Interim Remedial Measure/Remedial Investigation Work Plan

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408 West 207th Street
Block 2203 Lot 21
New York, New York 10034

May 7, 2021

Prepared for:

Harlem River Ninth Avenue Development LLC
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Certification

I, Noelle Clarke, certify that I am currently a NYS registered professional engineer and that this Interim Remedial Measure/Remedial Investigation Work Plan for the 408 West 207th Street Site was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Noelle Clarke, P.E.		
NYS Professional Engineer #072491	Date	Signature

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux) has prepared this Interim Remedial Measure/Remedial Investigation Work Plan (IRM/RIWP) on behalf of Harlem River Ninth Avenue Development LLC (Applicant) to detail the scope of work to conduct demolition/removal of the existing asphalt parking lot and surface features (i.e., light poles and fencing), a remedial investigation (RI), and the localized remedial excavation of contaminated soil at 408 W 207th Street, Inwood, New York (Site). The Site is approximately 20,000-square feet (sq ft) and is identified as Block 2203, Lot 21 on the New York City Tax Map. A Site Location Map is included as Figure 1.

The Applicant is submitting this IRM/RIWP concurrently with a New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) application for the Site. The property is currently owned by the Applicant and is an active parking lot. As part of this IRM/RIWP, the existing asphalt parking lot at the Site will be removed to facilitate the investigation of the impacts to soil, groundwater, and soil vapor and begin the removal of documented soil contamination. This will facilitate the selection and implementation of the final remedy. The Applicant intends an unrestricted use and to redevelop the site with affordable and market rate housing, retail/commercial space, and parking. A foundation pile/pile cap will be installed in the remediated area.

This IRM/RIWP has been prepared in accordance with NYSDEC procedures set forth in the document titled DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10), and complies with all applicable Federal, State, and local laws, regulations and requirements. The IRM/RI is a component of, but does not constitute, the overall remedy for the Site. The objectives of the IRM/RI are to remove existing surface structures to allow for a thorough and complete investigation of the Site and source area excavation of contaminated soil. This will advance the BCP goals but will not constitute the entire remedy for the Site.

The remainder of this IRM/RIWP is organized as follows:

Section 2: Site Background
Section 3: Objectives, Scope of Work, and Rationale
Section 4: Elements of the Interim Remedial Measure
Section 5: Soils/Materials Management Plan
Section 6: Reporting
Section 7: IRM/RI Implementation Schedule

2. Site Background

Relevant Site background information is presented in this section. A Site Location Map is included as Figure 1.

2.1 Site Description and Setting

Site Location	
Site Name:	408 West 207th Street
Site Address:	408 West 207th Street
Site Town, County, State:	Manhattan, New York County New York
Site Tax Identification:	Block 2203, Lot 21
Site Topographic Quadrangle:	Central Park, New York
Nearest Intersection:	W 207th Street and 9th Avenue
Area Description:	The Site is bounded by West 207th Street and the 207th Street Train Yard Facility and a gasoline station across the street to the north, West 206th Street and residential apartment buildings to the south, 9th Avenue, beyond which is a commercial use building and the Harlem River, to the east, and a parking lot, grocery store and commercial use buildings to the west.

Site Information	
Site Acreage:	0.46
Site Shape:	Rectangular
Site Use:	An asphalt-paved parking lot
Number and Size of Buildings (Year Built):	None.
Basement/ Slab-on-Grade:	None.

2.1.1 Site History and Operations

Based on a review of previous environmental reports and documentation, including historic Sanborn Fire Insurance Maps and New York City Assessor's and Building Department records presented in the October 7, 2010 Phase I Environmental Site Assessment (ESA) prepared by EBI, the following Site history was established. From approximately 1896 through 1925, the Site and the surrounding area existed as undeveloped land. The southern portion of the Site was developed in 1926 with an automobile garage and operated from 1926 through 1968. From 1947 to 1968, a gasoline filling station was located in the northern area of the Site. According to historic records reviewed by EBI Consulting as part of a Phase I ESA, the former operations are suspected to have included the on-site storage and use of petroleum products, automotive fluids, battery acids, solvents, and/or other hazardous materials. By 1969, all structures were demolished and the paved parking lot was