Environmental Remediation. DER-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.

Taylor, J. K., 1987. Quality Assurance of Chemical Measurements. Lewis Publishers, Inc., Chelsea, Michigan

USEPA. Validating Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry. SOP No. HW-24, Revision 4, dated October 2014. USEPA Region II.

USEPA. Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15. SOP No. HW-31, Revision 6, dated June 2014. USEPA Region II.

USEPA. Polychlorinated Biphenyl (PCB) Aroclor Data Validation. SOP No. HW-37, Revision 3, dated May 2013. USEPA Region II.

USEPA. Pesticide Data Validation. SOP No. HW-36, Revision 4, dated May 2013. USEPA Region II.

USEPA. Semivolatile Data Validation. SOP No. HW-35, Revision 2, dated March 2013. USEPA Region II.

USEPA. Tetro-through Octa-chlorinated Dioxins and Furans by Isotope Dilution (HRGC/HRMS). SOP For EPA Method 1613, Revision B, dated December 2010. USEPA Region II.

USEPA. PCDDs/PCDFs using HRGC/HRMS. SOP for SW-846 Method 8290 HW-19, Revision 1.1, dated December 2010. USEPA Region II.

USEPA, Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans. SW-846 Method 8280 HW-11, Revision 3, dated December 2010. USEPA Region II.

USEPA. Low/Medium Volatile Data Validation. SOP No. HW-33, Revision 3, dated March 2013. USEPA Region II.

USEPA. ICP-AES Data Validation. SOP No. HW-2a, Revision 15, dated December 2012. USEPA Region II.

USEPA. ICP-MS Data Validation. SOP No. HW-2b, Revision 15, dated December 2012. USEPA Region II.

USEPA. Mercury and Cyanide Data Validation. SOP No. HW-2c, Revision 15, dated December 2012, USEPA Region II.

USEPA. Trace Volatile Data Validation. SOP No. HW-34, Revision 3, dated February 2013, USEPA Region II.

ATTACHMENT A

PER- AND POLY-FLUOROALKYL SUBSTANCES SAMPLING PROTOCOL

Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The procedure used must be consistent with the NYSDEC March 1991 Sampling Guidelines and Protocols http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Equipment blanks should be generated at least daily. Additional materials may be acceptable if pre-approved by NYSDEC. Requests to use alternate equipment should include clean equipment blanks. **NOTE: Grunfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at 4 ± 2º Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

Groundwater Sampling for Emerging Contaminants

February 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where "full TAL/TCL sampling" would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard "full TAL/TCL" sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by a data validator.

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Samples should be analyzed by an environmental laboratory certified by ELAP to use EPA method 537 or ISO 25101. ELAP does not currently offer certification for PFAS analysis of non-drinking water samples (including groundwater, soil and sediment), so there is no requirement to use an ELAP certified method. The preferred method is the modified EPA Method 537. Labs have been able to achieve reporting limits for PFOA and PFOS of 2 ng/l (part per trillion). If labs are not able to achieve similar reporting limits, the NYSDEC project manager will make case-by-case decisions as to whether the analysis can meet the needs for the specific site.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of

contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.28 µg/l (ppb). ELAP offers certification for both EPA Methods 8260 and 8270. In order to get the appropriate detection limits, the lab would need to run either of these methods in "selective ion monitoring" (SIM) mode. DER is advising PMS to use 8270, since this method provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents (we acknowledge that 8260 has been shown to have a higher recovery in some studies).

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	**Perfluorobutanesulfonic acid**	**PFBS**	**375-73-5**
	Perfluorohexanesulfonic acid	**PFHxS**	**355-46-4**
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	**PFOS**	**1763-23-1**
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	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	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

ATTACHMENT B

STANDARD OPERATING PROCEDURES FOR DETERMINATION OF PERFLUORINATED ALYKL SUBSTANCES

Determination of Selected Perfluorinated Alkyl Substances by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry Isotope Dilution (LC/MS/MS)

Reference: EPA Method 537, Version 1.1, September 2009, EPA Document #: EPA/600/R-08/09

EPA Method 537.1, Version 1, November 2018, EPA Document #: EPA/600/R-18/352

Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 5.2, .2019

1. Scope and Application

Matrices: Drinking water, Non-potable Water, and Soil Matrices

Definitions: Refer to Alpha Analytical Quality Manual.

1.1 This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl substances (PFAS) in Non-Drinking Water and soil Matrices. Accuracy and precision data have been generated in reagent water, and finished ground and surface waters for the compounds listed in Table 1.

1.2 The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

1.3 This method is restricted to use by or under the supervision of analysts experienced in the operation of the LC/MS/MS and in the interpretation of LC/MS/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

2. Summary of Method

2.1 A 250-mL water sample is fortified with extracted internal standards (EIS) and passed through a solid phase extraction (WAX) cartridge containing a mixed mode, Weak Anion Exchange, reversed phase, water-wettable polymer to extract the method analytes and isotopically-labeled compounds. The compounds are eluted from the solid phase in two fractions with methanol followed by a small amount of 2% ammonium hydroxide in methanol solution. The extract is concentrated with nitrogen in a heated water bath, and then adjusted to a 1-mL volume with 80:20% (vol/vol) methanol:water. A 3 µl injection is made into an LC equipped with a C18 column that is interfaced to an MS/MS. The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

2.2 Method Modifications from Reference

None.

Table 1

Parameter	Acronym	CAS
PERFLUOROALKYL ETHER CARBOXYLIC ACIDS (PFECAs)		
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	62037-80-3
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
PERFLUOROALKYLCARBOXILIC ACIDS (PFCAs)		
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	PFTA *	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
PERFLUOROALKYLSULFONATES (PFASs)		
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

*** also reportable via the standard 537 method**

Table 1 Cont.

Parameter	Acronym	CAS
CHLORO-PERFLUOROALKYLSULFONATE		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
PERFLUOROOCTANESULFONAMIDES (FOSAs)		
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2
TELOMER SULFONATES		
1H,1H,2H,2H-perfluorohexane sulfonate (4:2)	4:2FTS	27619-93-8
1H,1H,2H,2H-perfluorooctane sulfonate (6:2)	6:2FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonate (8:2)	8:2FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonate (10:2)	10:2FTS	120226-60-0
PERFLUOROOCTANESULFONAMIDOACETIC ACIDS		
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA *	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA *	2991-50-6
NATIVE PERFLUOROOCTANESULFONAMIDOETHANOLS (FOSEs)		
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NMeFOSE	24448-09-7
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtFOSE	1691-99-2

*** also reportable via the standard 537 method**

3. Reporting Limits

The reporting limit for PFAS's is 2 ng/L for aqueous samples (20 ng/L for HFPO-DA) and 1 ng/g (10 ng/g for HFPO-DA) for soil samples.

4. Interferences

4.1 PFAS standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAS analyte and EIS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.

4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such

as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/3 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.2. **Subtracting blank values from sample results is not permitted.**

4.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of humic content of the sample.

4.4 SPE cartridges can be a source of interferences. The analysis of field and laboratory reagent blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

5. Health and Safety

5.1 The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

5.2 All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

5.3 PFOA has been described as "likely to be carcinogenic to humans." Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection for Aqueous Samples

6.1.1 Samples must be collected in two (2) 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap.

6.1.2 The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

6.1.3 Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.

6.1.4 Fill sample bottles. Samples do not need to be collected headspace free.

6.1.5 After collecting the sample and cap the bottle. Keep the sample sealed from time of collection until extraction.

6.1.6 Field Reagent Blank (FRB)

6.1.6.1 A FRB must be handled along with each sample set. The sample set is composed of samples collected from the same sample site and at the same time. At the laboratory, fill the field blank sample bottle with reagent water and preservatives, seal, and ship to the sampling site along with the sample bottles. For each FRB shipped, an empty sample bottle (no preservatives) must also be shipped. At the sampling site, the sampler must open the shipped FRB and pour the reagent water into the empty shipped sample bottle, seal and label this bottle as the FRB. The FRB is shipped back to the laboratory along with the samples and analyzed to ensure that PFAS's were not introduced into the sample during sample collection/handling.

The reagent water used for the FRBs must be initially analyzed for method analytes as a MB and must meet the MB criteria in Section 9.2.1 prior to use. This requirement will ensure samples are not being discarded due to contaminated reagent water rather than contamination during sampling.

6.2 Sample Collection for Soil and Sediment samples.

Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided.

6.3 Sample Preservation

Not applicable.

6.4 Sample Shipping

Samples must be chilled during shipment and must not exceed 10 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction, but should not be frozen.

NOTE: Samples that are significantly above 10° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

6.5 Sample Handling

6.5.1 Holding Times

6.5.1.1 Water samples should be extracted as soon as possible but must be extracted within 14 days. Soil samples should be extracted within 28 days. Extracts are stored at < 10 ° C and analyzed within 28 days after extraction.

7. Equipment and Supplies

7.1 SAMPLE CONTAINERS – 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

7.2 POLYPROPYLENE BOTTLES – 4-mL narrow-mouth polypropylene bottles.

7.3 CENTRIFUGE TUBES – 50-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts.

7.4 AUTOSAMPLER VIALS – Polypropylene 0.7-mL autosampler vials with polypropylene caps.

7.4.1 NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.

7.5 POLYPROPYLENE GRADUATED CYLINDERS – Suggested sizes include 25, 50, 100 and 1000-mL cylinders.

7.6 Auto Pipets – Suggested sizes include 5, 10, 25, 50, 100, 250, 500, 1000, 5000 and 10,000-µls.

7.7 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets.

7.8 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.0001 g.

7.9 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

7.9.1 SPE CARTRIDGES – 0.5 g SPE cartridges containing a reverse phase copolymer characterized by a weak anion exchanger (WAX) sorbent phase.

7.9.2 VACUUM EXTRACTION MANIFOLD – A manual vacuum manifold with large volume sampler for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the MB (Sect. 9.2.1).

7.9.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8" O.D. x 1/16" I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB (Sect. 9.2.1) and LCS (Sect. 9.3) QC requirements. The PTFE transfer tubes may be used, but an MB must be run on each PFTE transfer tube and the QC requirements in Section 13.2.2 must be met. In the case of automated SPE, the removal of PTFE lines may not be feasible; therefore, MBs will need to be rotated among the ports and must meet the QC requirements of Sections 13.2.2 and 9.2.1.

7.10 Extract Clean-up Cartridge – 250 mg 6ml SPE Cartridge containing graphitized polymer carbon

7.11 EXTRACT CONCENTRATION SYSTEM – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 65 °C.

7.12 LABORATORY OR ASPIRATOR VACUUM SYSTEM – Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.

7.13 LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM

7.13.1 LC SYSTEM – Instrument capable of reproducibly injecting up to 10-µL aliquots, and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.4 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase bottle (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase bottle will volatilize the ammonium acetate mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.

NOTE: During the course of method development, it was discovered that while idle for more than one day, PFAS's built up in the PTFE solvent transfer lines. To prevent long delays in purging high levels of PFAS's from the LC solvent lines, they were replaced with PEEK tubing and the PTFE solvent frits were replaced with stainless steel frits. It is not possible to remove all PFAS background contamination, but these measures help to minimize their background levels.

7.13.2 LC/TANDEM MASS SPECTROMETER – The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.4 mL/min. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision.

7.13.3 DATA SYSTEM – An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

7.13.4 ANALYTICAL COLUMN – An LC BEH C_{18} column (2.1 x 50 mm) packed with 1.7 µm d_p C_{18} solid phase particles was used. Any column that provides adequate resolution, peak shape, capacity, accuracy, and precision (Sect. 9) may be used.

8. Reagents and Standards

8.1 GASES, REAGENTS, AND SOLVENTS – Reagent grade or better chemicals should be used.

8.1.1 REAGENT WATER – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

8.1.2 METHANOL (CH_3OH, CAS#: 67-56-1) – High purity, demonstrated to be free of analytes and interferences.

8.1.3 AMMONIUM ACETATE ($NH_4C_2H_3O_2$, CAS#: 631-61-8) – High purity, demonstrated to be free of analytes and interferences.

8.1.4 ACETIC ACID (H_3CCOOH, CAS#: 64-19-7) - High purity, demonstrated to be free of analytes and interferences.

8.1.5 1M AMMONIUM ACETATE/REAGENT WATER – High purity, demonstrated to be free of analytes and interferences.

8.1.6 2mM AMMONIUM ACETATE/METHANOL:WATER (5:95) – To prepare, mix 2 ml of 1M AMMONIUM ACETATE,1 ml ACETIC ACID and 50 ml METHANOL into l Liter of REAGENT WATER.

8.1.7 Methanol/Water (80:20) – To prepare a 1 Liter bottle, mix 200 ml of REAGENT WATER with 800 ml of METHANOL.

8.1.8 AMMONIUM HYDROXIDE (NH_3, CAS#: 1336-21-6) – High purity, demonstrated to be free of analytes and interferences.

8.1.9 Sodium Acetate ($NaOOCCH_3$, CAS#: 127-09-3) – High purity, demonstrated to be free of analytes and interferences.

8.1.10 25 mM Sodium Acetate Buffer – To prepare 250mls, dissolve .625 grams of sodium acetate into 100 mls of reagent water. Add 4 mls Acetic Acid and adjust the final volume to 250 mls with reagent water.

8.1.11 NITROGEN – Used for the following purposes: Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument manufacturer's specifications. In addition, Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).

8.1.12 ARGON – Used as collision gas in MS/MS instruments. Argon should meet or exceed instrument manufacturer's specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.

8.2 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

NOTE: Stock standards and diluted stock standards are stored at ≤4 °C.

8.2.1 ISOTOPE DILUTION Extracted Internal Standard (ID EIS) STOCK SOLUTIONS - ID EIS stock standard solutions are stable for at least 6 months when stored at 4 °C. The stock solution is purchased at a concentration of 1000 ng/mL.

8.2.2 ISOTOPE DILUTION Extracted Internal Standard PRIMARY DILUTION STANDARD (ID EIS PDS) – Prepare the ID EIS PDS at a concentration of 500 ng/mL. The ID PDS is prepared in 80:20% (vol/vol) methanol:water. The ID PDS is stable for 6 months when stored at ≤4 °C.

Table 2

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Vol. of EIS Stock (mL)	Final Vol. of EIS PDS (mL)	Final Conc. of EIS PDS (ng/mL)
M4PFBA	1000	1.0	2.0	500
M5PFPeA	1000	1.0	2.0	500
M5PFHxA	1000	1.0	2.0	500
M4PFHpA	1000	1.0	2.0	500
M8PFOA	1000	1.0	2.0	500
M9PFNA	1000	1.0	2.0	500
M6PFDA	1000	1.0	2.0	500
M7PFUdA	1000	1.0	2.0	500
MPFDoA	1000	1.0	2.0	500
M2PFTeDA	1000	1.0	2.0	500
M2PFHxDA	50,000	.02	2.0	500
d3-N-MeFOSA	50,000	.02	2.0	500
d5-N-EtFOSA	50,000	.02	2.0	500
d7-N-MeFOSE	50,000	.02	2.0	500
d9-N-EtFOSE	50,000	.02	2.0	500
M8FOSA	1000	1.0	2.0	500
d3-N-MeFOSAA	1000	1.0	2.0	500
d5-N-EtFOSAA	1000	1.0	2.0	500
M3PFBS	929	1.0	2.0	464.5
M3PFHxS	946	1.0	2.0	473
M8PFOS	957	1.0	2.0	478.5
M2-4:2FTS	935	1.0	2.0	467.5
M2-6:2FTS	949	1.0	2.0	474.5
M2-8:2FTS	958	1.0	2.0	479
M3HFPO-DA	50,000	.4	2.0	10,000

8.2.3 ANALYTE STOCK STANDARD SOLUTION – Analyte stock standards are stable for at least 6 months when stored at 4 °C. When using these stock standards to prepare a PDS, care must be taken to ensure that these standards are at room temperature and adequately vortexed.

8.2.4 Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only. ANALYTE PRIMARY SPIKING STANDARD – Prepare the spiking standard at a concentration of 500 ng/mL in methanol. The spiking standard is stable for at least two months when stored in polypropylene centrifuge tubes at room temperature.

Table 3

Analyte	Conc. of IS Stock (ng/mL)	Vol. of IS Stock (mL)	Final Vol. of IS PDS (mL)	Final Conc. of IS PDS (ng/mL)
PFBA	2000	1	4	500
PFPeA	2000	1	4	500
PFHxA	2000	1	4	500
PFHpA	2000	1	4	500
PFOA	2000	1	4	500
PFNA	2000	1	4	500
PFDA	2000	1	4	500
PFUdA	2000	1	4	500
PFDoA	2000	1	4	500
PFTrDA	2000	1	4	500
PFTeDA	2000	1	4	500
FOSA	2000	1	4	500
N-MeFOSAA	2000	1	4	500
N-EtFOSAA	2000	1	4	500
L-PFBS	1770	1	4	442.5
L-PFPeS	1880	1	4	470
L-PFHxSK	1480	1	4	370
Br-PFHxSK	344	1	4	86
L-PFHpS	1900	1	4	475
L-PFOSK	1460	1	4	365
Br-PFOSK	391	1	4	97.75
L-PFNS	1920	1	4	480
L-PFDS	1930	1	4	482.5
4:2FTS	1870	1	4	467.5
6:2FTS	1900	1	4	475
8:2FTS	1920	1	4	480

8.2.5 Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only.

Table 4

Analyte	Conc. of IS Stock (ng/mL)	Vol. of IS Stock (mL)	Final Vol. of IS PDS (mL)	Final Conc. of IS PDS (ng/mL)
ADONA	2000	1	4	500
PFHxDA	2000	1	4	500
PFODA	2000	1	4	500
HFPO-DA	100,000	.4	4	10,000
9ClPF3ONS	50,000	0.04	4	500
11ClPF3OUdS	50,000	0.04	4	500

8.2.6 LOW, MEDIUM AND HIGH LEVEL LCS – The LCS's will be prepared at the following concentrations and rotated per batch; 2 ng/L, 40 ng/L, 500 ng/l for drinking waters. The analyte PDS contains all the method analytes of interest at various concentrations in methanol. The analyte PDS has been shown to be stable for six months when stored at ≤4 °C.

8.2.7 Isotope Dilution Labeled Recovery Stock Solutions (ID REC) – ID REC Stock solutions are stable for at least 6 months when stored at 4 °C. The stock solution is purchased at a concentration of 1000 ng/mL.

8.2.8 Isotope Dilution Labeled Recovery Primary Dilution Standard (ID REC PDS) - Prepare the ID REC PDS at a concentration of 500 ng/mL. The ID REC PDS is prepared in 80:20% (vol/vol) methanol:water. The ID REC PDS is stable for at least six months when stored in polypropylene centrifuge tubes at ≤4 °C.

Table 5

Analyte	Conc. of REC Stock (ng/mL)	Vol. of REC Stock (mL)	Final Vol. of REC PDS (mL)	Final Conc. of REC PDS (ng/mL)
M2PFOA	2000	1	4	500
M2PFDA	2000	1	4	500
M3PFBA	2000	1	4	500
M4PFOS	2000	1	4	500

8.2.9 CALIBRATION STANDARDS (CAL) –

Current Concentrations (ng/mL): 0.5, 1.0, 5.0, 10.0, 50.0, 125, 150, 250, 500

Prepare the CAL standards over the concentration range of interest from dilutions of the analyte PDS in methanol containing 20% reagent water. 20 µl of the EIS PDS and REC PDS are added to the CAL standards to give a constant concentration of 10 ng/ml. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity. The CAL standards may also be used as CCVs (Sect. 9.8). To make calibration stock standards:

Table 6

Calibration Standard Concentration	Final Aqueous Cal STD Level Concentration	Final Soil Cal STD Level Concentration	24 compound stock added (ul)	PFHxDA Stock added (ul)	500 ng/ml PFHxDA dilution added (ul)	PFODA Stock added (ul)	500 ng/ml PFODA dilution added (ul)	ADONA, HFPO-DA, 11Cl-PF3OUdS, 9Cl-PF3ONS Stock added (ul)	500 ng/ml ADONA dilution added (ul)	Final Volume in MeOH/H_2O (82:20)
.5 ng/ml	2 ng/L	.25 ng/g	6.25		25		25		25	25 mls
1 ng/ml	4 ng/L	.5 ng/g	5		20		20		20	10 mls
5 ng/ml	20 ng/L	1 ng/g	25		100		100		100	10 mls
10 ng/ml	40 ng/L	5 ng/g	125	5		5		5		25 mls

50 ng/ml	200 ng/L	25 ng/g	250	10		10		10		10 mls
125 ng/ml	500 ng/L	62.5 ng/g	625	25		25		25		10 mls
150 ng/ml	600 ng/L	75 ng/g	750	30		30		30		10 mls
250 ng/ml	1000 ng/L	125 ng/g	625							5 mls
500 ng/ml	2000 ng/L	250 ng/g	1250							5 mls

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

9.1 MINIMUM REPORTING LIMIT (MRL) CONFIRMATION

9.1.1 Fortify, extract, and analyze seven replicate LCSs at 2 ng/l. Calculate the mean measured concentration (*Mean*) and standard deviation for these replicates. Determine the Half Range for the prediction interval of results (HR_{PIR}) using the equation below

$$HR_{PIR} = 3.963s$$

Where:

s = the standard deviation
3.963 = a constant value for seven replicates.

9.1.2 Confirm that the upper and lower limits for the Prediction Interval of Result ($PIR = Mean \pm HR_{PIR}$) meet the upper and lower recovery limits as shown below

The Upper PIR Limit must be ≤150% recovery.

$$\frac{Mean + HR_{PIR}}{Fortified\ Concentration} \times 100\% \leq 150\%$$

The Lower PIR Limit must be ≥ 50% recovery.

$$\frac{Mean - HR_{PIR}}{Fortified\ Concentration} \times 100\% \geq 50\%$$

9.1.3 The RL is validated if both the Upper and Lower PIR Limits meet the criteria described above. If these criteria are not met, the RL has been set too low and must be determined again at a higher concentration.

9.2 Blank(s)

9.2.1 **METHOD BLANK (MB)** - A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that

interfere with the measurement of method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch. Because background contamination is a significant problem for several method analytes, it is highly recommended that the analyst maintain a historical record of MB data.

9.2.2 **FIELD REAGENT BLANK (FRB)** - The purpose of the FRB is to ensure that PFAS's measured in the Field Samples were not inadvertently introduced into the sample during sample collection/handling. Analysis of the FRB is required only if a Field Sample contains a method analyte or analytes at or above the RL. The FRB is processed, extracted and analyzed in exactly the same manner as a Field Sample.

9.3 Laboratory Control Sample (LCS) and Laboratory Control Sample Duplicates (LCSD)

9.3.1 An LCS is required with each extraction batch. The fortified concentration of the LCS may be rotated between low, medium, and high concentrations from batch to batch. Default limits of 50-150% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation

$$\%R = \frac{A \times 100}{B}$$

Where:

A = measured concentration in the fortified sample
B =fortification concentration.

9.3.2 Where applicable, LCSD's are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS The RSD's must fall within ≤30% of the true value for medium and high level replicates, and ≤50% for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$RPD = \frac{|LCS - LCSD|}{(LCS + LCSD) / 2} \times 100$$

9.3.3 **If the LCS and or LCSD results do not meet these criteria for method analytes, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.**

9.4 Labeled Recovery Standards (REC)

The analyst must monitor the peak areas of the REC(s) in all injections during each analysis day.

9.5 Extracted Internal Standards (EIS)

9.5.1 The EIS standard is fortified into all samples, CCVs, MBs, LCSs, MSs, MSDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The EIS is a means of assessing method performance from extraction to final

chromatographic measurement. Calculate the recovery (%R) for the EIS using the following equation

$$\%R = (A / B) \times 100$$

Where:

A = calculated EIS concentration for the QC or Field Sample
B = fortified concentration of the EIS.

9.5.2 Default limits of 50-150% may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. A low or high percent recovery for a sample, blank, or CCV does not require discarding the analytical data but it may indicate a potential problem with future analytical data. When EIS recovery from a sample, blank, or CCV are outside control limits, check 1) calculations to locate possible errors, 2) standard solutions for degradation, 3) contamination, and 4) instrument performance. For CCVs and QC elements spiked with all target analytes, if the recovery of the corresponding target analytes meet the acceptance criteria for the EIS in question, the data can be used but all potential biases in the recovery of the EIS must be documented in the sample report. If the associated target analytes do not meet the acceptance criteria,the data must be reanalyzed.

9.6 Matrix Spike (MS)

9.6.1 Analysis of an MS is required in each extraction batch and is used to determine that the sample matrix does not adversely affect method accuracy. Assessment of method precision is accomplished by analysis of a Field Duplicate (FD) (Sect. 9.6); however, infrequent occurrence of method analytes would hinder this assessment. If the occurrence of method analytes in the samples is infrequent, or if historical trends are unavailable, a second MS, or MSD, must be prepared, extracted, and analyzed from a duplicate of the Field Sample. Extraction batches that contain MSDs will not require the extraction of a field sample duplicate. If a variety of different sample matrices are analyzed regularly, for example, drinking water from groundwater and surface water sources, method performance should be established for each. Over time, MS data should be documented by the laboratory for all routine sample sources.

9.6.2 Within each extraction batch, a minimum of one Field Sample is fortified as an MS for every 20 Field Samples analyzed. The MS is prepared by spiking a sample with an appropriate amount of the Analyte Stock Standard (Sect. 8.2.3). Use historical data and rotate through the low, mid and high concentrations when selecting a fortifying concentration. Calculate the percent recovery (%*R*) for each analyte using the equation

$$\%R = \frac{(A - B)}{C} \times 100$$

Where:

A = measured concentration in the fortified sample
B = measured concentration in the unfortified sample
C = fortification concentration.

9.6.3 Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 50-150%. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCS, the recovery is judged to be

matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7 Laboratory Duplicate

9.7.1 FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or MSD) – Within each extraction batch (not to exceed 20 Field Samples), a minimum of one FD or MSD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an MSD should be analyzed rather than an FD.

9.7.2 Calculate the relative percent difference (*RPD*) for duplicate measurements (*FD1* and *FD2*) using the equation

$$RPD = \frac{|FD1 - FD2|}{(FD1 + FD2) / 2} \times 100$$

9.7.3 RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the RL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCV, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7.4 If an MSD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$RPD = \frac{|MS - MSD|}{(MS + MSD) / 2} \times 100$$

9.7.5 RPDs for duplicate MSs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when MSs are fortified at analyte concentrations that are within a factor of 2 of the RL. MSs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCSD where applicable, the result is judged to be matrix biased. If no LCSD is present, the associated MS and MSD are to be re-analyzed to determine if any analytical has occurred. If the resulting RPDs are still outside control limits, the result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.8 Initial Calibration Verification (ICV)

9.8.1 As part of the IDC (Sect. 13.2), and after each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ±

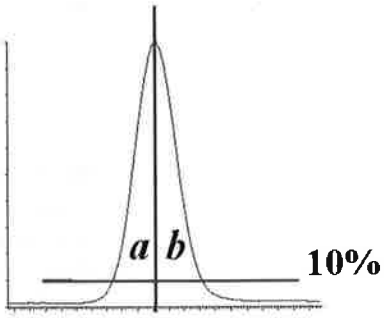
30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedureto locate and correct the problem.

9.9 Continuing Calibration Verification (CCV)

9.9.1 CCV Standards are analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch. See Section 10.7 for concentration requirements and acceptance criteria.

9.10 Method-specific Quality Control Samples

9.10.1 PEAK ASYMMETRY FACTOR – A peak asymmetry factor must be calculated using the equation below during the IDL and every time a calibration curve is generated. The peak asymmetry factor for the first two eluting peaks in a midlevel CAL standard (if only two analytes are being analyzed, both must be evaluated) must fall in the range of 0.8 to 1.5. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.



$$A_s = b / a$$

Where:

A_s = peak asymmetry factor .
b = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex
a = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

9.11 Method Sequence

- CCV-LOW
- MB
- LCS
- LCSD
- MS
- Duplicate or MSD
- Field Samples (1-10)
- CCV-MID
- Field Samples (11-20)
- CCV-LOW

10. Procedure

10.1 Equipment Set-up

10.1.1 This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the MBs should be rotated among the ports to ensure that all the valves and tubing meet the MB requirements (Sect. 9.2).

10.1.2 Some of the PFAS's adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent (Sect 10.3.4) whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected (Sect. 10.3.4).

10.1.3 **NOTE:** The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

10.2 Sample Preparation and Extraction of Aqueous Samples

10.2.1 Samples are preserved, collected and stored as presented in Section 6.

The entire sample that is received must be sent through the SPE cartridge. In addition, the bottle must be solvent rinsed and this rinse must be sent through the SPE cartridge as well. The method blank (MB) and laboratory control sample (LCS) must be extracted in exactly the same manner (i.e., must include the bottle solvent rinse). It should be noted that a water rinse alone is not sufficient. This does not apply to samples with high concentrations of PFAS that are prepared using serial dilution and not SPE.

10.2.2 Determine sample volume. Weigh all samples to the nearest 1g. If visible sediment is present, centrifuge and decant into a new 250mL HDPE bottle and record the weight of the new container.

NOTE: Some of the PFAS's adsorb to surfaces, thus the sample volume may **NOT** be transferred to a graduated cylinder for volume measurement.

10.2.3 The MB, LCS and FRB may be prepared by measuring 250 mL of reagent water with a polypropylene graduated cylinder or filling a 250-mL sample bottle to near the top.

10.2.4 Adjust the QC and sample pH to 3 by adding acetic acid in water dropwise

10.2.5 Add 20 µL of the EIS PDS (Sect. 8.2.2) to each sample and QC, cap and invert to mix.

10.2.6 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.

10.3 Cartridge SPE Procedure

10.3.1 CARTRIDGE CLEAN-UP AND CONDITIONING – DO NOT allow cartridge packing material to go dry during any of the conditioning steps. Rinse each cartridge with 3 X 5 mL of 2% ammonium hydroxide in methanol, followed by 5mls of methanol. Next, rinse each cartridge with 5 mls of the 25 mM acetate buffer, followed by 15 mL of reagent water, without allowing the water to drop below the top edge of the packing. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Add 4-5 mL of reagent water to each cartridge, attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.

10.3.2 SAMPLE EXTRACTON – Adjust the vacuum so that the approximate flow rate is approximately 4 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.

10.3.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample bottles with 4 ml reagent water followed by 4 ml 25 mM acetate buffer at pH 4 and draw the aliquot through the sample transfer tubes and the cartridges. Draw air or nitrogen through the cartridge for 5-10 min at high vacuum (10-15 in. Hg). **NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the entire sample has passed through the cartridge, the reservoirs must be rinsed to waste with reagent water.**

10.3.4 SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 1 – Turn off and release the vacuum. Lift the extraction manifold top and insert a rack with collection tubes into the extraction tank to collect the extracts as they are eluted from the cartridges. Rinse the sample bottles with 12 mls of methanol and draw the aliquot through the sample transfer tubes and cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.

SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 2 In a separate collection vial, rinse the sample bottles with 12 mL of 2% ammonium hydroxide in methanol and elute the analytes from the cartridges by pulling the 4 mL of methanol through the sample transfer tubes and the cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion. To the final extract, add 50 ul of acetic acid.

NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the reservoirs have been rinsed in Section 10.3.3, the elution solvent used to rinse the sample bottles must be swirled down the sides of the reservoirs while eluting the cartridge to ensure that any method analytes on the surface of the reservoirs are transferred to the extract.

CLEAN-UP CARTRIDGE ELUTION, Elute the clean-up cartridge with 8 additional mls of methanol and draw the aliquot through the cartridge. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.

10.3.5 Fractions 1 and 2 are to be combined during the concentration stage (section10.6)

10.4 Sample Prep and Extraction Protocol for Soils

10.4.1 Homogenize and weigh 2 grams of sample (measured to the nearest hundredth of a gram) intoa 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 2 grams of clean sand is used.

10.4.2 Add 20 µL of the EIS PDS (Sect. 8.2.2) to each sample and QC.

10.4.3 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.

10.4.4 To all samples, add 10 mls of methanol, cap, vortex for 25 seconds at 3000RPM and mix for 30 minutes using a shaker table of tumbler at 120RPM.

10.4.5 Following mixing, sonicate each sample for 30 minutes and let samples sit overnight (at least 2 hours is required for RUSH samples).

10.4.6 Centrifuge each sample at 3500RPM for 10 minutes.

10.4.7 Remove supernatant, and reserve for clean-up.

10.5 Extract Clean-up

10.5.1 CARTRIDGE CLEAN-UP AND CONDITIONING –. Rinse each cartridge with 15 mL of methanol and discard. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.

10.5.2 Adjust the vacuum so that the approximate flow rate is 1-2 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.

10.5.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample collection vial with two 1-mL aliquots of methanol and draw each aliquot through the cartridges. Draw air or nitrogen through the cartridge for 5 min at high vacuum (10-15 in. Hg).

10.5.4 If extracts are not to be immediately evaporated, cover collection tubes and store at ambient temperature till concentration.

10.6 Extract Concentration

10.6.1 Concentrate the extract to dryness under a gentle stream of nitrogen in a heated water bath (60-65 °C) to remove all the water/methanol mix. Add the appropriate amount of 80:20% (vol/vol) methanol:water solution and 20 µl of the ID REC PDS (Sect. 8.2.7) to the collection vial to bring the volume to 1 mL and vortex. Transfer two aliquots with a plastic pipet (Sect. 7.6) into 2 polypropylene autosampler vials.

NOTE: It is recommended that the entire 1-mL aliquot not be transferred to the autosampler vial because the polypropylene autosampler caps do not reseal after injection. Therefore, do not store the extracts in the autosampler vials as evaporation losses can occur occasionally in these autosampler vials. Extracts can be split between 2 X 700 µl vials (Sect. 7.4).

10.7 Sample Volume Determination

10.7.1 If the level of the sample was marked on the sample bottle, use a graduated cylinder to measure the volume of water required to fill the original sample bottle to the mark made prior to extraction. Determine to the nearest 10 mL.

10.7.2 If using weight to determine volume, weigh the empty bottle to the nearest 10 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight (Sect. 10.2.2). Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration (Sect. 11.2).

10.8 Initial Calibration - Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCV is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.

10.8.1 ESI-MS/MS TUNE

10.8.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.

10.8.1.2 Optimize the [M-H]- for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined. The method analytes may have different optima requiring some compromise between the optima.

10.8.1.3 Optimize the product ion for each analyte by Infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS/MS parameters (collision gas pressure, collision energy, etc.) are varied until optimal analyte responses are determined. Typically, the carboxylic acids have very similar MS/MS conditions and the sulfonic acids have similar MS/MS conditions.

10.8.2 Establish LC operating parameters that optimize resolution and peak shape. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

Cautions: LC system components, as well as the mobile phase constituents, contain many of the method analytes in this method. Thus, these PFAS's will build up on the head of the LC column during mobile phase equilibration. To minimize the background PFAS peaks and to keep background levels constant, the time the LC column sits at initial conditions must be kept constant and as short as possible (while ensuring reproducible retention times). In addition, prior to daily use, flush the column with 100% methanol for at least 20 min before initiating a sequence. It may be necessary on some systems to flush other LC components such as wash syringes, sample needles or any other system components before daily use.

10.8.3 Inject a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. If analyzing for PFTA, ensure that the LC

conditions are adequate to prevent co-elution of PFTA and the mobile phase interferants. These interferants have the same precursor and products ions as PFTA, and under faster LC conditions may co-elute with PFTA. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ([M-H]-) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation.

10.8.4 Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

10.8.4.1 If broad, split or fronting peaks are observed for the first two eluting chromatographic peaks (if only two analytes are being analyzed, both must be evaluated), change the initial mobile phase conditions to higher aqueous content until the peak asymmetry ratio for each peak is 0.8 – 1.5. The peak asymmetry factor is calculated as described in Section 9.9.1 on a mid-level CAL standard. The peak asymmetry factor must meet the above criteria for the first two eluting peaks during the IDL and every time a new calibration curve is generated. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

10.8.5 Prepare a set of CAL standards as described in Section 8.2.5. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity.

10.8.6 The LC/MS/MS system is calibrated using the IS technique. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve **must always** be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.

10.8.7 CALIBRATION ACCEPTANCE CRITERIA – A linear fit is acceptable if the coefficient of determination (r^2) is greater than 0.99. When quantitated using the initial calibration curve, each calibration point, except the lowest point, for each analyte should calculate to be within 70-130% of its true value. The lowest CAL point should calculate to be within 50-150% of its true value. If these criteria cannot be met, the analyst will have difficulty meeting ongoing QC criteria. It is

recommended that corrective action is taken to reanalyze the CAL standards, restrict the range of calibration, or select an alternate method of calibration (forcing the curve through zero is still required).

10.8.7.1 CAUTION: When acquiring MS/MS data, LC operating conditions must be carefully reproduced for each analysis to provide reproducible retention times. If this is not done, the correct ions will not be monitored at the appropriate times. As a precautionary measure, the chromatographic peaks in each window must not elute too close to the edge of the segment time window.

10.9 CONTINUING CALIBRATION CHECK (CCV) – Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a "sample" is considered to be a Field Sample. MBs, CCVs, LCSs, MSs, FDs FRBs and MSDs are not counted as samples. The beginning CCV of each analysis batch must be at or below the RL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet these criteria. Subsequent CCVs should alternate between a medium and Low concentration CAL standard.

10.9.1 Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.

10.9.2 Calculate the concentration of each analyte and EIS in the CCV. The calculated amount for each analyte for medium level CCVs must be within ± 30% of the true value with an allowance of 10% of the reported analytes to be greater than 30%, but less than 40%. The calculated amount for each EIS must be within ± 50% of the true value. The calculated amount for the lowest calibration point for each analyte must be within ± 50%. If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken (Sect. 10.7.4) which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. **If the CCV fails because the calculated concentration is greater than 130% (150% for the low-level CCV) for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.**

10.9.3 REMEDIAL ACTION – Failure to meet CCV QC performance criteria may require remedial action. Major maintenance, such as cleaning the electrospray probe, atmospheric pressure ionization source, cleaning the mass analyzer, replacing the LC column, etc., requires recalibration (Sect 10.6) and verification of sensitivity by analyzing a CCV at or below the RL (Sect 10.7).

10.10 EXTRACT ANALYSIS

10.10.1 Establish operating conditions equivalent to those summarized in Tables 6-8 of Section 16. Instrument conditions and columns should be optimized prior to the initiation of the IDC.

10.10.2 Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration and completing the IDC can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.

10.10.3 Calibrate the system by either the analysis of a calibration curve (Sect. 10.6) or by confirming the initial calibration is still valid by analyzing a CCV as described in Section 10.7. If establishing an initial calibration, complete the IDC as described in Section 13.2.

10.10.4 Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots under the same conditions used to analyze the CAL standards.

10.10.5 At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard.

10.10.6 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to insure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.

11. Data Evaluation, Calculations and Reporting

11.1 Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 7.

11.2 Calculate analyte concentrations using the multipoint calibration established in Section 10.6. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.6 where:

C_{ex} = (Area of target analyte * Concentration of Labeled analog) / (area of labeled analog * CF)

C_s = (C_{ex} / sample volume in ml) * 1000

C_{ex} = The concentration of the analyte in the extract
CF = calibration factor from calibration.

11.3 Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.

11.4 PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to the linear and branch isomers of these compounds (Sect. 10.6.4.1). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.

11.5 Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

12.1 Section 9.0 outlines sample batch QC acceptance criteria. If non-compliant organic compound results are to be reported, the Organic Section Head and/or the Laboratory Director, and the Operations Manager must approve the reporting of these results. The laboratory Project Manager shall be notified, and may choose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst, Data Reviewer, or Department Supervisor performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.

12.2 All results for the organic compounds of interest are reportable without qualification if extraction and analytical holding times are met, preservation requirements (including cooler temperatures) are met, all QC criteria are met, and matrix interference is not suspected during extraction or analysis of the samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-extraction and/or re-analysis.

13. Method Performance

13.1 Detection Limit Study (DL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

13.1.1 The laboratory follows the procedure to determine the DL, LOD, and/or LOQ as outlined in Alpha SOP ID 1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

13.2.1 The IDC must be successfully performed prior to analyzing any Field Samples. Prior to conducting the IDC, the analyst must first generate an acceptable Initial Calibration following the procedure outlined in Section 10.6.

13.2.2 INITIAL DEMONSTRATION OF LOW SYSTEM BACKGROUND – Any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipets, and autosampler vials are used, it must be demonstrated that an MB is reasonably free of contamination and that the criteria in Section 9.2.1 are met. If an automated extraction system is used, an MB should be extracted on each port to ensure that all the valves and tubing are free from potential PFAS contamination.

13.2.3 INITIAL DEMONSTRATION OF PRECISION (IDP) – Prepare, extract, and analyze four to seven replicate LCSs fortified near the midrange of the initial calibration curve according to the procedure described in Section 10. Sample preservatives as described in Section 6.2.1 must be added to these samples. The relative standard deviation (RSD) of the results of the replicate analyses must be less than 20%.

13.2.4 INITIAL DEMONSTRATION OF ACCURACY (IDA) – Using the same set of replicate data generated for Section 13.2.3, calculate average recovery. The average recovery of the replicate values must be within ± 30% of the true value.

13.2.5 INITIAL DEMONSTRATION OF PEAK ASYMMETRY FACTOR – Peak asymmetry factors must be calculated using the equation in Section 9.10.1 for the first two eluting peaks (if only two analytes are being analyzed, both must be evaluated) in a mid-level CAL standard. The peak asymmetry factors must fall in the range of 0.8 to 1.5. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.

13.2.6 Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.

13.2.7 The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

14.1 Refer to Alpha's Chemical Hygiene Plan and Hazardous Waste Management and Disposal SOP for further pollution prevention and waste management information.

14.2 This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.

14.3 The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

15. Referenced Documents

Chemical Hygiene Plan – ID 2124

SOP ID 1732 Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ) SOP

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

16. Attachments

Table 7: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 MeOH/H_2O)	100% Methanol
Initial	100.0	0.0
1.0	100.0	0.0
2.2	85.0	15.0
11	20.0	80.0
11.4	0.0	100.0
12.4	100.0	00.0
15.5	100.0	0.0
Waters Aquity UPLC ® BEHC_{18} 2.1 x 50 mm packed with 1.7 µm BEH C_{18} stationary phase Flow rate of 0.4 mL/min 2-5 µL injection		

Table 8: ESI-MS Method Conditions

ESI Conditions	
Polarity	Negative ion
Capillary needle voltage	.5 kV
Cone Gas Flow	25 L/hr
Nitrogen desolvation gas	1000 L/hr
Desolvation gas temp.	500 °C

Table 9: Method Analyte Source, Retention Times (RTs), and EIS References

#	Analyte	Transition	RT	IS	Type
1	M3PBA	216>171	2.65		REC
2	PFBA	213 > 169	2.65	2: M4PFBA	
3	M4PFBA	217 > 172	2.65	1: M3PBA	EIS
4	PFPeA	263 > 219	5.67	4: M5PFPEA	
5	M5PFPEA	268 > 223	5.66	1: M3PBA	EIS
6	PFBS	299 > 80	6.35	6: M3PFBS	
7	M3PFBS	302 > 80	6.35	29:M4PFOS	EIS
8	FtS 4:2	327 > 307	7.47	9: M2-4:2FTS	

#	Analyte	Transition	RT	IS	Type
9	M2-4:2FTS	329 > 81	7.47	29:M4PFOS	EIS
10	PFHxA	303 > 269	7.57	10: M5PFHxA	
11	M5PFHxA	318 > 273	7.57	19:M2PFOA	EIS
12	PFPeS	349 > 80	7.88	18: M3PFHxS	
13	PFHpA	363 > 319	8.80	14: M4PFHpA	
14	M4PFHpA	367 > 322	8.80	19:M2PFOA	EIS
15	L-PFHxS	399 > 80	8.94	18: M3PFHxS	
16	br-PFHxS	399 > 80	8.72	18: M3PFHxS	
17	PFHxS Total	399 > 80	8.94	18: M3PFHxS	
18	M3PFHxS	402 > 80	8.94	29:M4PFOS	EIS
19	MPFOA	415 > 370	9.7		REC
20	PFOA	413 > 369	9.7	23: M8PFOA	
21	br-PFOA	413 > 369	9.48	23: M8PFOA	
22	PFOA Total	413 > 369	9.7	23: M8PFOA	
23	M8PFOA	421 > 376	9.7	19: M2PFOA	EIS
24	FtS 6:2	427 > 407	9.66	25: M2-6:2FTS	
25	M2-6:2FTS	429 > 409	9.66	29:M4PFOS	EIS
26	PFHpS	449 > 80	9.78	33: M8PFOS	
27	PFNA	463 > 419	10.41	33: M8PFOS	
28	M9PFNA	472 > 427	10.41	19: M2PFOA	EIS
29	M4PFOS	501 > 80	10.45		REC
30	PFOS	499 > 80	10.45	33: M8PFOS	
31	br-PFOS	499 > 80	10.27	33: M8PFOS	
32	PFOS Total	499 > 80	10.45	33: M8PFOS	
33	M8PFOS	507 > 80	10.45	29: M4PFOS	EIS
34	FtS 8:2	527 > 507	10.99	38: M2-8:2FTS	
35	M2-8:2FTS	529 > 509	10.99	29:M4PFOS	EIS
36	M2PFDA	515 > 470	11.00		REC
37	PFDA	513 > 469	11.00	38: M6PFDA	
38	M6PFDA	519 > 474	11.00	36: M2PFDA	EIS
39	PFNS	549 > 80	11.02	33:M8PFOS	
40	NMeFOSAA	570 > 419	11.41	41: D3-NMeFOSAA	
41	d3-NMeFOSAA	573 > 419	11.41	36: M2PFDA	EIS
42	PFOSA	498 > 78	11.48	29: M8FOSA	
43	M8FOSA	506 > 78	11.48	19: M2PFOA	EIS
44	PFUnDA	563 > 519	11.51	41: M7-PFUDA	
45	M7-PFUDA	570 > 525	11.51	36: M2PFDA	EIS
46	PFDS	599 > 80	11.51	33:M8PFOS	
47	NEtFOSAA	584 > 419	11.68	48: d5-NEtFOSAA	

#	Analyte	Transition	RT	IS	Type
48	d5-NEtFOSAA	589 > 419	11.68	36: M2PFDA	EIS
49	PFDoA	613 > 569	11.96	50: MPFDOA	
50	MPFDOA	615 > 570	11.96	36: M2PFDA	EIS
51	PFTriA	663 > 619	12.34	50: MPFDOA	
52	PFTeA	713 > 669	12.6	53: M2PFTEDA	
53	M2PFTEDA	715 > 670	12.6	36: M2PFDA	EIS
54	M3HFPO-DA	329>285	7.97	19: M2PFOA	EIS
55	HFPO-DA	332>287	7.97	54: M3HFPO-DA	
56	ADONA	377>251	8.00	23: M8PFOA	
57	PFHxDA	813>769	13.20	59: M2PFHxDA	
58	PFODA	913>869	13.50	59: M2PFHxDA	
59	M2PFHxDA	815>770	13.20	36:M2PFDA	EIS
60	NEtFOSA	526>169	11.00	61: NMeFOSA	
61	NMeFOSA	512>169	10.50	63: d3-NMeFOSA	
62	d3-NMeFOSA	515>169	10.50	29: M4PFOS	EIS
63	d5-NEtFOSA	531>169	11.00	29: M4PFOS	EIS
64	NMeFOSE	556>122	11.25	66: d7-NMeFOSE	
65	NEtFOSE	570>136	10.75	67: d9-NEtFOSE	
66	d7-NMeFOSE	563>126	11.25	29: M4PFOS	EIS
67	d9-NEtFOSE	579>142	10.75	29: M4PFOS	EIS
68	FtS 10:2	627>607	11.50	25: M2-6:2FTS	
69	PFDoS	699>99	12.50	33: M8PFOS	

ATTACHMENT C

RESUMES

Jason J. Hayes, PE, LEED AP

Principal/Vice President
Environmental Engineering



18 years in the industry

Mr. Hayes has experience in New York, New Jersey, Washington D.C., California, Washington, Oregon, Alaska, and Internationally. His experience includes Environmental Protection Agency (EPA), New York State (NYS) Brownfields applications, investigation, and remediation; New York City Department of Environmental Protection (NYCDEP) and New York City Office of Environmental Remediation (OER) E-designated site applications, investigations, and remediation. His expertise also includes Phase I and II Environmental Site Investigations and Assessments; contaminated building cleanup and demolition; Underground Storage Tank (UST) permitting, removal specifications, and closure reporting; soil vapor intrusion investigation and mitigation system design (depressurization systems, etc.); development of groundwater contaminant plume migration models; environmental analysis; and oversight, design and specification generation for remediation operations with contaminants of concern to include polychlorinated biphenyls (PCBs), solvents, mercury, arsenic, petroleum products, asbestos, mold and lead.

Selected Projects

- Confidential Location (Remediation for Mercury-Contaminated Site), New York, NY
- Confidential Location (Phase II ESI and Remedial Design for Mercury Impacted Site), Brooklyn, NY
- NYC School Construction Authority (PCB Remediation), Various Locations, New York, NY
- 28-29 High Line (Phase I ESA, Phase II ESI, and Environmental Remediation), New York, NY
- Georgetown Heating Plant (Phase II ESI and Remedial Design for Mercury Impacted Site), Washington D.C.
- 268 West Street (BCP Application, RI and RIWP), New York, NY
- Confidential Multiple Mixed-Use Tower Location (BCP Application, RI, Phase I ESA, and Phase II ESI), New York, NY
- Dock 72 at Brooklyn Navy Yard, (NYS Voluntary Cleanup Program), Brooklyn, NY
- 27-21 44th Drive (BCP Application, Remedial Investigation Phase I ESA, and Phase II ESI), Long Island City, NY
- Purves Street Development, BCP Application, RAWP, and Phase II ESI, Long Island City, NY
- 267-273 West 87th Street (BCP Application, Remedial Investigation, RIWP, RAWP), New York, NY
- New York Aquarium, Shark Tank and Animal Care Facility (Environmental Remediation), Coney Island, NY
- International Leadership Charter School (Environmental Remediation), Bronx, NY
- West & Watts (BCP Application), New York, NY

Education

M.S., Environmental Engineering
Columbia University

B.S., Chemistry, Environmental Toxicology
Humboldt State University

Business Administration (minor)
Humboldt State University

Professional Registration

Professional Engineer (PE) in NY

LEED Accredited Professional (LEED AP)

Troxler Certification for Nuclear Densometer Training

CPR and First Aid Certification

OSHA 40-Hour HAZWOPER

OSHA HAZWOPER Site Supervisor

Affiliations

US Green Building Council, NYC Chapter (USGBC), Communications Committee

Urban Land Institute (ULI), member

Commercial Real Estate Development Association (NAIOP), member

NYC Brownfield Partnership, member

- Hudson Yards Redevelopment (Phase I ESA and Phase II ESI), New York, NY
- 627 Smith Street (RI and Report), Brooklyn, NY
- Gateway Center II Retail (Phase I ESA and Phase II ESI), Brooklyn, NY
- 261 Hudson Street (Phase I ESA, Phase II ESI, BCP, and RAWP), New York, NY
- Riverside Center, Building 2 (BCP, Phase I ESA and Phase II ESI), New York, NY
- New York Police Academy, (Sub-Slab Depressurization and Vapor Barrier System), College Point, NY
- Bronx Terminal Market (BCP, RIWP, RAWP, Phase I ESA and Phase II ESI), Bronx, NY
- Jacob Javits Convention Center (Phase I ESA and Phase II ESI), New York, NY
- Yankee Stadium Development Waterfront Park (NYSDEC Spill Sites), Bronx, NY
- Bushwick Inlet Park (Phase I ESA, Approvals for NYC E-Designation), Brooklyn, NY
- Silvercup West (BCP, RIWP, RIR, RAWP, and RAA), Long Island City, NY
- 29 Flatbush, Tall Residential Building (Groundwater Studies, RIR and RAWP), Brooklyn, NY
- Gowanus Village I (BCP, RIWP and RIR), Brooklyn, NY
- Sullivan Street Hotel (Site Characterization Study and Owner Representation), New York, NY
- Riker's Island Co-Generation Plant (Soil and Soil Vapor Quality Investigations), Bronx, NY
- The Shops at Atlas Park (Sub-Slab Depressurization and Vapor Barrier Design), Glendale, NY
- Memorial Sloan-Kettering Cancer Center (Subsurface and Soil Vapor Intrusion Investigations), New York, NY
- Element West 59th Street (Oversight and Monitoring of Sub-Slab Depressurization and Vapor Barrier Systems), New York, NY
- Teterboro Airport (Delineation and Remedial Oversight of Petroleum-Contaminated Soils), Teterboro, NJ
- Proposed New York JETS Stadium (Phase I ESA), New York, NY
- Former Con Edison Manufactured Gas Plant Sites (Research Reports), New York, NY
- 7 World Trade Center (Endpoint Sampling and Final Closure Report), New York, NY
- Peter Cooper Village, Environmental Subsurface Investigations, New York, NY

Selected Publications, Reports, and Presentations

NYC Mayor's Office of Environmental Remediation – Big Apple Brownfield Workshop – Presented on Soil Vapor Intrusion Remedies (e.g., SSD Systems, Vapor Barriers, Modified HVAC)

New York City Brownfield Partnership – Presented on environmental considerations and complications of the Hudson Yards Development

Waterfront Development Technical Course – Presented on Impacted Waterfront Planning Considerations

STUART KNOOP, PG, LEED AP

SENIOR PROJECT MANAGER

REMEDIAL AND GEOLOGICAL INVESTIGATIONS

Mr. Knoop is a geologist with experience at sites in New York, Connecticut, North Carolina, South Carolina, and Georgia. He has managed high profile, multi-disciplinary projects and worked extensively on projects under City and State regulatory oversight in New York City. Mr. Knoop has developed remedial action and waste management plans and executed remedial investigations, remedial actions, closures at brownfield sites, and former MGP and commercial development sites throughout New York City. He has conducted numerous Phase I and Phase II Environmental Site Assessments, and coordinated remedial action programs at commercial, residential, industrial, telecommunication, and undeveloped sites. He has also coordinated an on-call environmental contract with the New York City School Construction Authority and managed sites under the New York State Brownfield Cleanup Program, and the New York City Voluntary Cleanup Program.

Mr. Knoop's experience includes coordination of free product recovery, development of soil vapor mitigation systems, and implementation of soil and groundwater remediation programs utilizing soil vapor extraction, air sparging, chemical injection, and contaminant removal. He has also supervised the assessment and removal of petroleum underground storage tanks in accordance with state regulatory standards. Additional experience includes extensive geologic mapping, stable isotope reaction and transport modeling, geotechnical analysis of soil and rock for highway, and utility construction projects.

SELECTED PROJECTS

- Queens Plaza Park, Long Island City, NY
- Red Hook Development Sites, Brooklyn, NY
- 173-177 Harrison Avenue, Brooklyn, NY
- Gotham West Development (Studio City), New York, NY
- NYCHA, On-Call Environmental Contract, New York, NY
- Kingsbridge Armory Redevelopment, Bronx, NY
- 54 Rutledge Street Property, Brooklyn, NY
- Peter Cooper Village/Stuyvesant Town Utility Replacement Project, New York, NY
- Former Linen Cleaning Facility, Bronx, NY
- New York Sports Complex and Convention Center, New York, NY
- West Side Site, New York, NY
- Rikers Island Correctional Facility, East Elmhurst, NY
- Macon County School Bus Garage, Franklin, NC
- Skyland Distributing Facility, Asheville, NC
- Rental Uniform Facilities, Various Locations, Nationwide
- Interstate Brands Corporation, Winston-Salem, NC



EDUCATION

M.S., Geology
University of British Columbia

B.A., Economics and Environmental
Oberlin College

Hydrogeology and Geology Coursework
University of Texas

PROFESSIONAL REGISTRATION

Professional Geologist (PG) in NY, NC

LEED Accredited Professional (LEED AP)

10-Hour OSHA

CPR and First Adi Certified

AFFILIATIONS

Geological Society of America

Geological Association of New Jersey

SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

"*Small Site, Big Challenges: Negotiating Overlapping Regulatory Commitments for a Private School Development in Emergent, Post-Industrial Brooklyn, NY*", Poster Session, 2012 Langan Environmental Workshop, New Brunswick, NJ.

An Introduction to Phase I Environmental Site Assessments, Co-Presenter for Langan Training Webinar, November 2011.

"New Evidence for Syn-Tectonic Fluid Migration across the Hinterland-Foreland Transition of the Canadian Cordillera", Journal of Geophysical Research, *v. 107,* Knoop, S., Kennedy, L., and Dipple, G. 2002.

"Were the Hinterland and Foreland Hydrologically Coupled during Mesozoic Contraction?", Abstracts with Programs, Geological Society of America, Annual Meeting, Knoop, S., Kennedy, L., and Dipple, G. 1999. Presented at October 1999 meeting in Denver, CO.

"New Evidence for the Flow of Hinterland-Derived Fluids Into the Canadian Rockies During Mesozoic Contraction.", Abstracts with Programs, Geological Association of Canada, Annual Meeting, 2000. Presented as poster at May 2000 meeting in Calgary, AB. Knoop, S., Kennedy, L., and Dipple, G.

MARLA MILLER, PE, BCEE

SENIOR PROJECT ENGINEER

ENVIRONMENTAL ENGINEERING

Ms. Miller has over 19 years of experience managing site characterization and remediation projects. She is a senior environmental engineer experienced in environmental permitting, industrial pretreatment, compliance monitoring, and water quality evaluation. She has a strong background in data validation, laboratory analyses, and sampling procedures for soil, water, and air matrices. Her expertise in data interpretation includes natural attenuation monitoring, petroleum hydrocarbon chromatography, and aqueous geochemistry.



SELECTED PROJECTS

Data Validation

- St. Joseph's Parish Redevelopment Data Quality Assessment (DQA) and Data Usability (DUE) preparation, New York, NY
- 175 – 225 3rd Street Data Usability Summary Report (DUSR), Brooklyn, NY
- 805 – 825 Atlantic Ave DUSR, Brooklyn, NY
- John Evans Superfund Site DUSR, Lansdale, PA
- 50 North Road (Nokia Chester), DQA and DUE preparation, Chester, NJ
- Data Validation/Data Management for Brownfields Site Assessment, Port St. Joe, FL*

Industrial Wastewater Pretreatment

- Industrial Wastewater Discharge Limit Development, Inland Empire Utilities Agency (IEUA), CA*
- Local Limits Study, Hopewell, VA*
- Local Limits Study, Mesa, AZ*
- Local Limits Development and Sewer Use Ordinance Development, Prescott, AZ*
- Implementation of Industrial Pretreatment Program, Prescott, AZ*
- Industrial Pretreatment Development, Queen Creek, AZ*
- Selenium Wastewater Treatment Options for Meat Packing Facility, Tolleson, AZ*
- Arizona Pollutant Discharge Elimination System (AZPDES) Permit Application Preparation, Phoenix, AZ
- Preparation of Sampling and Analysis Plan for Sub-Regional Operating Group (SROG) Local Limits Development, Phoenix and Surrounding Cities, AZ

EDUCATION

M.S., Environmental Engineering
University of California, Berkeley

B.S., Biology
Loyola Marymount University

PROFESSIONAL REGISTRATION

Professional Engineer (PE) in AZ

Board Certified Environmental Engineer (BCEE) – Hazardous Waste Management (09-10019)

CERTIFICATIONS

The Wastewater Treatment, Wastewater Collection, and Water Distribution Operator Certification

Grade 2
Water Treatment Operator Certification Grade 1

Backflow Tester Certification (AABP)

*Denotes projects performed prior to employment at Langan

Site Investigation/Remediation/Compliance

- Arizona Electric Power Cooperative (AEPCO) Apache Generating Station Arizona Protection Permit (APP), Wilcox, AZ
- Arizona Department of Environmental Quality (ADEQ) Water Quality Assurance Revolving Fund (WQARF) Projects, Phoenix and Gilbert, AZ
- Long-Term Monitoring Program and 5-Year CERCLA Review, Luke Air Force Base (AFB), Glendale, AZ*
- Development of Stormwater Prevention Pollution Plan (SWPPP) and Stormwater Flow Modeling, Luke AFB, Glendale, AZ*
- Site Investigation and Clean Closure for Confidential Industrial Client, Tempe, AZ*
- RCRA Facility Investigation/Corrective Measures Assessment, San Jose, CA*
- Technical Resource for X-Ray Fluorescence (XRF) Field Screening Program for Former Small Arms Firing Range, Nogales, AZ*
- Designed and Implemented Sampling Procedures for Volatile Emissions from Tailings Impoundment Using Flux Chambers, Henderson, CO*
- Conceptual Site Model and Statistical Evaluation for Water Treatment Plant, Denver, CO*

Mining Project

- Third-Party Construction Quality Assurance (CQA) for Geotextile-Lined Tailings Repository, Casa Grande, AZ*
- CQA For Reclamation at Smelter, Miami, AZ*
- XRF Field Screening for Excavation at Former Smelter Site, El Paso, TX*
- CQA for Reclamation Projects at Active Smelter, Miami, AZ

ATTACHMENT D

SAMPLE NOMENCLATURE

LANGAN

SAMPLE NOMENCLATURE

The sample nomenclature outlined below provides consistency between sample events and projects but, most importantly, establish unique sample IDs that will avoid confusion months or years after the sample has been collected. Furthermore, unique sample IDs are required for any data submitted to the NYSDEC in EDD format or being uploaded to an EQuIS database.

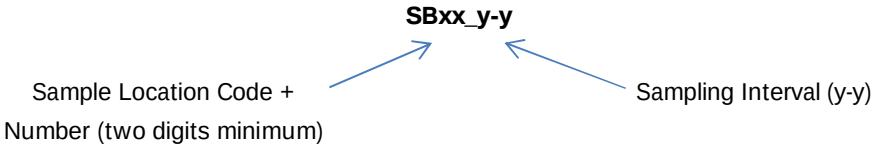
1.0 INVESTIGATION LOCATION CODES

SB	Soil Boring	SV	Soil Vapor Point
WC	Waste Characterization Boring	IA	Indoor Air
TP	Test Pit	AA	Ambient Air
EPSW	Endpoint Location (Sidewall)	SVE	Vapor Extraction Well
EPB	Endpoint Location (Bottom)	DS	Drum
MW	Monitoring Well	IDW	Investigation Derived Waste
TMW	Temporary Monitoring Well	SL	Sludge
SW	Surface Water	FP	Free Product

2.0 SAMPLE NOMENCLATURE

Each sample at a site must have a unique value.

- **Soil/Sediment Samples:**

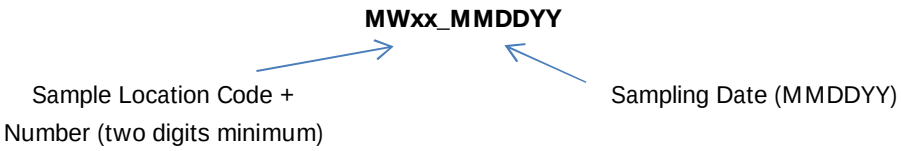


Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
Phase II/Remedial Investigation			
Grab Soil Sample	SB01	2 to 4	SB01_2-4
	SB02	4	SB02_4
Waste Characterization			
Grab Soil Sample	WC01	2 to 4	WC01_2-4
	WC02	4	WC02_4
Composite Soil Sample from one or more locations	COMP01 or COMP02 + COMP03	0 to 10 (Fill)	COMP01_0-10

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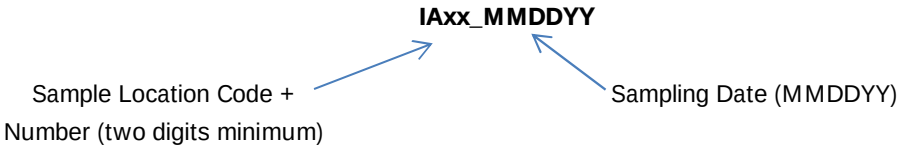
Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
Endpoint Sampling			
Grab Soil Sample	EPSW01_N	5	EPSW01_N_5
	EPSW01_S	5	EPSW01_S_5
	EPSW01_E	5	EPSW01_E_5
	EPSW01_W	5	EPSW01_W_5
	EPB01	6	EPB01_6

- **Groundwater/Surface Water Samples:**



Sample Type	Sample Location Code	Sampling Date	Sample Name
Groundwater Sample	MW01	02/21/2013	MW01_022113

- **Air/Soil Vapor Samples:**



Sample Type	Sample Location Code	Date	Sample Name
Air Sample	IA01	02/21/2013	IA01_022113
Soil Vapor Sample	SV01	02/21/2013	SV01_022113
Vapor Extraction Well Sample	SVE01 (INLET/MIDPOINT/OUTLET)	02/21/2013	SVE01_IN_022113 SVE01_ MID_022113 SVE01_ OUT_022113

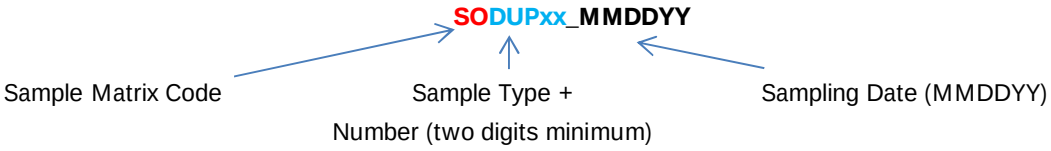
- **QA/QC Samples:**

Sample Matrix Codes

SO	Soil	AS	Air
SE	Sediment	SV	Soil Vapor
GW	Groundwater	SL	Sludge
SW	Surface Water	FP	Free Product

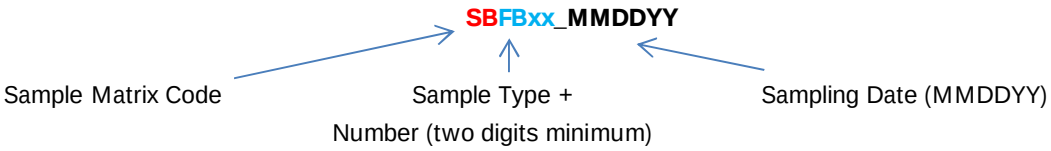
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- Duplicates Samples



Sample Type	Parent Sample Code	Date	Sample Name
Groundwater Duplicate Sample (DUP)	MW01_022113	02/21/2013	GWDUP01_022113
Soil boring Duplicate Sample (DUP)	SBP01_022113	02/21/2013	SODUP01_022113
Grab Waste Characterization	WC01	02/21/2013	WCDUP01_022113
Composite Waste Characterization	COMP01	02/21/2013	COMPDUP01_022113

- Field Blanks and Trip Blanks



Sample Type	Date	Sample Name
Groundwater Field Blank (FB)	02/21/2013	GWFB01_022113
Groundwater Trip Blank (TB)	02/21/2013	GWTB01_022113
Soil Field Blank	02/21/2013	SOFB01_022113
Soil Trip Blank	02/21/2013	SOTB01_022113

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

Parent Sample Name_MS or MSD

Sample Type	Sample Location	Parent Sample Name	Sample Name
Matrix Spike Soil (MS)	SB01	SB01_2-4	SB01_2-4_MS
Matrix Spike Soil Duplicate (MSD)	SB01	SB01_2-4	SB01_2-4_MSD
Matrix Spike GW (MS)	MW01	MW01	MW01_MS
Matrix Spike GW Duplicate (MSD)	MW01	MW01	MW01_MSD

3.0 NOTES

1. The sample location code should not exceed 20 characters and the sample name should not exceed 40 characters.
2. Sample location code (**SB01, MW01, etc.)** is a sequential number (starting with 01) and should be a minimum of two digits.
3. Sample Interval (SB01_**0-5**) is separated from the sample location code with an underscore, and the top and bottom interval with a dash. Soil and sediment sample intervals should always be in

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feet. Soil and sediment sample intervals should contain no "/" or "()" or unit.

4. Sample date (MW01_**022113**) is separated from the sample location code with an underscore and should be provided in MMDDYY format [the date should contain no "/" or "-"].
5. If groundwater samples are collected from multiple intervals within one well, you may assign a letter designation (in lower case) to the well ID to differentiate between intervals (i.e., MW01a_022113, MW01b_022113, and MW01c_022113). The letter "a" would indicate the shallowest interval and "c" the deepest. The actual depth intervals should be documented in the project field book or field sheets and the letter designations should be used consistently between sampling events.
6. According to USEPA's Contract Laboratory Program (CLP) Guidance for Field Samplers (January 2011), field duplicate samples should remain "blind" to the laboratory (i.e., they should have separate CLP Sample numbers). Assign two separate (unique) CLP sample numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory. (http://www.epa.gov/superfund/programs/clp/download/sampler/CLPSamp-01-2011.pdf)

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Appendix C

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

FOR

261 WALTON AVENUE
BRONX, NY 10451

Prepared for:

Tuck-It-Away Associates – Deegan, LLC
555 Madison Avenue
New York, NY 10022

Prepared by:

Langan Engineering, Environmental, Surveying,
Landscape Architecture, and Geology, D.P.C.
21 Penn Plaza
360 West 31st Street, 8th Floor
New York, New York 10001

January 2020
Langan Project No. 170601701

LANGAN

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Attachment F Jobsite Safety Inspection Checklist

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***** Items to be posted prominently on site, or made readily available to personnel.

1.0 INTRODUCTION

1.1 General

This health and safety plan (HASP) was developed to address disturbance of known and reasonably anticipated subsurface contaminants and comply with Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120(b) (4), *Hazardous Waste Operations and Emergency Response* during anticipated site work on portions of 261 Walton Avenue in the Bronx, New York (Tax Map Block 2344, Lot 60) ("the Site). This HASP provides the minimum requirements for implementing site operations during environmental investigation activities. All contractors performing work on this Site shall implement their own Health and Safety Plans that, at a minimum, adhere to this HASP. The contractor is solely responsible for their own health and safety and that of their subcontractors. Langan personnel will implement this HASP while on-site.

The management of the day-to-day site activities and implementation of this HASP in the field is the responsibility of the site Langan Field Team Leader (FTL). Assistance in the implementation of this HASP can also be obtained from the site Langan Health and Safety Officer (HSO) and the Langan Health and Safety Manager (HSM). Contractors operating on the Site shall designate their own FTL, HSO and HSM. The content of this HASP may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the work plan.

1.2 Site Location and Background

The site is located at 261 Walton Avenue in the Mott Haven neighborhood of the Bronx, New York. The site is about 27,454 square feet (0.63 acres) in area and is identified on the Bronx Borough Tax Map as Block 2344, Lot 60. The site is bound by an industrial/manufacturing building to the north, Walton Avenue followed by industrial buildings to the east, a gas station to the south, and Gerard Avenue followed by the Major Deegan Expressway to the west. A site location map is attached as Figure 1.

The site is improved with a vacant six-story building, with associated garages and an asphalt-paved lot spanning the remainder of the lot.

1.3 Summary of Work Tasks

The general categories of work tasks being performed during implementation of the work plan include:

1.3.1 Geotechnical Soil Boring

Langan will retain a geotechnical drilling contractor to advance geotechnical soil borings to a depth below grade surface (bgs) specified in the work plan. Borings locations will be based on the results of site inspection and document review. The drilling contractor will contact the appropriate utility mark-out authority and make available to their drilling staff the verification number and effective dates.

Langan will observe the borehole advancement and record appropriate geotechnical data including the results of Standard Penetration Tests (SPT), soil and stratigraphic identification and other data as required by the work plan. One or more borings may be completed as temporary observation wells to be completed as specified in the work plan. All borings and temporary observations wells will be filled with clean soil cuttings after the subsurface exploration is completed.

1.3.2 Geophysical Investigation

Prior to the commencement of intrusive field activities (i.e., soil borings); a geophysical consultant will conduct a geophysical survey using ground penetrating radar (GPR) and electromagnetic detection equipment. Langan personnel will coordinate the geophysical survey. The objective of the survey will be to identify any underground storage tank (UST) structures and/or associated piping and subsurface utilities that may be encountered during the investigation. During this time Langan personnel will inspect the Site and confirm sample locations.

1.3.3 Soil Investigation and Sampling

Langan will retain a drilling contractor to advance soil borings to a depth below grade surface (bgs) specified in the work plan. Borings locations will be based on the results of the geophysical survey and the site inspection and document review. The drilling contractor will contact the appropriate utility mark-out authority and make available to their drilling staff the verification number and effective dates.

Langan personnel will screen soil for visual, olfactory, and instrumental indicators suggestive of a potential petroleum release. Instrument screening for the presence of volatile organic compounds (VOCs) may be performed with a calibrated photoionization detector (PID). Langan personnel will collect soil samples from the two-foot interval exhibiting the greatest degree of visual, olfactory, instrumental impact, or as otherwise specified in the work. The borings will be filled with clean soil cuttings after samples are collected.

Soil samples will be submitted to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory and analyzed in accordance with work plan specifications.

1.3.4 Groundwater Investigation and Sampling

One or more soil borings will be converted into temporary groundwater monitoring wells and sampled to evaluate groundwater quality. Groundwater samples will be collected from one or more of the temporary monitoring wells in accordance with the Langan Low Flow Groundwater Sampling SOP (SOP #12). Groundwater samples will be submitted to an NYSDOH ELAP-certified laboratory and analyzed for constituents as specified in the work plan. The temporary monitoring wells will be backfilled and abandoned in accordance with State and Local regulations.

1.3.5 Soil Vapor Point Installation and Sampling

The drilling contractor will install soil vapor points to a depth specified by the work plan. Vapor samples will be collected in accordance with the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (New York State Department of Health [NYSDOH] October 2006) and Langan's Soil Vapor Sampling SOP (SOP #13). Conditions in the field may require adjustment of sampling locations.

Ambient air sample may be collected for use as a comparison sample. The subsurface soil vapor samples will be collected using a soil vapor implant and tubing or similar method. The annulus around the probe and tubing will be filled with sand to two inches above the probe. Bentonite slurry will be applied to the top of the sand up to seal the sampling points.

1.3.6 Drum Sampling

Excess or impacted soil and water drummed during the remedial action activities must be labeled in accordance with the Langan Drum Labeling Standard Operating Procedure (SOP-#9). Langan personnel will collect drum samples, as required, prior to off-site drum disposal. Samples will be placed into laboratory-supplied batch-certified clean glassware and submitted to a NYSDOH ELAP-certified laboratory.

2.0 IDENTIFICATION OF KEY PERSONNEL/HEALTH AND SAFETY PERSONNEL

The following briefly describes the health and safety (H&S) designations and general responsibilities that may be employed for this site. The titles have been established to accommodate the project needs and requirements and ensure the safe conduct of site activities. The H&S personnel requirements for a given work location are based upon the proposed site activities.

2.1 Langan Project Manager

The Langan Environmental Project Manager (PM) is Ilkay Cam-Spanos. Their responsibilities include:

- Ensuring that this HASP is developed and approved prior to on-site activities.
- Ensuring that all the tasks in the project are performed in a manner consistent with

Langan's comprehensive *Health and Safety Program for Hazardous Waste Operations* and this HASP.

2.2 Langan Corporate Health and Safety Manager

The Langan Corporate Health and Safety Manager (HSM) is Tony Moffa. His responsibilities include:

- Updating the *Health and Safety Program for Hazardous Waste Operations*.
- Assisting the site Health and Safety Officer (HSO) with development of the HASP, updating HASP as dictated by changing conditions, jobsite inspection results, etc. and approving changes to this HASP.
- Assisting the HSO in the implementation of this HASP and conducting Jobsite Safety Inspections and assisting with communication of results and correction of shortcomings found.
- Maintaining records on personnel (medical evaluation results, training and certifications, accident investigation results, etc.).

2.3 Langan Site Health & Safety Officer

The Langan site HSO is William Bohrer. His responsibilities include:

- Participating in the development and implementation of this HASP.
- When on-site, assisting the Langan Field Team Leader in conducting Tailgate Safety Meetings and Jobsite Safety Inspections and correcting any shortcomings in a timely manner.
- Ensuring that proper PPE is available, worn by employees and properly stored and maintained.
- Controlling entry into and exit from the site contaminated areas or zones.
- Monitoring employees for signs of stress, such as heat stress, fatigue, and cold exposure.
- Monitoring site hazards and conditions.
- Knowing (and ensuring that all site personnel also know) emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department.
- Resolving conflicts that may arise concerning safety requirements and working conditions.
- Reporting all incidents, injuries and near misses to the Langan Incident/Injury Hotline immediately and the client representative.

2.4 Langan Field Team Leader Responsibilities

The Langan Field Team Leader (FTL) is to be determined prior to the start of site activities. The

Field Team Leader's responsibilities include:

- The management of the day-to-day site activities and implementation of this HASP in the field.
- Participating in and/or conducting Tailgate Safety Meetings and Jobsite Safety Inspections and correcting any shortcomings in a timely manner.
- When a Community Air Monitoring Operating Program (CAMP) is part of the scope, the FTL will set up and maintaining community air monitoring activities and instructing the responsible contractor to implement organic vapor or dust mitigation when necessary.
- Overseeing the implementation of activities specified in the work plan.

2.5 Contractor Responsibilities

The contractor shall develop and implement their own HASP for their employees, lower-tier subcontractors, and consultants. The contractor is solely responsible for their own health and safety and that of their subcontractors. Contractors operating on the Site shall designate their own FTL, HSO and HSM. The contractor's HASP will be at least as stringent as this Langan HASP. The contractor must be familiar with and abide by the requirements outlined in their own HASP. A contractor may elect to adopt Langan's HASP as its own provided that it has given written notification to Langan, but where Langan's HASP excludes provisions pertinent to the contractor's work (i.e., confined space entry); the contractor must provide written addendums to this HASP. Additionally, the contractor must:

- Ensure their employees are trained in the use of all appropriate PPE for the tasks involved;
- Notify Langan of any hazardous material brought onto the job site or site related area, the hazards associated with the material, and must provide a material safety data sheet (MSDS) or safety data sheet (SDS) for the material;
- Have knowledge of, understand, and abide by all current federal, state, and local health and safety regulations pertinent to the work;
- Ensure their employees handling hazardous materials, if identified at the Site, have received current training in the appropriate levels of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response* (HAZWOPER) if hazardous waste is identified at the Site;
- Ensure their employees handling hazardous materials, if identified at the Site, have been fit-tested within the year on the type respirator they will wear;
- Ensure all air monitoring is in place pertaining to the health and safety of their employees as required by OSHA 1910.120; and
- All contractors must adherer to all federal, state, and local regulatory requirements.

3.0 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSES

A Task-Hazard Analysis (Table 1) was completed for general construction hazards that may be encountered at the Site. Known and suspected chemical contaminant hazards that could be encountered during site operations are included in Table 2. A complete inventory of MSDS/SDS for chemical products used on site is included as Attachment E.

3.1 Specific Task Safety Analysis

3.1.1 Excavation of Debris and Shoreline Stabilization

Working near the water will pose potential drowning hazards due to slipping or falling into the Harlem River. Potential adverse health effects are similar to slips, trips, and falls, and may also result in drowning. Good housekeeping at the site must be maintained at all times. Employees must be aware of the location of the water's edge and must either stay at least 5 feet away from the embankment to the Harlem River, or wear a personal floatation device approved by the US Coast Guard.

3.1.2 Geophysical Survey

Langan personnel are not permitted to operate or otherwise handle the geophysical equipment including any downhole geophysical equipment subsequently used to survey boreholes. When soil, groundwater or soil vapor points are surveyed with surface geophysical equipment, the locations of the point as well as possible utilities and other artifacts that may interfere with the subsurface investigation are to be marked with indelible paint, flags, or color tape (when marking indoor locations that the client has specifically requested not be marked with indelible paint). When applying paint, proper PPE including at a minimum hand protections should be used.

3.1.3 Soil Investigation and Sampling

Sampling the soil requires the donning of chemical resistant gloves in addition to the standard PPE. Langan personnel are not to operate drilling or excavation equipment nor open sampling devices (acetate liners, sonic sample bags, etc.). These tasks are to be completed by the driller or excavation contractor.

3.1.4 Groundwater Investigation and Sampling

Sampling groundwater requires the donning of chemical resistant gloves in addition to the standard PPE and cut resistant gloves when cutting sampling-tubing to length. Langan personnel are not to operate drilling equipment nor assemble or install monitoring well equipment. These tasks are to be completed by the driller contractor.

3.1.5 Soil Vapor Investigation and Sampling

Sampling soil vapor requires the donning of work gloves in addition to the standard PPE when

assembling the Summa™ canister with the regulator and cut resistant gloves when cutting sampling- or silicone-tubing to length. Langan personnel are not to operate drilling equipment nor assemble or install soil vapor point equipment. These tasks are to be completed by the driller contractor.

3.1.6 Drum Sampling

Drilling fluid, rinse water, grossly-contaminated soil samples and cuttings will be containerized in 55-gallon drums for disposed off-site. Each drum must be labeled in accordance with the Langan Drum Labeling Standard Operating Procedure (SOP-#9). Sampling drums requires the donning of work gloves when opening the drums and chemical resistant gloves when sampling in addition to standard PPE.

Langan personnel and contractors are not to move or opened any orphaned (unlabeled) drum found on the site without approval of the project manager.

3.2 Radiation Hazards

No radiation hazards are known or expected at the site.

3.3 Physical Hazards

Physical hazards, which may be encountered during site operations for this project, are detailed in Table 1.

3.3.1 Explosion

No explosion hazards are expected for the scope of work at this site.

3.3.2 Heat Stress

The use of Level C protective equipment, or greater, may create heat stress. Monitoring of personnel wearing personal protective clothing should commence when the ambient temperature is 72^{O}F or above. Table 6 presents the suggested frequency for such monitoring. Monitoring frequency should increase as ambient temperature increases or as slow recovery rates are observed. Refer to the Table 7 to assist in assessing when the risk for heat related illness is likely. To use this table, the ambient temperature and relative humidity must be obtained (a regional weather report should suffice). Heat stress monitoring should be performed by the HSO or the FTL, who shall be able to recognize symptoms related to heat stress.

To monitor the workers, be familiar with the following heat-related disorders and their symptoms:

- **Heat Cramps:** Painful spasm of arm, leg or abdominal muscles, during or after work

- **Heat Exhaustion:** Headache, nausea, dizziness; cool, clammy, moist skin; heavy sweating; weak, fast pulse; shallow respiration, normal temperature
- **Heat Stroke**: Headache, nausea, weakness, hot dry skin, fever, rapid strong pulse, rapid deep respirations, loss of consciousness, convulsions, coma. *This is a life threatening condition***.**

Do not permit a worker to wear a semi-permeable or impermeable garment when they are showing signs or symptoms of heat-related illness.

To monitor the worker, measure:

- **Heart rate:** Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 100 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one-third. A worker cannot return to work after a rest period until their heart rate is below 100 beats per minute.
- **Oral temperature:** Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6^{o}F (37.6^{o}C), shorten the next work cycle by one-third without changing the rest period. A worker cannot return to work after a rest period until their oral temperature is below 99.6^{o}F. If oral temperature still exceeds 99.6^{o}F (37.6^{o}C) at the beginning of the next rest period, shorten the following cycle by one-third. Do not permit a worker to wear a semi-permeable or impermeable garment when oral temperature exceeds 100.6^{o}F (38.1^{o}C).

Prevention of Heat Stress - Proper training and preventative measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress the following steps should be taken:

- Adjust work schedules.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, id., eight fluid ounces (0.23 liters) of water must be ingested for approximately every eight ounces (0.23 kg) of weight lost. The normal

thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

- Maintain water temperature 50^{O} to 60^{O}F (10^{O} to 16.6^{O}C).
- Provide small disposal cups that hold about four ounces (0.1 liter).
- Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
- Train workers to recognize the symptoms of heat related illness.

3.3.3 Cold-Related Illness

If work on this project begins in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia. Local cold exposure is generally called frostbite.

- **Hypothermia -** Hypothermia is defined as a decrease in the patient core temperature below 96^{O}F. The body temperature is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interference with any of these mechanisms can result in hypothermia, even in the absence of what normally is considered a "cold" ambient temperature. Symptoms of hypothermia include: shivering, apathy, listlessness, sleepiness, and unconsciousness.
- **Frostbite -** Frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20^{O}F. Symptoms of frostbite are: a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

Prevention of Cold-Related Illness - To prevent cold-related illness:

- Educate workers to recognize the symptoms of frostbite and hypothermia
- Identify and limit known risk factors:
- Assure the availability of enclosed, heated environment on or adjacent to the site.
- Assure the availability of dry changes of clothing.
- Assure the availability of warm drinks.
- Start (oral) temperature recording at the job site:
- At the FSO or Field Team Leader's discretion when suspicion is based on changes in a worker's performance or mental status.
- At a worker's request.
- As a screening measure, two times per shift, under unusually hazardous conditions

(e.g., wind-chill less than 20^{O}F, or wind-chill less than 30^{O}F with precipitation).

- As a screening measure whenever anyone worker on the site develops hypothermia.

Any person developing moderate hypothermia (a core temperature of 92^{O}F) cannot return to work for 48 hours.

3.3.4 Noise

Work activities during the proposed activities may be conducted at locations with high noise levels from the operation of equipment. Hearing protection will be used as necessary.

3.3.5 Hand and Power Tools

The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. All hand and power tools should be inspected for health and safety hazards prior to use. If deemed unserviceable/un-operable, notify supervisor and tag equipment out of service. Ground Fault Circuit Interrupters (GFCIs) are required for all power tools requiring direct electrical service.

3.3.6 Slips, Trips and Fall Hazards

Care should be exercised when walking at the site, especially when carrying equipment. The presence of surface debris, uneven surfaces, pits, facility equipment, and soil piles contribute to tripping hazards and fall hazards. To the extent possible, all hazards should be identified and marked on the Site, with hazards communicated to all workers in the area.

3.3.7 Utilities (Electrocution and Fire Hazards)

The possibility of encountering underground utilities poses fire, explosion, and electrocution hazards. All excavation work will be preceded by review of available utility drawings and by notification of the subsurface work to the N.Y. One –Call–Center. Potential adverse effects of electrical hazards include burns and electrocution, which could result in death.

3.4 Biological Hazards

3.4.1 Animals

No animals are expected to be encountered during site operations.

3.4.2 Insects

Insects are not expected to be encountered during site operations.

3.5 Additional Safety Analysis

3.5.1 Presence of Non-Aqueous Phase Liquids (NAPL)

There is potential for exposure to NAPL at this site. Special care and PPE should be considered when NAPL is observed as NAPL is a typically flammable fluid and releases VOCs known to be toxic and/or carcinogenic. If NAPL is present in a monitoring well, vapors from the well casing may contaminate the work area breathing zone with concentrations of VOCs potentially exceeding health and safety action levels. In addition, all equipment used to monitor or sample NAPL (or groundwater from wells containing NAPL) must be intrinsically safe. Equipment that directly contacts NAPL must also be resistant to organic solvents.

At a minimum, a PID should be used to monitor for VOCs when NAPL is observed. If NAPL is expected to be observed in an excavation or enclosed area, air monitoring must be started using calibrated air monitoring equipment designed to sound an audio alarm when atmospheric concentrations of VOC are within 10% of the LEL. In normal atmospheric oxygen concentrations, the LEL monitoring may be done with a Wheatstone bridge/catalytic bead type sensor (i.e. MultiRAE). However in oxygen depleted atmospheres (confined space), only an LEL designed to work in low oxygen environments may be used. Best practices require that the LEL monitoring unit be equipped with a long sniffer tube to allow the LEL unit to remain outside the UST excavation.

When NAPL is present, Langan personnel are required to use disposable nitrile gloves at all times to prevent skin contact with contaminated materials. They should also consider having available a respirator and protective clothing (Tyvek® overalls), especially if NAPL is in abundance and there are high concentrations of VOCs.

All contaminated disposables including PPE and sampling equipment must be properly disposed of in labeled 55-gallon drums.

3.6 Job Safety Analysis

A Job Safety Analysis (JSA) is a process to identify existing and potential hazards associated with each job or task so these hazards can be eliminated, controlled or minimized. A JSA will be performed at the beginning of each work day, and additionally whenever an employee begins a new task or moves to a new location. All JSAs must be developed and reviewed by all parties involved. A blank JSA form and documentation of completed JSAs are in Attachment G.

4.0 PERSONNEL TRAINING

4.1 Basic Training

Completion of an initial 40-hour HAZWOPER training program as detailed in OSHA's 29 CFR 1910.120(e) is required for all employees working on a site engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances, health hazards, or safety hazards as defined by 29 CFR 1910.120(a). Annual 8-hour

refresher training is also required to maintain competencies to ensure a safe work environment. In addition to these training requirements, all employees must complete the OSHA 10 hour Construction Safety and Health training and supervisory personnel must also receive eight additional hours of specialized management training. Training records are maintained by the HSM.

4.2 Initial Site-Specific Training

Training will be provided to specifically address the activities, procedures, monitoring, and equipment for site operations at the beginning of each field mobilization and the beginning of each discrete phase of work. The training will include the site and facility layout, hazards, and emergency services at the site, and will detail all the provisions contained within this HASP. For a HAZWOPER operation, training on the site must be for a minimum of 3 days. Specific issues that will be addressed include the hazards described in Section 3.0.

4.3 Tailgate Safety Briefings

Before starting work each day or as needed, the Langan HSO will conduct a brief tailgate safety meeting to assist site personnel in conducting their activities safely. Tailgate meetings will be documented in Attachment H. Briefings will include the following:

- Work plan for the day;
- Review of safety information relevant to planned tasks and environmental conditions;
- New activities/task being conducted;
- Results of Jobsite Safety Inspection Checklist;
- Changes in work practices;
- Safe work practices; and
- Discussion and remedies for noted or observed deficiencies.

5.0 MEDICAL SURVEILLANCE

All personnel who will be performing field work involving potential exposure to toxic and hazardous substances (defined by 29 CFR 1910.120(a)) will be required to have passed an initial baseline medical examination, with follow-up medical exams thereafter, consistent with 29 CFR 1910.120(f). Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine.

Additionally, personnel who may be required to perform work while wearing a respirator must receive medical clearance as required under CFR 1910.134(e), *Respiratory Protection*. Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine. Results of medical evaluations are maintained by the HSM.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 Levels of Protection

Langan will provide PPE to Langan employees to protect them from the specific hazards they are likely to encounter on-site. Direct hired contractors will provide their employees with equivalent PPE to protect them from the specific hazards likely to be encountered on-site. Selection of the appropriate PPE must take into consideration: (1) identification of the hazards or suspected hazards; (2) potential exposure routes; and, (3) the performance of the PPE construction (materials and seams) in providing a barrier to these hazards.

Based on anticipated site conditions and the proposed work activities to be performed at the site, Level D protection will be used. The upgrading/downgrading of the level of protection will be based on continuous air monitoring results as described in Section 6.0 (when applicable). The decision to modify standard PPE will be made by the site HSO or FTL after conferring with the PM. The levels of protection are described below.

Level D Protection (as needed)

- Safety glasses with side shields or chemical splash goggles
- Safety boots/shoes
- Coveralls (Tyvek® or equivalent)
- Hard hat
- Long sleeve work shirt and work pants
- Nitrile gloves
- Hearing protection
- Reflective safety vest

Level D Protection (Modified, as needed)

- Safety glasses with sideshields or chemical splash goggles
- Safety boots/shoes (toe-protected)
- Disposable chemical-resistant boot covers
- Coveralls (polycoated Tyvek or equivalent to be worn when contact with wet contaminated soil, groundwater, or non-aqueous phase liquids is anticipated)
- Hard hat
- Long sleeve work shirt and work pants
- Nitrile gloves
- Hearing protection (as needed)
- Personal floatation device (for work within 5 ft of the water)
- Reflective traffic vest

Level C Protection (as needed)

- Full or Half face, air-purifying respirator, with NIOSH approved HEPA filter
- Inner (latex) and outer (nitrile) chemical-resistant gloves
- Safety glasses with side shields or chemical splash goggles
- Chemical-resistant safety boots/shoes
- Hard hat
- Long sleeve work shirt and work pants
- Coveralls (Tyvek® or equivalent)
- Hearing protection (as needed)
- Reflective safety vest

The action levels used in determining the necessary levels of respiratory protection and upgrading to Level C are summarized in Table 4. The written Respiratory Protection Program is maintained by the HSM and is available if needed. The monitoring procedures and equipment are outlined in Section 6.0 (when applicable).

6.2 Respirator Fit-Test

All Langan employees who may be exposed to hazardous substances at the work site are in possession of a full or half face-piece, air-purifying respirator and have been successfully fit-tested within the past year. Fit-test records are maintained by the HSM.

6.3 Respirator Cartridge Change-Out Schedule

Respiratory protection is required to be worn when certain action levels (table 2) are reached. A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. The respirator cartridge change-out schedule for this project is as follows:

- Cartridges shall be removed and disposed of at the end of each shift, when cartridges become wet or wearer experiences breakthrough, whichever occurs first.
- If the humidity exceeds 85%, then cartridges shall be removed and disposed of after 4 hours of use.

Respirators shall not be stored at the end of the shift with contaminated cartridges left on. Cartridges shall not be worn on the second day, no matter how short the time period was the previous day they were used.

7.0 AIR QUALITY MONITORING AND ACTIONS LEVELS

7.1 Monitoring During Site Operations

Atmospheric air monitoring results are used to provide data to determine when exclusion zones need to be established and when certain levels of personal protective equipment are required. For all instruments there are Site-specific action level criteria which are used in making field

health and safety determinations. Other data, such as the visible presence of contamination or the steady state nature of air contaminant concentration, are also used in making field health and safety decisions. Therefore, the HSO may establish an exclusion zone or require a person to wear a respirator even though atmospheric air contaminant concentrations are below established HASP action levels.

During site work involving disturbance of petroleum-impacted or fill material, real time air monitoring will be conducted for volatile organic compounds (VOCs). A photoionization detector (PID) and/or flame ionization detector (FID) will be used to monitor concentrations of VOCs at personnel breathing-zone height. Air monitoring will be the responsibility of the HSO or designee. Air monitoring will be conducted during intrusive activities associated with the completion of excavation, debris removal, and soil grading. All manufacturers' instructions for instrumentation and calibration will be available onsite.

Subcontractors' air monitoring plans must be equal or more stringent as the Langan plan.

An air monitoring calibration log is provided in Attachment D of this HASP.

7.1.1 Volatile Organic Compounds

Monitoring with a PID, such as a MiniRAE 2000 (10.6v) or equivalent will occur during intrusive work in the AOCs. Colormetric Indicator Tubes for benzene may be used as backup for the PID, if measurements remain above background monitor every 2 hours. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (odors, visible gases, etc.) since the last measurement. If VOC levels are observed above 5 ppm for longer than 5 minutes or if the site PPE is upgraded to Level C, the HSO will begin monitoring the site perimeter at a location downwind of the AOC every 30 minutes in addition to the employee breathing zone. Instrument action levels for monitored gases are provided in Table 4.

7.1.2 Metals

Based upon the site historical fill, there is a potential for the soils to contain PAHs and metals. During invasive procedures which have the potential for creating airborne dust, such as excavation of dry soils, a real time airborne dust monitor such as a Mini-Ram should be used to monitor for air particulates. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (appearance of visible dust) since the last measurement. If dust levels are observed to be greater than 0.100 mg/m^3 or visible dust is observed for longer than 15 minutes or if the site PPE is upgraded to Level C, the HSO will begin monitoring the site perimeter at a location

downwind of the AOC every 30 minutes in addition to the employee breathing zone. Instrument action levels for dust monitoring are provided in Table 4.

7.2 Monitoring Equipment Calibration and Maintenance

Instrument calibration shall be documented and included in a dedicated safety and health logbook or on separate calibration pages of the field book. All instruments shall be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

All instruments shall be operated in accordance with the manufacturers' specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on site by the HSO for reference.

7.3 Determination of Background Levels

Background (BKD) levels for VOCs and dust will be established prior to intrusive activities within the AOC at an upwind location. A notation of BKD levels will be referenced in the daily monitoring log. BKD levels are a function of prevailing conditions. BKD levels will be taken in an appropriate upwind location as determined by the HSO.

Table 4 lists the instrument action levels.

8.0 COMMUNITY AIR MONITORING PROGRAM

Community air monitoring may be conducted in compliance with the NYSDOH Generic CAMP outlined below:

Monitoring for dust and odors will be conducted during all ground intrusive activities by the FTL. Continuous monitoring on the perimeter of the work zones for odor, VOCs, and dust may be required for all ground intrusive activities such as soil excavation and handling activities. The work zone is defined as the general area in which machinery is operating in support of remediation activities. A portable PID will be used to monitor the work zone and for periodic monitoring for VOCs during activities such as soil and groundwater sampling and .soil excavation. The site perimeter will be monitored for fugitive dust emissions by visual observations as well as instrumentation measurements (if required). When required, particulate or dust will be monitored continuously with real-time field instrumentation that will meet, at a minimum, the performance standards from DER-10 Appendix 1B.

If VOC monitoring is required, the following actions will be taken based on VOC levels measured:

- If total VOC levels exceed 5 ppm above background for the 15-minute average at the perimeter, work activities will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work activities will resume with continued monitoring.
- If total VOC levels at the downwind perimeter of the hot zone persist at levels in excess of 5 ppm above 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 will resume provided that the total organic vapor level 200 feet downwind of the hot 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 above background for the 15-minute average.
- If the total VOC level is above 25 ppm at the perimeter of the hot zone, activities will be shutdown.

If dust monitoring with field instrumentation is required, the following actions will be taken based on instrumentation measurements:

- If the downwind particulate level is 100 micrograms per cubic meter (µg/m³) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression must be employed. Work may continue with dust suppression techniques provided that downwind PM10 levels do not exceed 150 µg/m³ above the background level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM10 levels are greater than 150 µg/m³ above the background level, work must 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 PM10 concentration to within 150 µg/m³ of the upwind level and in preventing visible dust migration.

8.1 Vapor Emission Response Plan

This section applies if VOC monitoring is required. If the ambient air concentration of organic vapors exceeds 5 ppm above background at the perimeter of the hot zone, boring and well installation, and excavation activities will be halted or odor controls will be employed, and monitoring continued. When work shut-down occurs, downwind air monitoring as directed by the HSO or FTL will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section.

If the organic vapor level decreases below 5 ppm above background, sampling and boring and well installation can resume, provided:

- The organic vapor level 200 feet downwind of the hot zone or half the distance to the nearest residential or commercial structure, whichever is less, is below 1 ppm over background, and
- More frequent intervals of monitoring, as directed by the HSO or FTL, are conducted.

8.2 Major Vapor Emission

This section applies if VOC monitoring is required. If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work site, or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted or odor controls must be implemented.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the hot zone, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone).

If either of the following criteria is exceeded in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be implemented.

- Sustained organic vapor levels approaching 5 ppm above background for a period of more than 30 minutes, or
- Organic vapor levels greater than 5 ppm above background for any time period.

8.3 Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

- The local police authorities will immediately be contacted by the HSO or FTL and advised of the situation;
- Frequent air monitoring will be conducted at 30-minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the HSO or FTL; and
- All Emergency contacts will go into effect as appropriate.

8.4 Dust Suppression Techniques

Preventative measures for dust generation may include wetting site fill and soil, construction of an engineered construction entrance with gravel pad, a truck wash area, covering soils with tarps, and limiting vehicle speeds to five miles per hour.

Work practices to minimize odors and vapors include limiting the time that the excavations remain open, minimizing stockpiling of contaminated-source soil, and minimizing the handling of contaminated material. Offending odor and organic vapor controls may include the

application of foam suppressants or tarps over the odor or VOC source areas. Foam suppressants may include biodegradable foams applied over the source material for short-term control of the odor and VOCs.

If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: direct load-out of soils to trucks for off-Site disposal; use of chemical odorants in spray or misting systems; and, use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

9.0 WORK ZONES AND DECONTAMINATION

9.1 Site Control

Work zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas.

Any person working in an area where the potential for exposure to site contaminants exists will only be allowed access after providing the HSO with proper training and medical documentation.

Exclusion Zone (EZ) - All activities which may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an EZ. Decontamination of field equipment will also be conducted in the Contaminant Reduction Zone (CRZ) which will be located on the perimeter of the EZ. The EZ and the CRZ will be clearly delineated by cones, tapes or other means. The HSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the HSO allowing adequate space for the activity to be completed, field members and emergency equipment.

9.2 Contamination Zone

9.2.1 Personnel Decontamination Station

Personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

9.2.2 Minimization of Contact with Contaminants

During completion of all site activities, personnel should attempt to minimize the chance of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination as PPE is intended to minimize accidental contact. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

Field procedures will be developed to control over spray and runoff and to ensure that unprotected personnel working nearby are not affected.

9.2.3 Personnel Decontamination Sequence

Decontamination will be performed by removing all PPE used in EZ and placing it in drums/trash cans at the CRZ. Baby wipes shall be available for wiping hands and face. Drums/trash cans-will be labeled by the field crews in accordance with all local, state, and federal requirements. Management plans for contaminated PPE, and tools are provided below.

9.2.4 Emergency Decontamination

If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment. If the injured person can be moved, he/she will be decontaminated by site personnel as described above before emergency responders handle the victim. If the person cannot be moved because of the extent of the injury (a back or neck injury), provisions shall be made to ensure that emergency response personnel will be able to respond to the victim without being exposed to potentially hazardous atmospheric conditions. If the potential for inhalation hazards exist, such as with open excavation, this area will be covered with polyethylene sheeting to eliminate any potential inhalation hazards. All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent data.

9.2.5 Hand-Held Equipment Decontamination

Hand-held equipment includes all monitoring instruments as stated earlier, samples, hand tools, and notebooks. The hand-held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the CRZ.

To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident. Sampling equipment, hand tools, etc. will be cleaned with non-phosphorous soap to remove any

potentially contaminated soil, and rinsed with deionized water. All decontamination fluids will be containerized and stored on-site pending waste characterization sampling and appropriate off-site disposal.

9.2.6 Heavy Equipment Decontamination

All heavy equipment and vehicles arriving at the work site will be free from contamination from offsite sources. Any vehicles arriving to work that are suspected of being impacted will not be permitted on the work site. Potentially contaminated heavy equipment will not be permitted to leave the EZ unless it has been thoroughly decontaminated and visually inspected by the HSO or his designee.

9.3 Support Zone

The support zone or cold zone will include the remaining areas of the job site. Break areas and support facilities (include equipment storage and maintenance areas) will be located in this zone. No equipment or personnel will be permitted to enter the cold zone from the hot zone without passing through the decontamination station in the warm zone (if necessitated). Eating, smoking, and drinking will be allowed only in this area.

9.4 Communications

The following communications equipment will be utilized as appropriate.

- Telephones - A cellular telephone will be located with the HSO for communication with the HSM and emergency support services/facilities.
- Hand Signals - Hand signals shall be used by field teams, along with the buddy system. The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals are the following:

Hand Signal	Meaning
Hand gripping throat	Out of air; cannot breathe
Grip partners wrists or place both hands around waist	Leave immediately without debate
Hands on top of head	Need assistance
Thumbs up	OK; I'm alright; I understand
Thumbs down	No; negative
Simulated "stick" break with fists	Take a break; stop work

9.5 The Buddy System

When working in teams of two or more, workers will use the "buddy system" for all work activities to ensure that rapid assistance can be provided in the event of an emergency. This requires work groups to be organized such that workers can remain close together and maintain visual contact with one another. Workers using the "buddy system" have the following responsibilities:

- Provide his/her partner with assistance.
- Observe his/her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his/her partner's PPE.
- Notify the HSO or other site personnel if emergency service is needed.

10.0 NEAREST MEDICAL ASSISTANCE

The address and telephone number of the nearest hospital:

Lincoln Medical and Mental Health Center
234 East 149th Street
Bronx, NY
718-579-5700

Map with directions to the hospital are shown in Figure 2. This information will either be posted prominently at the site or will be available to all personnel all of the time. Further, all field personnel, including the HSO & FTL, will know the directions to the hospital.

11.0 STANDING ORDERS/SAFE WORK PRACTICES

The standing orders, which consist of a description of safe work practices that must always be followed while on-site by Langan employees and contractors, are shown in Attachment A. The site HSO and FTL each have the responsibility for enforcing these practices. The standing orders will be posted prominently at the site, or are made available to all personnel at all times. Those who do not abide by these safe work practices will be removed from the site.

12.0 SITE SECURITY

No unauthorized personnel shall be permitted access to the work areas.

13.0 UNDERGROUND UTILITIES

As provided in Langan's Underground Utility Clearance Guidelines, the following safe work practices should be followed by Langan personnel and the contractor before and during subsurface work in accordance with federal, state and local regulations:

- Obtain available utility drawings from the property owner/client or operator.
- Provide utility drawings to the project team.

- In the field, mark the proposed area of subsurface disturbance (when possible).
- Ensure that the utility clearance system has been notified.
- Ensure that utilities are marked before beginning subsurface work.
- Discuss subsurface work locations with the owner/client and contractors.
- Obtain approval from the owner/client and operators for proposed subsurface work locations.
- Use safe digging procedures when applicable.
- Stay at least 10 feet from all equipment performing subsurface work.

14.0 SITE SAFETY INSPECTION

The Langan HSO or alternate will check the work area daily, at the beginning and end of each work shift or more frequently to ensure safe work conditions. The HSO or alternate must complete the Jobsite Safety Inspection Checklist, found in Attachment F. Any deficiencies shall be shared with the FTL, HSM and PM and will be discussed at the daily tailgate meeting.

15.0 HAND AND POWER TOOLS

All hand- and electric-power tools and similar equipment shall be maintained in a safe operating condition. All electric-power tools must be inspected before initial use. Damaged tools shall be removed immediately from service or repaired. Tools shall be used only for the purpose for which they were designed. All users must be properly trained in their safe operation.

16.0 EMERGENCY RESPONSE

16.1 General

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures. In case of emergency, in addition to 911 the Langan Incident/Injury Hotline ***(800) 9-LANGAN*** (800-952-6426) extension 4699 should be called as soon as possible.

16.2 Responsibilities

16.2.1 Health and Safety Officer (HSO)

The HSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The HSO is responsible for ensuring the HSM are notified of all incidents, all injuries, near misses,

fires, spills, releases or equipment damage. The HSO is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the HSM can notify OSHA within the required time frame.

16.2.2 Emergency Coordinator

The HSO or their designated alternate will serve as the Emergency Coordinator. The Emergency Coordinator is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. They are also responsible for ensuring the HSM are notified of all incidents, all injuries, near misses, fires, spills, releases or equipment damage. The Emergency Coordinator is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized.

The Emergency Coordinator shall locate emergency phone numbers and identify hospital routes prior to beginning work on the sites. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator is responsible for implementing the Emergency Response Plan.

16.2.3 Site Personnel

Project site personnel are responsible for knowing the Emergency Response Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency. Project site personnel, including all subcontractors will be trained in the Emergency Response Plan.

16.3 Communications

Once an emergency situation has been stabilized, or as soon as practically possible, the HSO will contact the Langan Incident/Injury Hotline (1-800-952-6426) or (973-560-4699) and Project Manager of identify any emergency situation.

16.4 Local Emergency Support Units

In order to be able to deal with any emergency that might occur during investigative activities at the site, the Emergency Notification Numbers (Table 5) will be posted and provided to all personnel conducting work within the EZ.

Figure 2 shows the hospital route map. Outside emergency number 911 and local ambulance should be relied on for response to medical emergencies and transport to emergency rooms.

Always contact first responders when there are serious or life threatening emergencies on the site. Project personnel are instructed not to drive injured personnel to the Hospital. In the event of an injury, provide first aid and keep the injured party calm and protected from the elements and treat for shock when necessary.

16.5 Pre-Emergency Planning

Langan will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from any of the contaminants expected to be found on the site. Instructions for finding the hospital will be posted conspicuously in the site office and in each site vehicle.

16.6 Emergency Medical Treatment

The procedures and rules in this HASP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the HSO immediately. First-aid equipment will be available on site at the following locations:

- First Aid Kit: Contractor Mobile Office and Vehicles
- Emergency Eye Wash: Contractor Mobile office and Vehicles

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

16.7 Personnel with current first aid and CPR certification will be identified.

Only in non-emergency situations may an injured person be transported to an urgent care facility. Due to hazards that may be present at the site and the conditions under which operations are conducted, it is possible that an emergency situation may develop. Emergency situations can be characterized as injury or acute chemical exposure to personnel, fire or explosion, environmental release, or hazardous weather conditions.

16.8 Emergency Site Evacuation Routes and Procedures

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs as a result of the site investigation activities, including but not limited to fire,

explosion or significant release of toxic gas into the atmosphere, the Langan Project Manager will be verbally notified immediately. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the nearest intersection to be accounted for and to receive further instructions.

16.9 Fire Prevention and Protection

In the event of a fire or explosion, procedures will include immediately evacuating the site and notification of the Langan Project Manager of the investigation activities. Portable fire extinguishers will be provided at the work zone. The extinguishers located in the various locations should also be identified prior to the start of work. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

16.9.1 Fire Prevention

Fires will be prevented by adhering to the following precautions:

- Good housekeeping and storage of materials.
- Storage of flammable liquids and gases away from oxidizers.
- Shutting off engines to refuel.
- Grounding and bonding metal containers during transfer of flammable liquids.
- Use of UL approved flammable storage cans.
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities.

The person responsible for the control of fuel source hazards and the maintenance of fire prevention and/or control equipment is the HSO.

16.10 Significant Vapor Release

Based on the proposed tasks, the potential for a significant vapor release is low. However, if a release occurs, the following steps will be taken:

- Move all personnel to an upwind location. All non-essential personnel shall evacuate.
- Upgrade to Level C Respiratory Protection.
- Downwind perimeter locations shall be monitored for volatile organics.
- If the release poses a potential threat to human health or the environment in the community, the Emergency Coordinator shall notify the Langan Project Manager.
- Local emergency response coordinators will be notified.

16.11 Overt Chemical Exposure

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Material Safety Data Sheet (MSDS) will be followed, when necessary.

SKIN AND EYE: Use copious amounts of soap and water from eye-wash kits and portable hand wash stations.

CONTACT: Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Skin shall also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs. Affected items of clothing shall also be removed from contact with skin.

Providing wash water and soap will be the responsibility of each individual contractor or subcontractor on-site.

16.12 Decontamination During Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or omitted. The HSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

16.13 Adverse Weather Conditions

In the event of adverse weather conditions, the HSO will determine if work will continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds).

- Limited visibility (fog).
- Potential for electrical storms.
- Earthquakes.
- Other major incidents.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The HSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

16.14 Spill Control and Response

All small spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining proper waste characterization and the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill.

All contractor vehicles shall have spill kits on them with enough material to contain and absorb the worst-case spill from that vehicle. All vehicles and equipment shall be inspected prior to be admitted on site. Any vehicle or piece of equipment that develops a leak will be taken out of service and removed from the job site.

The following seven steps shall be taken by the Emergency Coordinator:

1. Determine the nature, identity and amounts of major spills.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify the HSO immediately.
4. Use proper PPE in consultation with the HSO.
5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosion-proof equipment to contain or clean up the spill (diesel-only vehicles, air-operated pumps, etc.)
6. If possible, try to stop the leak with appropriate material.
7. Remove all surrounding materials that can react or compound with the spill.

In addition to the spill control and response procedures described in this HASP, Langan personnel will coordinate with the designated project manager relative to spill response and

control actions. Notification to the Project Manager must be immediate and, to the extent possible, include the following information:

- Time and location of the spill.
- Type and nature of the material spilled.
- Amount spilled.
- Whether the spill has affected or has a potential to affect a waterway or sewer.
- A brief description of affected areas/equipment.
- Whether the spill has been contained.
- Expected time of cleanup completion. If spill cleanup cannot be handled by Langan's on-site personnel alone, such fact must be conveyed to the Project Manager immediately.

Langan shall not make any notification of spills to outside agencies. The client will notify regulatory agencies as per their reporting procedures.

16.15 Emergency Equipment

The following minimum emergency equipment shall be kept and maintained on site:

- Industrial first aid kit.
- Fire extinguishers (one per site).

16.16 Restoration and Salvage

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers.
- Refilling medical supplies.
- Recharging eyewashes and/or showers.
- Replenishing spill control supplies.

16.17 Documentation

Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan Incident/Injury Hotline at 1-(800)-9-LANGAN (ext. #4699) and the client representative to report the incident or near miss. For emergencies involving personnel injury and/or exposure, the HSO and affected employee will complete and submit an Employee Exposure/Injury Incident Report (Attachment C) to the Langan Corporate Health and Safety Manager as soon as possible following the incident.

17.0 RECORDKEEPING

The following is a summary of required health and safety logs, reports and recordkeeping.

17.1 Field Change Authorization Request

Any changes to the work to be performed that is not included in the HASP will require an addendum that is approved by the Langan project manager and Langan HSM to be prepared. Approved changes will be reviewed with all field personnel at a safety briefing.

17.2 Medical and Training Records

Copies or verification of training (40-hour, 8-hour, supervisor, site-specific training, documentation of three-day OJT, and respirator fit-test records) and medical clearance for site work and respirator use will be maintained in the office and available upon request. Records for all subcontractor employees must also be available upon request. All employee medical records will be maintained by the HSM.

17.3 Onsite Log

A log of personnel on site each day will be kept by the HSO or designee.

17.4 Daily Safety Meetings ("Tailgate Talks")

Completed safety briefing forms will be maintained by the HSO.

17.5 Exposure Records

All personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be maintained by the HSO during site work. At the end of the project they will be maintained according to 29 CFR 1910.1020.

17.6 Hazard Communication Program/MSDS-SDS

Material safety data sheets (MSDS) of Safety Data Sheets (SDS) have been obtained for applicable substances and are included in this HASP (Attachment E). Langan's written hazard communication program, in compliance with 29 CFR 1910.1200, is maintained by the HSM.

17.7 Documentation

Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan incident/injury hotline at 1-800-952-6426, extension 4699 and the Project Manager to report the incident or near miss. The Project Manager will contact the client or client representative. A written report must be completed and submitted HSM within 24 hours of the incident. For emergencies involving personnel injury and/or exposure, employee will complete and submit the Langan

incident/injury report to the Langan corporate health and safety manager as soon as possible following the incident. Accidents will be investigated in-depth to identify all causes and to recommend hazard control measures.

18.0 CONFINED SPACE ENTRY

Confined spaces are not anticipated at the Site during planned construction activities. If confined spaces are identified, the contractor must implement their own confined space program that all applicable federal, state and local regulations. Confined spaces **will not** be entered by Langan personnel.

19.0 HASP ACKNOWLEDGEMENT FORM

All Langan personnel and contractors will sign this HASP Compliance Agreement indicating that they have become familiar with this HASP and that they understand it and agree to abide by it.

Printed Name	Signature	Company	Date

TABLES

TABLE 1
TASK HAZARD ANALYSES

Task	Hazard	Description	Control Measures	First Aid
1.3.1 – 1.3.6	Contaminated Soil or Groundwater-Dermal Contact	Contaminated water spills on skin, splashes in eyes; contact with contaminated soil/fill during construction activities or sampling.	Wear proper PPE; follow safe practices, maintain safe distance from construction activities	See Table 2, seek medical attention as required
1.3.1 – 1.3.6	Lacerations, abrasions, punctures	Cutting bailer twine, pump tubing, acetate liners, etc. with knife; cuts from sharp site objects or previously cut piles, tanks, etc.; Using tools in tight spaces	Wear proper PPE; follow safe practices	Clean wound, apply pressure and/or bandages; seek medical attention as required.
1.3.1 – 1.3.6	Contaminated Media Inhalation	Opening drums, tanks, wells; vapors for non-aqueous phase liquids or other contaminated site media; dust inhalation during excavation; vapor accumulation in excavation	Follow air monitoring plan; have quick access to respirator, do not move or open unlabeled drums found at the site, maintain safe distance from construction activities	See Table 2, seek medical attention as required
1.3.1 – 1.3.6	Lifting	Improper lifting/carrying of equipment and materials causing strains	Follow safe lifting techniques; Langan employees are not to carry contractor equipment or materials	Rest, ice, compression, elevation; seek medical attention as required
1.3.1 – 1.3.6	Slips, trips, and falls	Slips, trips and falls due to uneven surfaces, cords, steep slopes, debris and equipment in work areas	Good housekeeping at site; constant awareness and focus on the task; avoid climbing on stockpiles; maintain safe distance from construction activities and excavations; avoid elevated areas over six feet unless fully accredited in fall protection and wearing an approved fall protection safety apparatus	Rest, ice, compression, elevation; seek medical attention as required
1.3.1 – 1.3.6	Noise	Excavation equipment, hand tools, drilling equipment.	Wear hearing protection; maintain safe distance from construction activities	Seek medical attention as required
1.3.1 – 1.3.6	Falling objects	Soil material, tools, etc. dropping from drill rigs, front-end loaders, etc.	Hard hats to be worn at all times while in work zones; maintain safe distance from construction activities and excavations	Seek medical attention as required
1.3.1 – 1.3.6	Underground/ overhead utilities	Excavation equipment, drill rig auger makes contact with underground object; boom touches overhead utility	"One Call" before dig; follow safe practices; confirm utility locations with contractor; wear proper PPE; maintain safe distance from construction activities and excavations	Seek medical attention as required
1.3.1 – 1.3.6	Insects (bees, wasps, hornet, mosquitoes, and spider)	Sings, bites	Insect Repellent; wear proper protective clothing (work boots, socks and light colored pants);field personnel who may have insect allergies (e.g., bee sting) should provide this information to the HSO or FSO prior to commencing work, and will have allergy medication on Site.	Seek medical attention as required
1.3.1 – 1.3.6	Vehicle traffic / Heavy Equipment Operation	Vehicles unable to see workers on site, operation of heavy equipment in tight spaces, equipment failure, malfunctioning alarms	Wear proper PPE, especially visibility vest; use a buddy system to look for traffic; rope off area of work with cones and caution tape or devices at points of hazard, maintain safe distance from construction activities and equipment	Seek medical attention as required

TABLE 2
CONTAMINANT HAZARDS OF CONCERN

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	1,1′-Biphenyl Biphenyl Phenyl benzene Diphenyl	92-52-4	None	1 mg/m^3 100 mg/m^3	Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, throat; headache, nausea, lassitude (weakness, exhaustion), numb limbs; liver damage	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	1,2,4-Trimethylbenzene	95-63-6	PID	None None	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	1,2-Dichloroethylene 1,2-DCE cis-1,2-Dichloroethylene mixture of cis and trans Acetylene dichloride cis-Acetylene dichloride trans-Acetylene dichloride sym-Dichloroethylene cis- 1,2-Dichloroethene Trans-1,2-Dichloroethylene, tDCE cDCE cis-1,2-Dichloroethene Trans-1,2-Dichloroethene	540-59-0	PID	200 ppm 1000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, respiratory system; central nervous system depression	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	1,3,5-Trimethylbenzene Mesitylene sym-Trimethylbenzene	108-67-8	PID	None None	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	1,3-Butadiene Biethylene Bivinyl Butadiene Divinyl Erythrene Vinylethylene	106-99-0	PID	1 ppm 2000 ppm	Vapor	inhalation, skin and/or eye contact (liquid)	irritation to the eyes, nose, throat; drowsiness, dizziness; liquid: frostbite; teratogenic, reproductive effects; [potential occupational carcinogen]	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
1.3.1 – 1.3.6	2-Butanone Ethyl methyl ketone MEK Methyl acetone Methyl ethyl ketone	78-93-3	PID	200 ppm 3000 ppm	Soil Groundwater Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose; headache; dizziness; vomiting; dermatitis	Eye: Irrigate immediately Skin: Water wash immediately Breathing: Fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	2-Hexanone Butyl methyl ketone MBK Methyl butyl ketone Methyl n-butyl ketone	591-78-6	PID	100 ppm 1600 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, nose; peripheral neuropathy: lassitude (weakness, exhaustion), paresthesia; dermatitis; headache, drowsiness	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	2-Methylnaphthalene β-methylnaphthalene	91-57-6	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion or skin absorption, eye contact	irritation to the skin, eyes, mucous membranes and upper respiratory tract. It may also cause headaches, nausea, vomiting, diarrhea, anemia, jaundice, euphoria, dermatitis, visual disturbances, convulsions and comatose	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	4-Methyl-2-pentanone Hexone Isobutyl methyl ketone Methyl isobutyl ketone MIBK	108-10-1	PID	100 ppm 500 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; headache, narcosis, coma; dermatitis; in animals: liver, kidney damage	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Acenaphthene 1,2-Dihydroacenaphthylene 1,8-Ethylenenaphthalene peri-Ethylenenaphthalene Naphthyleneethylene Tricyclododecapentaene	83-32-9	PID	NA NA	Soil	inhalation, ingestion, skin and/or eye contact,	irritation to the skin, eyes, mucous membranes and upper respiratory tract; If ingested, it can cause vomiting	Eye: Irrigate immediately Skin: Soap wash immediately, if redness or irritation develop, seek medical attention immediately Breathing: Move to fresh air Swallow: do not induce vomiting, seek medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Acenaphthylene Cycopental(de)naphthalene, Acenaphthalene	208-96-8	PID	NA NA	Soil	inhalation, ingestion, skin and/or eye contact	irritation to the skin, eyes, mucous membranes and upper respiratory tract	Eye: Irrigate immediately, seek medical attention immediately, Skin: Soap wash immediately, if redness or irritation develop, seek medical attention immediately Breathing: Move to fresh air Swallow: do not induce vomiting, seek medical attention immediately
1.3.1 – 1.3.6	Acetone Dimethyl ketone Ketone propane 2-Propanone	67-64-1	PID	1000 ppm 2500 ppm	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Aluminum	7429-90-5	None	0.5 mg/m3 50 mg/m3	Soil	inhalation, skin and/or eye contact	irritation to the eyes, skin, respiratory system	Eye: Irrigate immediately Breathing: Fresh air

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Anthracene	120-12-7	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to the skin, eyes, mucous membranes and upper respiratory tract, abdominal pain if ingested.	Eye: Irrigate immediately, seek medical attention immediately, Skin: Soap wash immediately, Breathing: Move to fresh air, refer to medical attention; Swallow: refer to medical attention
1.3.1 – 1.3.6	Antimony	7440-36-0	None	0.5 mg/m^3 50 mg/m^3	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation skin, possible dermatitis; resp distress; diarrhea; muscle tremor, convulsions; possible gastrointestinal tract	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Arsenic	NA	None	0.5 mg/m^3 NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation skin, possible dermatitis; resp distress; diarrhea; muscle tremor, convulsions; possible gastrointestinal tract	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Barium	10022-31-8	None	0.5 mg/m^3 50 mg/m^3	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Benzene Benzol Phenyl hydride	71-43-2	PID	3.19 mg/m^3 1,595 mg/mg^3	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; lassitude (weakness, exhaustion) [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Benzo(a)anthracene Benzanthracene Benzanthrene 1,2-Benzanthracene Benzo[b]phenanthrene Tetraphene	56-55-3	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	dermatitis, bronchitis, [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Benzo(a)pyrene	50-32-8	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	dermatitis, bronchitis, [potential occupational carcinogen]	Eye: Irrigate immediately, seek medical attention Skin: Soap wash immediately; Breathing: move to fresh air; Swallow: Induce vomiting if conscious, seek medical attention immediately
1.3.1 – 1.3.6	Benzo(b)fluoranthene	205-99-2	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Benzo(g,h,i)perylene Benzo(ghi)perylene	191-24-2	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	NA	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Benzo(k)fluoranthene	207-08-9	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation (dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Benzyl butyl phthalate Butyl benzyl phthalate	86-66-7	None	NA NA	Groundwater Soil Vapor	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation (dizziness, weakness, fatigue, nausea, headache	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Beryllium	7440-41-7	None	0.002 mg/m^3 4 mg/m^3	Soil	inhalation, skin and/or eye contact	berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation to the eyes; dermatitis; [potential occupational carcinogen]	Eye: Irrigate immediately Breathing: Fresh air

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Bis(2-ethylhexyl)phthalate Di-sec octyl phthalate DEHP Di(2-ethylhexyl)phthalate Octyl phthalate	117-81-7	None	5 mg/m^3 5000 mg/m^3	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen	Eye: Irrigate immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Cadmium	7440-43-9	None	0.005 mg/m^3 9 mg/m^3	Soil	inhalation, ingestion	pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Calcium	7440-70-2	None	NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, upper resp tract; ulcer, perforation nasal septum; pneumonitis; dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Carbazole 9-azafluorene Dibenzopyrrole Diphenylenimine diphenyleneimide	86-74-8	None	NA NA	Soil	inhalation, skin absorption (liquid), skin and/or eye contact	irritation to eyes and skin, respiratory irritation	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Carbon disulfide	75-15-0	PID	20 ppm 500 ppm	Soil Groundwater Vapor	inhalation, skin or eye contact, ingestion	irritation to the eyes, skin, respiratory system	Eye: Irrigate immediately (liquid) Skin: Water flush immediately (liquid) Breathing: Respiratory support
1.3.1 – 1.3.6	Chloroform Methane trichloride Trichloromethane	67-66-3	None	50 ppm 500 ppm	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Chromium Hexavalent- Trivalent-	7440-47-3	None	1.0 mg/m^3 250 mg/m^3	Groundwater Soil	inhalation absorption ingestion	irritation to eye, skin, and respiratory	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Chrysene Benzo[a]phenanthrene 1,2-Benzphenanthrene	218-01-9	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Groundwater Soil	inhalation, absorption, ingestion, consumption	irritation to eye, skin, and respiratory, gastrointestinal irritation nausea, vomit, diarrhea [potential occupational carcinogen]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Cis-Chlordane a-Chlordane alpha Chlordane cis-Chlordan CIS-CHLORDANE Chlordane cis-;Chlordane cis;ALPHA-CHLORDAN Chlordan, cis-ALPHA-CHLORDANE alpha(cis)-chlordane α-chlordane solution	5102-71-9	None	0.5 mg/m³ 100 mg/m³	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Cobalt	7440-48-4	None	0.1mg/m³ 20 mg/m³	Soil	inhalation, ingestion, skin and/or eye contact	Cough, dyspnea (breathing difficulty), wheezing, decreased pulmonary function; weight loss; dermatitis; diffuse nodular fibrosis; resp hypersensitivity, asthma	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Copper	7440-50-8	None	1.0 mg/m³ 100 mg/m³	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, metallic taste; dermatitis; anemia	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Cyclohexane Benzene hexahydride Hexahydrobenzene Hexamethylene Hexanaphthene	110-82-7	PID	300 ppm 1300 ppm	Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, respiratory system; drowsiness; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Dibenzo(a,h)anthracene	53-70-3	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Groundwater Soil	inhalation, absorption, ingestion, consumption	irritation to eyes, skin, respiratory, and digestion [potential occupational carcinogen]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Respiratory support PID Swallow: Medical attention immediately
1.3.1 – 1.3.6	Dibenzofuran	132-64-9	None	NA NA	Soil	inhalation, absorption	irritation to eyes, and skin	Eyes: Irrigate immediately Skin: Soap wash promptly.
1.3.1 – 1.3.6	Dichlorodifluoromethane Difluorodichloromethane, Fluorocarbon 12, Freon® 12, Genetron® 12, Halon® 122, Propellant 12, Refrigerant 12	75-71-8	None	1000 pp, 15,000 ppm	Groundwater Soil Vapor	inhalation, skin and/or eye contact (liquid)	dizziness, tremor, asphyxia, unconsciousness, cardiac arrhythmias, cardiac arrest; liquid: frostbite	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Diesel Fuel automotive diesel fuel oil No. 2 distillate diesoline diesel oil diesel oil light diesel oil No. 1-D summer diesel	68334-30-5	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Ethanol Absolute alcohol Alcohol cologne spirit drinking alcohol ethane monoxide ethylic alcohol EtOH ethyl alcohol ethyl hydrate ethyl hydroxide ethylol grain alcohol hydroxyethane methylcarbinol	64-17-5	PID	1000 ppm 3300 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Ethyl benzene Ethylbenzene Ethylbenzol Phenylethane	100-40-4	PID	435 mg/m^3 3,472 mg/m^3	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Ethyl chloride Chloroethane Hydrochloric ether Monochloroethane Muriatic ether	75-00-3	PID	1000 ppm 3800 ppm	Groundwater Soil Vapor	inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact	incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Fluoranthene Benzo(j, k)fluorene	206-44-0	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Fluorene	86-73-7	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Fuel Oil No. 2	68476-30-2	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Gasoline	8006-61-9	PID	NA NA	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Helium	7440-59-7	Helium Detector	NA NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support
1.3.1 – 1.3.6	Heptane n-Heptane	142-82-5	PID	500 ppm 750 ppm	Goundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	dizziness, stupor, incoordination; loss of appetite, nausea; dermatitis; chemical pneumonitis (aspiration liquid); unconsciousness	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Indeno(1,2,3-cd)pyrene	193-39-5	None	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Groundwater Soil	inhalation, absorption, ingestion, consumption	irritation to eyes, skin, respiratory, and digestion [potential occupational carcinogen]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Respiratory support Swallow: Medical attention immediately, wash mouth with water
1.3.1 – 1.3.6	Iron	7439-89-6	None	10 mg/m^3 NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; abdominal pain, diarrhea, vomiting	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Isopropyl alcohol Iso-Propyl Alcohol Carbinol IPA Isopropanol 2-Propanol sec-Propyl alcohol Rubbing alcohol	67-63-0	PID	400 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, throat; drowsiness, dizziness, headache; dry cracking skin; in animals: narcosis	Eye: Irrigate immediately Skin: Water flush Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Lead	7439-92-1	None	0.050 mg/m^3 100 mg/m^3	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation to the eyes; hypertension	Eye: Irrigate immediately Skin: Soap flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Magnesium	7439-95-4	None	15 mg/m^3 NA	Soil	inhalation, skin and/or eye contact	irritation to the eyes, skin, respiratory system; cough	Eye: Irrigate immediately Breathing: Fresh air
1.3.1 – 1.3.6	Manganese	7439-96-5	None	5 mg/m^3 500 mg/m^3	Groundwater Soil	inhalation, ingestion	aerosol is irritating to the respiratory tract	Eye: Irrigate immediately Skin: Soap flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Mercury	7439-97-6	None	0.1 mg/m^3 10 mg/m^3	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Methyl Acetate	79-20-9	PID	200 ppm 3100 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; headache, drowsiness; optic nerve atrophy; chest tightness; in animals: narcosis	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Methyl Chloride Chloromethane Monochloromethane	74-87-3	NA	100 ppm 2000 ppm	Groundwater Soil	inhalation, skin and/or eye contact	dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen]	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
1.3.1 – 1.3.6	Methyl *tert*-butyl ether MTBE Methyl tertiary-butyl ether Methyl t-butyl ether tert-Butyl methyl ether tBME tert-BuOMe	1634-04-4	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	m-Xylenes 1,3-Dimethylbenzene m-Xylol Metaxylene	108-38-3	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Naphthalene Naphthalin Tar camphor White tar	91-20-3	PID	50 mg/m^3 250 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; hematuria (blood in the urine); dermatitis, optical neuritis	Eye: Irrigate immediately Skin: Molten flush immediately/solid-liquid soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	n-Hexane Hexane, Hexyl hydride, normal-Hexane	110-54-3	PID	500 ppm 1100 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose; nausea, headache; peripheral neuropathy: numb extremities, muscle weak; dermatitis; dizziness; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Nickel	7440-02-0	None	NA 10 mg/m^3	Groundwater Soil	ion, ingestion, skin and/or eye contact	sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Non-Flammable Gas Mixture CALGAS (Equipment Calibration Gas : Oxygen Methane Hydrogen Sulfide Carbon Monoxide Nitrogen	 7782-44-7 74-82-8 7783-08-4 830-08-0 7727-37-9	Multi-Gas PID	 NA/NA NA/NA 10/100 ppm 50/1200 ppm NA/NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support
1.3.1 – 1.3.6	Non-Flammable Gas Mixture CALGAS (Equipment Calibration Gas : Oxygen Isobutylene Nitrogen	 7782-44-7 115-11-7 7727-37-9	PID	 NA/NA NA/NA NA/NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support
1.3.1 – 1.3.6	o-Xylenes 1,2-Dimethylbenzene ortho-Xylene o-Xylol	95-47-6	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	p-Ethyltoluene 4-Ethyltoluene 1-ethyl-4-methyl-benzene	622-96-8	NA	NA NA	Soil	ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Phenanthrene	85-01-8	PID	0.2 mg/m^3 80 mg/m^3 (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Potassium	7440-09-7	None	NA NA	Soil	inhalation, skin absorption, ingestion, skin and/or eye contact inhalation, ingestion, skin and/or eye contact	eye: Causes eye burns. Skin: Causes skin burns. Reacts with moisture in the skin to form potassium hydroxide and hydrogen with much heat. ingestion: Causes gastrointestinal tract burns. inhalation: May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.	Eyes: Get medical aid immediately Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. ingestion: If victim is conscious and alert, give 2-4 full cups of milk or water. Get medical aid immediately. inhalation: Get medical aid immediately.

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	p-Xylenes 1,4-Dimethylbenzene para-Xylene p-Xylol	106-42-3	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Pyrene benzo[def]phenanthrene	129-00-0	PID	0.2 mg/m³ 80 mg/m³ (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.6	Selenium	7782-49-2	None	1 mg/m³ 0.2 mg/m³	Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns; in animals: anemia; liver necrosis, cirrhosis; kidney, spleen damage	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Sodium	7440-23-5	None	NA NA	Groundwater Soil	ion, ingestion, skin and/or eye contact	sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Styrene Ethenyl benzene Phenylethylene Styrene monomer Styrol Vinyl benzene	100-42-5	PID	100 ppm 700 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, nose, respiratory system; headache, lassitude (weakness, exhaustion), dizziness, confusion, malaise (vague feeling of discomfort), drowsiness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects	Eye: Irrigate immediately Skin: Water flush Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Tert-Butyl Alcohol Tertiary Butyl Alcohol 2-Methyl-2-propanol Trimethyl carbinol TBA	75-65-0	PID	100 ppm 1600 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; drowsiness, narcosis	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Tetrachloroethylene Perchlorethylene Perchloroethylene PCE Perk Tetrachlorethylene Tetrachloroethene	127-18-4	PID	100 ppm 150 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Tetrahydrofuran Diethylene oxide 1,4-Epoxybutane Tetramethylene oxide THF	109-99-9	PID	200 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, skin and/or eye contact, ingestion	irritation to the eyes, upper respiratory system; nausea, dizziness, headache, central nervous system depression	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immedi
1.3.1 – 1.3.6	Thallium	7440-28-0	None	0.1 mg/m^3 15 mg/m^3	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Toluene Methyl benzene Methyl benzol Phenyl methane Toluol	108-88-3	PID	200 ppm 500 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, paresthesia; dermatitis	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Total Xylenes Dimethylbenzene Xylol	1330-20-7	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Trans-Chlordane gamma-Chlordane	5103-74-2	None	0.5 mg/m^3 100 mg/m^3	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Trichlorofluoromethane Fluorotrichloromethane Freon® 11 Monofluorotrichloromethane Refrigerant 11 Trichloromonofluoromethane	75-69-4	PID	1000 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.6	Vanadium	7440-62-2	None	0.1 mg/m3 15 mg/m3	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.6	Zinc	7440-62-2	None	15 mg/m^3 500 mg/m^3	Groundwater Soil	inhalation	chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Breathing: Respiratory support

EXPLANATION OF ABBREVIATIONS

PID = Photoionization Detector
PEL = Permissible Exposure Limit (8-hour Time Weighted Average
IDLH = Immediately Dangerous to Life and Health
ppm = part per million
mg/m^3 = milligrams per cubic meter
500 mg/m3

TABLE 3
Summary of Monitoring Equipment

Instrument	Operation Parameters
Photoionization Detector (PID)	**Hazard Monitored:** Many organic and some inorganic gases and vapors. **Application:** Detects total concentration of many organic and some inorganic gases and vapors. Some identification of compounds is possible if more than one probe is measured. **Detection Method:** Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions. **General Care/Maintenance:** Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories. **Typical Operating Time:** 10 hours. 5 hours with strip chart recorder.
Oxygen Meter	**Hazard Monitored:** Oxygen (O_2). **Application:** Measures the percentage of O_2 in the air. **Detection Method:** Uses an electrochemical sensor to measure the partial pressure of O_2 in the air, and converts the reading to O_2 concentration. **General Care/Maintenance:** Replace detector cell according to manufacturer's recommendations. Recharge or replace batteries prior to explanation of the specified interval. If the ambient air is less than 0.5% C O_2, replace the detector cell frequently. **Typical Operating Time:** 8 – 12 hours.
Additional equipment (if needed, based on site conditions)	
Combustible Gas Indicator (CGI)	**Hazard Monitored:** Combustible gases and vapors. **Application:** Measures the concentration of combustible gas or vapor. **Detection Method:** A filament, usually made of platinum, is heated by burning the combustible gas or vapor. The increase in heat is measured. Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present. **General Care/Maintenance:** Recharge or replace battery. Calibrate immediately before use. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.
Flame Ionization Detector (FID) with Gas Chromatography Option *(i.e., Foxboro Organic Vapor Analyzer (OVA))*	**Hazard Monitored:** Many organic gases and vapors (approved areas only). **Application:** In survey mode, detects the concentration of many organic gases and vapors. In gas chromatography (GC) mode, identifies and measures specific compounds. In survey mode, all the organic compounds are ionized and detected at the same time. In GC mode, volatile species are separated. **General Care/Maintenance:** Recharge or replace battery. Monitor fuel and/or combustion air supply gauges. Perform routine maintenance as described in the manual. Check for leaks. **Typical Operating Time:** 8 hours; 3 hours with strip chart recorder.
Potable Infrared (IR) Spectrophotometer	**Hazard Monitored:** Many gases and vapors. **Application:** Measures concentration of many gases and vapors in air. Designed to quantify one or two component mixtures. **Detection Method:** Passes different frequencies of IR through the sample. The frequencies absorbed are specific for each compound. **General Care/Maintenance:** As specified by the manufacturer.

Instrument	Operation Parameters
Direct Reading Colorimetric Indicator Tube	**Hazard Monitored:** Specific gas and vapors. **Application:** Measures concentration of specific gases and vapors. **Detection Method:** The compound reacts with the indicator chemical in the tube, producing a stain whose length or color change is proportional to the compound's concentration. **General Care/Maintenance:** Do not use a previously opened tube even if the indicator chemical is not stained. Check pump for leaks before and after use. Refrigerate before use to maintain a shelf life of about 2 years. Check expiration dates of tubes. Calibrate pump volume at least quarterly. Avoid rough handling which may cause channeling.
Aerosol Monitor	**Hazard Monitored:** Airborne particulate (dust, mist, fume) concentrations **Application:** Measures total concentration of semi-volatile organic compounds, PCBs, and metals. **Detection Method:** Based on light-scattering properties of particulate matter. Using an internal pump, air sample is drawn into the sensing volume where near infrared light scattering is used to detect particles. **General Care/Maintenance:** As specified by the mfr. Also, the instrument must be calibrated with particulates of a size and refractive index similar to those to be measured in the ambient air.
Monitox	**Hazard Monitored:** Gases and vapors. **Application:** Measures specific gases and vapors. **Detection Method:** Electrochemical sensor relatively specific for the chemical species in question. **General Care/Maintenance:** Moisten sponge before use; check the function switch; change the battery when needed.
Gamma Radiation Survey Instrument	**Hazard Monitored:** Gamma Radiation. **Application:** Environmental radiation monitor. **Detection Method:** Scintillation detector. **General Care/Maintenance:** Must be calibrated annually at a specialized facility. **Typical Operating Time:** Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.

TABLE 4
INSTRUMENTATION ACTION LEVELS

Photoionization Detector Action Levels	**Action Required**
Background to 5 ppm	No respirator; no further action required
> 1 ppm but < 5 ppm for > 5 minutes	1. Temporarily discontinue all activities and evaluate potential causes of the excessive readings. If these levels persist and cannot be mitigated (i.e., by slowing drilling or excavation activities), contact HSO to review conditions and determine source and appropriate response action. 2. If PID readings remain above 1 ppm, temporarily discontinue work and upgrade to Level C protection. 3. If sustained PID readings fall below 1 ppm, downgrading to Level D protection may be permitted.
> 5 ppm but < 150 ppm for > 5 minutes	1. Discontinue all work; all workers shall move to an area upwind of the jobsite. 2. Evaluate potential causes of the excessive readings and allow work area to vent until VOC concentrations fall below 5 ppm. 3. Level C protection will continue to be used until PID readings fall below 1 ppm.
> 150 ppm	Evacuate the work area

Notes:
1. 1 ppm level based on OSHA Permissible Exposure Limit (PEL) for benzene.
2. 5 ppm level based on OSHA Short Term Exposure Limit (STEL) maximum exposure for benzene for any 15 minute period.
3. 150 ppm level based on NIOSH Immediately Dangerous to Life and Health (IDLH) for tetrachloroethylene.

TABLE 5
EMERGENCY NOTIFICATION LIST

ORGANIZATION	CONTACT	TELEPHONE
Local Police Department	NYPD	911
Local Fire Department	NYFD	911
Ambulance/Rescue Squad	NYFD	911
Hospital	Lincoln Medical and Mental Health Center	911 or 718-579-5700
Langan Incident / Injury Hotline		800-952-6426 ex 4699
Langan Project Manager	Ilkay Cam-Spanos	917-892-3222 (cell)
Langan Health and Safety Manager (HSM)	Tony Moffa	215-756-2523 (cell)
Langan Health & Safety Officer (HSO)	William Bohrer	410-984-3068 (cell)
Langan Field Team Leader (FTL)	Julia Leung	212-479-5452
Client's Representative	Matthew Sprayregen	860-598-0382
National Response Center (NRC)		800-424-8802
Chemical Transportation Emergency Center (Chemtrec)		800-424-9300
Center for Disease Control (CDC)		404-639-3534
EPA (RCRA Superfund Hotline)		800-424-9346
TSCA Hotline		202-554-1404
Poison Control Center		800-222-1222

Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan Incident/Injury Hotline at 1-(800)-9-LANGAN (ext. #4699).

TABLE 6
SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING FOR FIT AND ACCLIMATED WORKERS[A]

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F or above (32.2°C) or above	After each 45 min. of work	After each 15 min. of work
87.5°F (30.8°-32.2°C)	After each 60 min. of work	After each 30 min. of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 min. of work	After each 60 min. of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 min. of work	After each 90 min. of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 min. of work	After each 120 min. of work

a For work levels of 250 kilocalories/hour.

b Calculate the adjusted air temperature (ta adj) by using this equation: ta adj ^{o}F = ta ^{o}F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

c A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

TABLE 7

HEAT INDEX

	ENVIRONMENTAL TEMPERATURE (Fahrenheit)										
	70	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**
RELATIVE HUMIDITY	**APPARENT TEMPERATURE***										
0%	64	69	73	78	83	87	91	95	99	103	107
10%	65	70	75	80	85	90	95	100	105	111	116
20%	66	72	77	82	87	93	99	105	112	120	**130**
30%	67	73	78	84	90	96	104	113	123	**135**	**148**
40%	68	74	79	86	93	101	110	123	**137**	**151**	
50%	69	75	81	88	96	107	120	**135**	**150**		
60%	70	76	82	90	100	114	**132**	**149**			
70%	70	77	85	93	106	124	**144**				
80%	71	78	86	97	113	**136**					
90%	71	79	88	102	122						
100%	72	80	91	108							

*Combined Index of Heat and Humidity...what it "feels like" to the body
Source: National Oceanic and Atmospheric Administration

How to use Heat Index:
1. Across top locate Environmental Temperature
2. Down left side locate Relative Humidity
3. Follow across and down to find Apparent Temperature
4. Determine Heat Stress Risk on chart at right

Note: Exposure to full sunshine can increase Heat Index values by up to 15 degrees F.

Apparent Temperature	**Heat Stress Risk with Physical Activity and/or Prolonged Exposure**
90-105	Heat Cramps or Heat Exhaustion Possible
105-130	Heat Cramps or Heat Exhaustion Likely, Heat Stroke Possible
>130	Heatstroke Highly Likely

FIGURES

FIGURE 1

Site Location Map



NOTES:
1. BASE MAP REFERENCED FROM THE UNITED STATE GEOLOGICAL SURVEY 7.5 MINUTE SERIES CENTRAL PARK QUADRANGLE
2. ALL LOCATIONS APPROXIMATE

WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

LANGAN Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. 21 Penn Plaza, 360 West 31st Street, 8th Floor New York, NY 10001 T: 212.479.5400 F: 212.479.5444 www.langan.com	Project **261 WALTON AVENUE** BLOCK No. 2344, LOT No. 60 BRONX NEW YORK	Figure Title **SITE LOCATION MAP**	Project No. 170601701 Date 10/29/2019 Drawn By KW Checked By JL	Figure No. **1** Sheet 1 of 4

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FIGURE 2

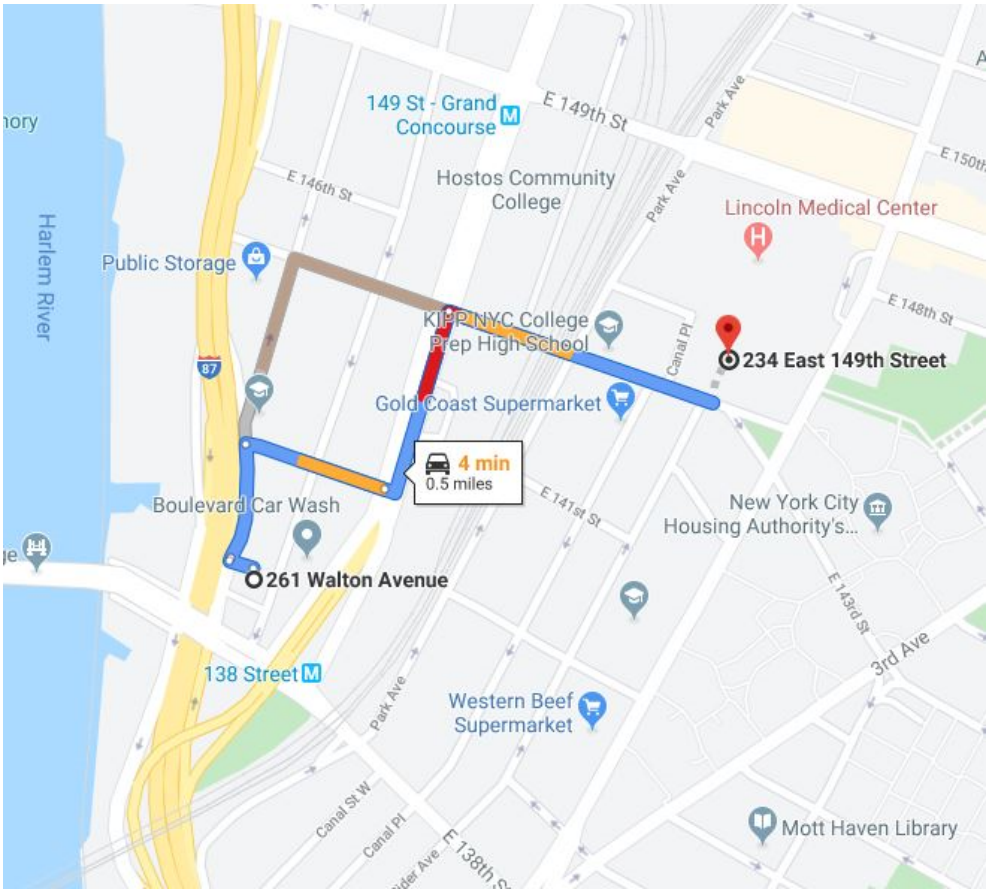
HOSPITAL ROUTE PLAN

Hospital Location: **Lincoln Medical and Mental Health Center**
234 East 149th Street
Bronx, New York
718-579-5700

START: 2671 Walton Avenue, Bronx, NY

1. Head west towards Gerard Avenue
2. Turn right onto Gerard Avenue
3. Keep right to stay on Gerard Avenue
4. Turn right onto East 140th Street
5. Turn left onto Grand Concourse
6. Turn right onto East 144th street, destination will be on the left.

END: Lincoln Medical and Mental Health Center, 234 East 149th Street, Bronx, New York



ATTACHMENT A

STANDING ORDERS

STANDING ORDERS

GENERAL

- No smoking, eating, or drinking in this work zone.
- Upon leaving the work zone, personnel will thoroughly wash their hands and face.
- Minimize contact with contaminated materials through proper planning of work areas and decontamination areas, and by following proper procedures. Do not place equipment on the ground. Do not sit on contaminated materials.
- No open flames in the work zone.
- Only properly trained and equipped personnel are permitted to work in potentially contaminated areas.
- Always use the appropriate level of personal protective equipment (PPE).
- Maintain close contact with your buddy in the work zone
- Contaminated material will be contained in the Exclusion Zone (EZ).
- Report any unusual conditions.
- Work areas will be kept clear and uncluttered. Debris and other slip, trip, and fall hazards will be removed as frequently as possible.
- The number of personnel and equipment in the work zone will be kept to an essential minimum.
- Be alert to the symptoms of fatigue and heat/cold stress, and their effects on the normal caution and judgment of personnel.
- Conflicting situations which may arise concerning safety requirements and working conditions must be addressed and resolved quickly by the site HSO.

TOOLS AND HEAVY EQUIPMENT

- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other device not specifically designed to carrying passengers.
- Loose-fitting clothing or loose long hair is prohibited around moving machinery.
- Ensure that heavy equipment operators and all other personnel in the work zone are using the same hand signals to communicate.
- Drilling/excavating within 10 feet in any direction of overhead power lines is prohibited.
- The locations of all underground utilities must be identified and marked out prior to initiating any subsurface activities.
- Check to insure that the equipment operator has lowered all blades and buckets to the ground before shutting off the vehicle.
- If the equipment has an emergency stop device, have the operator show all personnel its location and how to activate it.
- Help the operator ensure adequate clearances when the equipment must negotiate in tight quarters; serve as a signalman to direct backing as necessary.
- Ensure that all heavy equipment that is used in the Exclusion Zone is kept in that zone until the job is done, and that such equipment is completely decontaminated before moving it into the clean area of the work zone.
- Samplers must not reach into or get near rotating equipment such as the drill rig. If personnel must work near any tools that could rotate, the equipment operator must completely shut down the rig prior to initiating such work. It may be necessary to use a remote sampling device.

ATTACHMENT B

DECONTAMINATION PROCEDURES

PERSONNEL DECONTAMINATION

LEVEL C DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves and Outer Garment Removal	5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	Face piece Removal	6. Face piece is removed (avoid touching face with fingers). Face piece deposited on plastic sheets.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

LEVEL D DECONTAMINATION

Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Boot, Gloves and Outer Garment Removal	4. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 5:	Field Wash	5. Hands and face are thoroughly washed. Shower as soon as possible.

EQUIPMENT DECONTAMINATION

GENERAL:

Equipment to be decontaminated during the project may include tools, monitoring equipment, respirators, sampling containers, laboratory equipment and drilling equipment.

All decontamination will be done by personnel in protective gear, appropriate for the level of decontamination, as determined by the site HSO. The decontamination work tasks will be split or rotated among support and work crews.

Depending on site conditions, backhoe and pumps may be decontaminated over a portable decontamination pad to contain wash water; or, wash water may be allowed to run off into a storm sewer system. Equipment needed may include a steam generator with high-pressure water, empty drums, screens, screen support structures, and shovels. Drums will be used to hold contaminated wash water pumped from the lined pit. These drums will be labeled as such.

Miscellaneous tools and equipment will be dropped into a plastic pail, tub, or other container. They will be brushed off and rinsed with a detergent solution, and finally rinsed with clean water.

MONITORING EQUIPMENT:

Monitoring equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The PID, HNu or OVA meter, for example, can be placed in a clear plastic bag, which allows reading of the scale and operation of knobs. The probes can be partially wrapped keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe.

RESPIRATORS:

Respirators will be cleaned and disinfected after every use. Taken from the drop area, the masks (with the cartridges removed and disposed of with other used disposable gear) will be immersed in a cleaning solution and scrubbed gently with a soft brush, followed by a rinse in plain warm water, and then allowed to air dry. In the morning, new cartridges will be installed. Personnel will inspect their own masks for serviceability prior to donning them. And, once the mask is on, the wearer will check the respirator for leakage using the negative and positive pressure fit check techniques.

ATTACHMENT C

EMPLOYEE EXPOSURE/ INJURY INCIDENT REPORT

EMPLOYEE INCIDENT/INJURY REPORT
LANGAN ENGINEERING & ENVIRONMENTAL SERVICES

(Complete and return to Tony Moffa in the Doylestown Office)

Affected Employee Name: _____ Date: _____

Incident type: ☐ Injury ☐ Report Only/No Injury
☐ Near Miss ☐ Other: _____

EMPLOYEE INFORMATION (Person completing Form)

Employee Name: _____ Employee No: _____

Title: _____ Office Location: _____

Length of time employed or date of hire: _____

Mailing address: _____

_____

Sex: M ☐ F ☐ Birth date: _____

Business phone & extension: _____ Residence/cell phone: _____

ACCIDENT INFORMATION

Project: _____ Project #: _____

Date & time of incident: _____ Time work started & ended: _____

Site location: _____

Incident Type: Possible Exposure ☐ Exposure ☐ Physical Injury ☐

Names of person(s) who witnessed the incident: _____

_____

Exact location incident occurred: _____

_____

Describe work being done: _____

Describe what affected employee was doing prior to the incident occurring: _____

Describe in detail how the incident occurred: _____

Nature of the incident (List the parts of the body affected): _____

Person(s) to whom incident was reported (Time and Date): _____

List the names of other persons affected during this incident: _____

Possible causes of the incident (equipment, unsafe work practices, lack of PPE, etc.): _____

Weather conditions during incident: _____

MEDICAL CARE INFORMATION

Did affected employee receive medical care? Yes ☐ No ☐

If Yes, when and where was medical care received: _____

Provide name of facility (hospital, clinic, etc.): _____

Length of stay at the facility? _____

Did the employee miss any work time? Yes ☐ No ☐ Undetermined ☐

Date employee last worked: _____ Date employee returned to work: _____

Has the employee returned to work? Yes ☐ No ☐

Does the employee have any work limitations or restrictions from the injury? : Yes ☐ No ☐

If Yes, please describe: _____

_____

Did the exposure/injury result in permanent disability? Yes ☐ No ☐ Unknown ☐

If Yes, please describe: _____

HEALTH & SAFETY INFORMATION

Was the operation being conducted under an established site specific CONSTRUCTION HEALTH AND SAFETY PLAN?
Yes ☐ No ☐ Not Applicable: ☐

Describe protective equipment and clothing used by the employee:

_____

_____

_____

Did any limitations in safety equipment or protective clothing contribute to or affect exposure / injury? If so, explain:

_____

_____

_____

_____ _____
Employee Signature Date

_____ _____
Langan Representative Date

ATTACHMENT D

CALIBRATION LOG

DATE:_____ **PROJECT:**_____

CALIBRATION LOG

Date & Time	Inst Type	Inst #	Media	Initial Reading	Span #	Calibrat. Reading	Performed By:

ATTACHMENT E

MATERIAL SAFETY DATA SHEETS

SAFETY DATA SHEETS

All Langan Field Personnel Completing This Work Plan Are To Have Real Time Accessibility To Material Safety Data Sheet (MSDs) or Safety Data Sheet (SDSs) Through Their Smart Phone.

The link is http://www.msds.com/
The login name is "drapehead"
The password is "2angan987"

If You Are Unable To Use the Smart Phone App, You Are To Bring Printed Copies of the MSDs/SDSs to The Site

ATTACHMENT F

JOBSITE SAFETY INSPECTION CHECKLIST

Jobsite Safety Inspection Checklist

Date: _____ **Inspected By:** _____

Location: _____ **Project #:** _____

Check one of the following: **A:** Acceptable **NA**: Not Applicable **D**: Deficiency

	A	NA	D	Remark
1. HASP available onsite for inspection?				
2. Health & Safety Compliance agreement (in HASP) appropriately signed by Langan employees and contractors?				
3. Hospital route map with directions posted on site?				
4. Emergency Notification List posted on site?				
5. First Aid kit available and properly stocked?				
6. Personnel trained in CPR/First Aid on site?				
7. MSDSs readily available, and all workers knowledgeable about the specific chemicals and compounds to which they may be exposed?				
8 Appropriate PPE being worn by Langan employees and contractors?				
9. Project site safe practices ("Standing Orders") posted?				
10. Project staff have 40-hr./8-hr./Supervisor HAZWOPER training?				
11. Project staff medically cleared to work in hazardous waste sites and fit-tested to wear respirators, if needed?				
12. Respiratory protection readily available?				
13. Health & Safety Incident Report forms available?				
14. Air monitoring instruments calibrated daily and results recorded on the Daily Instrument Calibration check sheet?				
15. Air monitoring readings recorded on the air monitoring data sheet/field log book?				
16. Subcontract workers have received 40-hr./8-hr./Spvsr. HAZWOPER training, as appropriate?				
17. Subcontract workers medically cleared to work on site, and fit-tested for respirator wear?				
18. Subcontract workers have respirators readily available?				
19. Mark outs of underground utilities done prior to initiating any subsurface activities?				
20. Decontamination procedures being followed as outlined in HASP?				
21. Are tools in good condition and properly used?				
22. Drilling performed in areas free from underground objects including utilities?				

23. Adequate size/type fire extinguisher supplied?				
24. Equipment at least 20 feet from overhead powerlines?				
25. Evidence that drilling operator is responsible for the safety of his rig.				
26. Trench sides shored, layer back, or boxed?				
27. Underground utilities located and authorities contacted before digging?				
28. Ladders in trench (25-foot spacing)?				
29. Excavated material placed more than 2 feet away from excavation edge?				
30. Public protected from exposure to open excavation?				
31. People entering the excavation regarding it as a permit-required confined space and following appropriate procedures?				
32. Confined space entry permit is completed and posted?				
33. All persons knowledgeable about the conditions and characteristics of the confined space?				
34. All persons engaged in confined space operations have been trained in safe entry and rescue (non-entry)?				
35. Full body harnesses, lifelines, and hoisting apparatus available for rescue needs?				
36. Attendant and/or supervisor certified in basic first aid and CPR?				
37. Confined space atmosphere checked before entry and continuously while the work is going on?				
38. Results of confined space atmosphere testing recorded?				
39. Evidence of coordination with off-site rescue services to perform entry rescue, if needed?				
40. Are extension cords rated for this work being used and are they properly maintained?				
41. Are GFCIs provided and being used?				

Unsafe Acts: _____

_____

_____

_____

Notes: _____

_____

_____

_____

ATTACHMENT G

JOB SAFETY ANALYSIS FORM

LANGAN	Job Safety Analysis (JSA) Health and Safety
JSA TITLE: **JSA NUMBER:**	**DATE CREATED:** **CREATED BY**: **REVISION DATE:** **REVISED BY:**

Langan employees must review and revise the Job Safety Analysis (JSA) as needed to address the any site specific hazards not identified. Employees must provide their signatures on the last page of the JSA indicating they have review the JSA and are aware the potential hazards associated with this work and will follow the provided preventive or corrective measures.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED: (PPE): ■ Required ☒ As Needed		
☐ Steel-toed boots	☐ Nitrile gloves	☐ Dermal Protection (Specify)
☐ Long-sleeved shirt	☐ Leather/ Cut-resistant gloves	☐ High visibility vest/clothing
☐ Safety glasses	☐Face Shield	☐ Hard hat
ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT NEEDED (Provide specific type(s) or descriptions)		
☐ Air Monitoring:	☐ Respirators:	☐ Other:

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1.	1. 2.	1a. 1b. 2a. 2b.
2.	1.	1
Additional items identified in the field.		
Additional Items.		

If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.

LANGAN	Job Safety Analysis (JSA) Health and Safety

JSA Title: Subsurface Investigation

JSA Number: JSA030-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☒ Safety Goggles	☐ Face Shield	☐ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Dielectric Overshoes, Sun Block				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work area	1. Back/strain 2. Slip/Trip/Falls 3. Traffic 4. Cuts/abrasions/contusions from equipment 5. Accidents due to vehicle operations	1. Use proper lifting techniques/Use wheeled transport 2. Minimize distance to work area/unobstructed path to work area/follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves, Langan approved safety shoes) 5. Observe posted speed limits/ Wear seat belts at all times
2. Traffic	1. Hit by moving vehicle	1. Use traffic cones and signage/ Use High visibility traffic vests and clothing/ Caution tape when working near active roadways.
3. Field Work (drilling, resistivity testing, and inspection)	1. Biological Hazards: insects, rats, snakes, poisonous plants, and other animals 2. Heat stress/injuries 3. Cold Stress/injuries 4. High Energy Transmission Lines 5. Underground Utilities 6. Electrical (soil resistivity testing)	1. Inspect work area to identify biological hazards. Wear light colored long sleeve shirt and long pants/ Use insect repellant as necessary/ Beware of tall grass, bushes, woods and other areas where ticks may live/ Avoid leaving garbage on site to prevent attracting animals/ Identify and avoid contact with poisonous plants/Beware of rats, snakes, or stray animals. 2. Wear proper clothing (light colored)/ drink plenty of water/ take regular breaks/use sun block 3. Wear proper clothing/ dress in layers/ take regular breaks. 4. Avoid direct contact with high energy transmission lines/ position equipment at least 15 feet or as required by PSE&G from the transmission lines/ wear proper PPE (dielectric overshoes 15 kV minimum rating). 5. Call one-call service before performing intrusive field work/ Review utility mark-outs and available utility drawings (with respect to proposed work locations)/ Follow Underground Utility Guidelines 6. See AGI Sting R1 operating manual for specific concerns during operating instrument
4. All activities	1. Slips/ Trips/ Falls	7. Be aware of potential trip hazards / Follow good housekeeping

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	procedures/ Mark significant hazards 8. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 9. Wear Langan approved safety shoes 10. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 11. Wear high visibility clothing & vest / Use cones or signs to designate work area 12. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 13. Wear proper hearing protection 14. Wear hard hat / Avoid areas were overhead hazards exist. 15. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 16. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

LANGAN	Job Safety Analysis (JSA) Health and Safety

JSA Title: Sub-slab soil gas temporary point installation and sampling

JSA Number: JSA037-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☐ Hearing Protection
☒ Safety Glasses	☒ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☒ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☒ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek Sleeves				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
5. Transport equipment to work site	6. Back injuries 7. Slips/Trips/Falls 8. Traffic 9. Hand injuries	6. Use proper lifting techniques/ Use wheeled transport/ Get assistance when need with moving equipment/ Minimize distance from vehicle 7. Minimize distance from vehicle/ Have unobstructed pathway to vehicle and collection points/ Mark tripping hazards with spray paint, cones, or caution tape/ Observe good housekeeping procedures. 8. Wear proper PPE (High Visibility vest and clothing)/ Exercise caution (stay alert-stay alive) 9. Wear proper PPE (leather gloves)/ Keep finger and hands clear of pinch points.
6. Mark area for drilling	1. Slips/Trips/Falls	1. Minimize distance from vehicle/ Have unobstructed pathway to vehicle and collection points/ Mark tripping hazards with spray paint, cones, or caution tape/ Observe good housekeeping procedures
7. Drill sampling points with hammer drill	1. Eye injuries 2. Dust exposure 3. Hand injuries 4. Catch items (clothing) 5. Electric shock 6. Chemical atmosphere hazard (vapor) 7. Slips/Trips/Falls	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (dust mask) 3. Wear proper PPE (leather gloves)/ Keep hands and fingers out of pinch points/ Avoid drill catching on ground and twisting wrist or hand/ Release drill grip if drill becomes caught/ Ensure drill is unplugged prior to inserting bit. 4. Tie up or tuck-in all loose clothing/ Maintain distance from drill 5. Inspect power cable for cuts or nicks before use/ Use GFCI outlet on power cord/ Do not use in wet conditions 6. Monitor air, vapors with Photo-ionization detector (PID) 7. Minimize distance from vehicle/ Have unobstructed pathway to vehicle and collection points/ Mark tripping hazards with spray paint, cones, or caution tape/ Observe good housekeeping procedures
8. Measure vapor content and depth to bottom of hole	1. Chemical atmosphere hazard (vapors)	1. Monitor air, vapors with Photo-ionization detector (PID)/ Keep face away from opening of hole while collecting measurements

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
9. Set-up of shroud and sampling canister system	1. Hand injuries 2. Chemical atmosphere hazard (vapors) 3. Slips/Trips/Falls	1. Wear proper PPE (leather gloves, nitrile gloves)/ Keep fingers away from pinch points when installing pump/ Do not use open blades, use tubing cutter 2. Monitor air, vapors with Photo-ionization detector (PID)/ Keep face away from opening of hole while collecting measurements 3. Minimize distance from vehicle/ Have unobstructed pathway to vehicle and collection points/ Mark tripping hazards with spray paint, cones, or caution tape/ Observe good housekeeping procedures
10.Purge soil gas	1. Chemical atmosphere hazard (vapors)	1. Monitor air, vapors with Photo-ionization detector (PID)/ Keep face away from exhaust port of pump
11.Sample collection (opening and closing valves)	1. Hand injuries	1. Wear proper PPE (leather gloves)/ Keep fingers away from pinch points
12.Sealing sampling holes	1. Back injuries 2. Concrete dust 3. Eye injuries	1. Use proper lifting techniques for lifting of cement bags 2. Wear proper PPE (dust mask) 3. Wear proper PPE (safety glasses)
13. All activities	11. Slips/ Trips/ Falls 12. Hand injuries, cuts or lacerations during manual handling of materials 13. Foot injuries 14. Back injuries 15. Traffic 16. Wildlife: Stray animals, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 17. High Noise levels 18. Overhead hazards 19. Heat or cold injuries 20. Eye Injuries	17. Be aware of potential trip hazards/ Follow good housekeeping procedures/ Mark significant hazards 18. Inspect for jagged/sharp edges, and rough or slippery surfaces/ Keep fingers away from pinch points/ Wipe off greasy, wet, slippery or dirty objects before handling/ Wear leather/ cut-resistant gloves 19. Wear proper PPE (Langan approved safety shoes) 20. Use proper lifting techniques/ Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift/ Obtain assistance when possible 21. Wear high visibility clothing & vest/ Use cones or signs to designate work area 22. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray animals/ Carry and use animal repellant when needed/ Use bug spray when needed 23. Wear hearing protection 24. Wear hard hat/ Avoid areas were overhead hazards exist. 25. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather)/ Drink plenty of fluids to avoid dehydration/ Takes breaks as necessary to avoid heat/cold stress 26. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date

Prepared by:		
Reviewed by:		

LANGAN	Job Safety Analysis (JSA) Health and Safety

JSA Title: Monitoring Well Development

JSA Number: JSA026-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☐ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☒ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek Sleeves				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
14. Transport equipment to work area	10. Back Strains 11. Slips/Trips/Falls 12. Traffic 13. Cuts/Abrasions/Contusions from equipment	10. Use proper lifting techniques/ Use wheeled transport/ use buddy system when lifting equipment. 11. Minimize distance from work area/ unobstructed path to collection points and vehicle/ Follow good housekeeping procedures. 12. Wear high-visibility vest or clothing/Exercise caution/ Use traffic cones or signage if needed. 13. Wear proper PPE (leather gloves, long sleeves, Langan approved safety shoes).
15. Measure depth of water	2. Exposure to hazardous substances 3. Pinched fingers	2. Wear proper PPE (Nitrile gloves, Safety glasses/Face shield). 3. Wear proper PPE (cut-resistant gloves).
16. Install Tremie pipe in the monitoring well and connect to water source.	8. Hand injuries during installation (pinched fingers/hands). 9. Back strain from holding Tremie pipe. 10. High pressure water spray.	8. Wear proper PPE (Nitrile gloves/cut-resistant gloves). 9. Use proper lifting techniques/ Use two personnel when lowering pump greater than 80 feet. 10. Ensure all hose connections are tight and secure/ Use proper PPE (face shield and safety glasses).
17. Install pump in to well a. Connect pump to sample tubing. b. Lower pump to desired depth in well. c. Connect sample tubing to flow cell d. Connect pump to power source (generator) e. Turn on power source (generator)	1. Hand injuries during pump installation and sample tubing cutting. 2. Back strain 3. Electric shock 4. Exhaust gases from generator 5. Burns from hot equipment	1. Wear proper PPE when installing pump and cutting sample tubing (Nitrile and cut-resistant gloves)/ Use tubing cutter. 2. Proper lifting techniques/ Two personnel when installing pump at depths greater than 80 feet/ Use buddy when lifting heavy loads (pump, generator)/Use wheeled transport. 3. Ensure equipment is (LO/TO: locked out/tagged out) prior to preforming any electrical connections/ Inspect wires for frays or cuts/Ensure generator is properly grounded prior to starting. 4. Position generator so that exhaust is flowing away from work area. 5. Do not touch exhaust or any hot part of generator/ Allow equipment time to cool down prior to carrying/ Use proper PPE (long sleeves, leather gloves)
18. Develop monitoring well	21. Hand injuries	27. Wear proper PPE (cut-resistant gloves and nitrile gloves).

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
a. Jet water into well using Tremie pipe b. Turn pump on and adjust to desired flow rate. c. Surge pump up and down well to remove sediment from screen d. Containerize all purge water from well.	22. Face injuries 23. Contaminated spray from water	28. Wear proper PPE (face shield and safety glasses)/do not stand over well opening. 29. Wear proper PPE (Face shield and safety goggles)/Tyvek over garments/ Ensure all connections are secure and tight/ Tubing outlet is contained in an overflow container.
19. Drum staging area.	1. Back, Arm, and shoulder strain. 2. Pinch points 3. Cross contamination 4. Slip/Trips/Falls	1. Use proper lifting techniques/ Use drum carts when moving drums/ use buddy system for moving of drums if needed/Move drums shortest distance needed. 2. Keep fingers and feet away from pinch points/ Use proper PPE (cut-resistant gloves, Langan approved safety shoes) 3. Use proper PPE (Nitrile gloves, Tyvek sleeves) 4. Ensure pathway is clear prior to moving equipment/ Mark all hazards/ Use additional person as a spotter if needed.
20. Equipment pack-up	1. Back Strains 2. Slips/Trips/Falls 3. Traffic 4. Cuts/Abrasions/Contusions from equipment.	1. Use proper lifting techniques/ Use wheeled transport/ use buddy system when lifting equipment. 2. Minimize distance from work area/ Unobstructed path to collection points and vehicle/ Follow good housekeeping procedures. 3. Wear high-visibility vest or clothing/Exercise caution/ Use traffic cones or signage if needed. 30. Wear proper PPE (leather gloves, long sleeves, Langan approved safety shoes).
21. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 24. Back injuries 25. Traffic 26. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 27. High Noise levels 28. Overhead hazards 29. Heat Stress/ Cold Stress 30. Eye Injuries	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 10. Wear safety glasses.
Additional items.		

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Direct-Push Soil Borings
JSA Number: JSA004-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED:				
☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Half-face respirator, dust cartridges, PID (if applicable)				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
22. Move equipment to work site	14. Back strain when lifting equipment 15. Slips/ Trips/ Falls while moving equipment 16. Traffic (if applicable) 17. Pinched fingers or running over toes during geoprobe set-up 18. Overturn drilling rig while transporting to loading dock on flat-bed tow truck	14. Use proper lifting technique (use legs for bending and lifting and not the back)/ Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle 15. Use proper lifting technique (use legs for bending and lifting and not the back) / Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle / Have unobstructed path to vehicle or collection point / Do not lift/walk with boxes that are heavy/difficult to lift 16. Wear high visibility safety vests or clothing / Exercise caution 17. Wear proper PPE (cut-resistant gloves) / Stay alert, be aware of geoprobe rig at all times 18. Drill rig should be parked in center of flat-bed tow truck / Emergency brake shall be used at all times during transport on the flat-bed truck/ All unnecessary personnel should stay away from the flat-bed truck during moving activities
23. Calibration of monitoring equipment	4. Skin or eye contact with calibration chemicals 5. Pinch fingers in monitoring equipment	4. Wear proper PPE (safety glasses/ goggles) 5. Wear proper PPE (leather gloves)
24. Set-up geoprobe rig	11. Geoprobe rig movement	11. All field personnel should stay clear of the geoprobe rig while moving / Use a spotter when backing up the geoprobe
25. Advance geoprobe rods below ground surface to desired depth	6. Underground utilities 7. High noise levels	6. Clean all subsurface soil borings to a minimum of 5 feet below grade 7. Wear proper PPE (hearing protection)
26. Remove and open acetate liner	31. Pinched fingers while removing macrocore 32. Cuts/lacerations when cutting acetate liner open 33. Exposure to hazardous vapors	1. Wear proper PPE (nitrile gloves, cut-resistant or leather gloves 2. Wear proper PPE (cut-resistant or leather gloves) 3. Do not place face over acetate liner when opening / Monitor hazardous vapors in air with PID / Upgrade PPE as necessary based on levels contained in the Health and Safety Plan

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
5. Remove and open acetate liner (cont'd)	34. Skin contact with contaminated soil	4. Wear proper PPE (nitrile gloves)
27. Sample Collections a) Monitor parameters b) Prepare sample containers and labels	1. Contact with potentially contaminated soil 2. Lacerations from broken sample bottles 3. Back strain while transporting full coolers 4. Internal exposure to contaminants and metals through inhalation of dust 5. Slips/ Trips/ Falls	1. Use monitoring devices / Wear proper PPE (safety glasses, nitrile gloves) 2. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage 8. Use proper lifting techniques / Do not lift heavy loads without assistance 9. Avoid creating dust / If necessary, wear a half mask respirator with applicable dust cartridge / Inspect respirator for damage and cleanliness prior to use / Clean respirator after each use and store in a clean, secure location 10. Be alert / Follow good housekeeping procedures
28. Remove excess soil from acetate liner and place in 55-gallon drum (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Cuts/lacerations from acetate liner 2. Pinched fingers/hand while opening/closing drum 3. Skin contact with contaminated soil 4. Soil debris in eyes	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (nitrile gloves) 4. Wear proper PPE (safety glasses)
8. Transport drums to central staging location (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drums 6. Drop drum on feet/toes	31. Use drum cart for moving drums / Use proper lifting techniques / Do not lift heavy loads without assistance 32. Wear proper PPE (cut-resistant or leather gloves) 33. Wear proper PPE (cut-resistant or leather gloves) 34. Wear proper PPE (nitrile gloves underneath work gloves) 35. Follow good housekeeping procedures / Ensure route to move drum and storage space is free from obstructions 36. Wear proper PPE (safety shoes) / Work in a safe manner to prevent dropped drum
9. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas were overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
9. All activities (cont'd)	10. Eye Injuries	10. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Groundwater Sampling

JSA Number: JSA008-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☒ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☒ Other: Tyvek sleeves, Dermal Protection, PID				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
29. Transport equipment to work area	1. Back Strain 2. Slips/ Trips/ Falls 3. Traffic 4. Cuts/abrasions from equipment 5. Contusions from dropped equipment	1. Use proper lifting techniques / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
30. Remove well cover	6. Scrape knuckles/hand 7. Strain wrist/bruise palm 8. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using a hammer, tap the end of the wrench to loosen grip of bolts 3. Wear proper PPE (leather gloves)
31. Remove well cap and lock	12. Well can pops from pressure 13. Exposure to hazardous substances through inhalation or dermal exposure 14. Scrape knuckles/hand 15. Strain write/bruise palm	1. Remove cap slowly to relieve pressure / Do not place face over well when opening / Wear proper PPE (safety glasses) 2. Use direct air monitoring/reading instrument (i.e. PID) / Be familiar with and follow actions prescribed in the HASP / Wear proper PPE (nitrile gloves) 3. Wear proper PPE (leather gloves) 4. Using hammer, tap the end of the wrench to loosen grip
32. Measure head-space vapor levels	1. Exposure to hazardous substances through inhalation	1. Do not place face over well when collecting measurement
33. Remove dedicated tubing (if necessary)	1. Exposure to hazardous substances through inhalation or dermal exposure 2. Tubing swings around after removal	1. Wear proper PPE (nitrile gloves, Tyvek sleeves) 2. Wear proper PPE (safety glasses)
34. Set-up plastic sheeting for work site around the well	1. Lacerations when cutting plastic sheeting	1. Use scissors to cut plastic sheeting / Cut motions should always be away from body and body parts
35. Measure depth to water	1. Exposure to hazardous substances through inhalation or dermal exposure 2. Pinch fingers or hand in water level instrument	1. Wear proper PPE (nitrile gloves) 2. Wear proper PPE (leather gloves)
36. Calibrate monitoring	1. Skin or eye contact with calibration chemicals	1. Wear proper PPE (safety glasses, nitrile gloves)

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
equipment	2. Pinch fingers or hand in monitoring equipment	2. Wear proper PPE (leather gloves) / Avoid pinch points
37. Install sampling pump in well	1. Hand injuries during installation of pump 2. Lacerations when cutting tubing 3. Back strain during installation of pump 4. Physical hazards associated with manual lifting of heavy equipment 5. Back strain from starting generator 6. Burns from hot exhaust from generator 7. Electrical shock from improper use of generator and pump 8. Contaminated water spray from loose connections	1. Wear proper PPE (leather gloves, nitrile gloves) 2. Use safety tubing cutter 3. Use proper lifting techniques 4. Use proper lifting techniques / Use wheeled transport for heavy equipment 5. Use arm when starting generator / Do not over-strain if generator does not start 6. Do not touch generator near exhaust / Use proper handle to carry / Allow generator to cool down before moving 7. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord 8. Check all tubing connections to ensure they are tight and secure
10. Purge water	1. Contact with potentially contaminated groundwater 2. Back strain from lifting buckets of water 3. Tripping potential on sample discharge lines and pump electric line	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Use proper lifting techniques / Use wheeled transport 3. Organize discharge of electric line to keep out of way as much as possible / Mark potential tripping hazards with caution tape or safety cones
11. Sample water collection	1. Contact with potentially contaminated groundwater through dermal exposure 2. Contact with and burns from acid used for sample preservation 3. Tripping potential on sample discharge lines and pump electric line 4. Lacerations from broken sample bottles 5. Back strain when transporting coolers full of collected samples 6. Slips/ Trips/ Falls	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (safety glasses, nitrile gloves) / Ensure sample bottle lids are secure before use and after sample collection 3. Organize line to keep out of the way as much as possible / Mark potential tripping hazards with caution tape or safety cones 4. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage / Wrap glass bottles in bubble wrap, if possible 5. Use proper lifting techniques / Use wheeled transport / Seek assistance if coolers weight exceeds 50lbs. / Minimize distance to vehicle 6. Have unobstructed path to vehicle or collection point / Follow good housekeeping procedures / Do not lift/walk with coolers that are too heavy/difficult to lift
12. Remove pump and pack up equipment	1. Back strain when removing pump or lifting heavy equipment	1. Use proper lifting technique / Use wheeled transport for heavy equipment
13. Replace well cap and lock	1. Scrape fingers/hand 2. Strain wrist/bruise palm	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the well cap to tighten grip
14. Replace well cover	1. Scrape knuckles/hand 2. Strain write/bruise palm 3. Pinch fingers or hand	1. Wear proper PPE (leather gloves) 2. Using hammer, tap the end of the wrench to tighten the grip of the bolts 3. Wear proper PPE (leather gloves)
15. Transport drums to disposal staging location	1. Back, arm or shoulder strain from moving drums 2. Pinch hazard 3. Contact with potentially contaminated groundwater when moving improperly sealed drums 4. Slips/ Trips/ Falls when moving drum 5. Drop drum on feet/toes	1. Use drum cart for moving drums / Use proper lifting techniques / Obtain assistance, if needed 2. Wear proper PPE (leather gloves) 3. Wear proper PPE (nitrile gloves under leather gloves) / Properly seal drum to prevent leak 4. Ensure route to move drum to storage space is dry and free from obstructions 5. Wear proper PPE (safety shoes)
16. Place used PPE in	1. Pressure build-up inside drum	1. Remove cap from bung hole in drum to relieve pressure

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
designated disposal drum	2. Pinch hazard	2. Wear proper PPE (leather gloves)
17. Decontaminate equipment	1. Splashing water/soap from decontamination 2. Contact with potentially contaminated groundwater through dermal exposure 3. Electrical shock from broken electric cords	1. Wear proper PPE (safety glasses) 2. Wear proper PPE (safety glasses, dermal protection) 3. Properly plug in pump to generator / Do not allow the pump or generator to contact water / Check for breaks in the cord
18. All activities	35. Slips/ Trips/ Falls 36. Hand injuries, cuts or lacerations during manual handling of materials 37. Foot injuries 38. Back injuries 39. Traffic 40. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 41. High Noise levels 42. Overhead hazards 43. Heat Stress/ Cold Stress 44. Eye Injuries	37. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 38. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 39. Wear Langan approved safety shoes 40. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 41. Wear high visibility clothing & vest / Use cones or signs to designate work area 42. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 43. Wear hearing protection 44. Wear hard hat / Avoid areas were overhead hazards exist. 45. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 46. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date

Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Field Sampling

JSA Number: JSA022-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☐ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☐ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☒ Traffic Cones/Signs	☐ Life Vest/Jacket	
☐ Other:				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
38. Unpack/Transport equipment to work area.	19. Back Strains 20. Slip/Trips/Falls 21. Cuts/Abrasions from equipment 22. Contusions from dropped equipment	19. Use proper lifting techniques/Use wheeled transport 20. Minimize distance to work area/Unobstructed path to work area/follow good housekeeping procedures. Mark slip/trip/fall hazards with orange safety cones. 21. Wear proper PPE (leather gloves, long sleeves). 22. Wear proper PPE (Langan approved safety shoes).
39. Initial Site Arrival-Site Assessment	9. Traffic	6. Situational awareness (be alert of your surroundings). Secure area from through traffic.
40. Surface Water Sampling	16. Contaminated media. Skin/eye contact with biological agents and/or chemicals.	12. Wear appropriate PPE (Safety glasses, appropriate gloves). Review (M)SDS for all chemicals being.
41. Sampling from bridges	8. Struck by vehicles	11. Wear appropriate PPE (Safety Vest). Use buddy system and orange safety cones.
42. Icing of Samples/ Transporting coolers/equipment from work area.	45. Back Strains 46. Slips/Trips/Falls 47. Cuts/Abrasions from equipment 48. Pinch/Crushing Hazards.	47. Drain coolers of water. Use proper lifting techniques. Use wheeled transport. 48. Have unobstructed path from work area. Aware of surroundings. 49. Wear proper PPE (Leather gloves, long sleeves) 50. Wear proper PPE (Leather gloves, long sleeves)
43. Site Departure	1. Contaminated PPE/Vehicle	1. Contaminated PPE should be disposed of on-site. Remove boots and soiled clothing for secure storage in trunk. Wash hands promptly.
44. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 49. Traffic 50. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.)	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	51. High Noise levels 52. Overhead hazards 53. Heat Stress/ Cold Stress 54. Eye Injuries	when possible 51. Wear high visibility clothing & vest / Use cones or signs to designate work area 52. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 53. Wear hearing protection 54. Wear hard hat / Avoid areas were overhead hazards exist. 55. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 56. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

LANGAN

Job Safety Analysis (JSA)
Health and Safety

JSA Title: Geophysical Investigation

JSA Number: JSA023-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

☒ Safety Shoes	☒ Long Sleeves	☒ Safety Vest (Class 2)	☒ Hard Hat	☒ Hearing Protection
☒ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☒ Nitrile Gloves	☐ PVC Gloves
☒ Leather Gloves	☒ Cut Resist. Gloves	☐ Fall Protection	☐ Fire Resistant Clothing	☐ Rubber Boots
☐ Insect/Animal Repellent	☐ Ivy Blocker/Cleaner	☐ Traffic Cones/Signs	☐ Life Vest/Jacket	
☐ Other:				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
45. Transport equipment to work area	23. Back/strain 24. Slip/Trip/Falls 25. Traffic 26. Cuts/abrasions/contusions from equipment	23. Use proper lifting techniques/Use wheeled transport 24. Minimize distance to work area/unobstructed path to work area/follow good housekeeping procedures 25. Wear proper PPE (high visibility vest or clothing) 26. Wear proper PPE (leather gloves, long sleeves, Langan approved safety shoes)
46. Supervision of subcontractor and all other activities	10. Slip/Trips/Falls 11. Hand injuries 12. Foot injuries 13. Back injuries/Strains 14. Traffic 15. Wildlife a. Wildlife b. Mice/rats c. Vectors (i.e. mosquitoes, bees, etc.) 7. Heat/Cold Stress	7. Be aware of potential trip hazards/follow good housekeeping procedures/mark significant below-grade hazards (i.e. holes, trenches, wires, ropes) with safety cones or spray paint. 8. Wear proper PPE (leather gloves)/watch wear you place your hands/inspect material or equipment for jagged, rough or slippery surfaces/ watch for pinch points/ wipe off slippery, wet, or dirty items prior to handling. 9. Wear proper PPE (Langan approved safety shoes)/ Be aware of uneven terrain) 10. Use proper lifting techniques/ Buddy system when lifting/ use wheeled transport. 11. Wear proper PPE (high-visibility shirts and vests)/ use cones if appropriate/ notify equipment operators of work area. 12. Be aware of surroundings at all times for the presence of wildlife. a. Do not approach stray animals b. Carry animal repellant/ use if situation arises. c. Use bug spray when needed. 7. Wear proper attire for weather conditions (sunscreen, protective clothing in sunlight or layer clothing in cold weather)/ drink plenty of fluids/ take regular breaks.
47. All activities	55. Slips/ Trips/ Falls	57. Be aware of potential trip hazards / Follow good housekeeping

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	56. Hand injuries, cuts or lacerations during manual handling of materials 57. Foot injuries 58. Back injuries 59. Traffic 60. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 61. High Noise levels 62. Overhead hazards 63. Heat Stress/ Cold Stress 64. Eye Injuries	procedures/ Mark significant hazards 58. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 59. Wear Langan approved safety shoes 60. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 61. Wear high visibility clothing & vest / Use cones or signs to designate work area 62. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 63. Wear proper hearing protection 64. Wear hard hat / Avoid areas were overhead hazards exist. 65. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 66. Wear safety glasses
Additional items.		
Additional Items identified while in the field. (Delete row if not needed.)		

Print Name	Sign Name	Date
Prepared by:		
Reviewed by:		

ATTACHMENT H

TAILGATE SAFETY BRIEFING FORM

LANGAN TAILGATE SAFETY BRIEFING

Date:_____ Time: _____

Leader:_____ Location:_____

Work Task: _____

SAFETY TOPICS (*provide some detail of discussion points*)

Chemical Exposure Hazards and Control:_____
_____

Physical Hazards and Control: _____

Air Monitoring: _____

PPE: _____
_____

Communications:_____

Safe Work Practices: _____
_____

Emergency Response: _____

Hospital/Medical Center Location: _____

Phone Nos.: _____

Other: _____

FOR FOLLOW-UP (the issues, responsibilities, due dates, etc.**)**

_____
_____
_____

ATTENDEES

PRINT NAME	COMPANY	SIGNATURE

Appendix D

COMMUNITY AIR MONITORING PLAN

New York State Department of Health Generic Community Air Monitoring Plan

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 and 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 require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH. Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from 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 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) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a **continuous** bases or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment

should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- 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 must 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.

- 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 must 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.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored **continuously** at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed 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 must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must 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 mcg/m3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations next to occupied adjoining properties to the north and south of the site exceed 1 ppm, monitoring should occur within the adjoining properties. Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work. Response levels and actions should be pre-determined for the site.

- If total particulate concentrations to occupied adjoining properties to the north and south of the site exceed 150 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

Special Requirements for Indoor Work with Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work area, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under “Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures” except that in this instance “nearby/occupied structures” would be adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings conduits, etc.) relative to adjoining rooms, should be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work area during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.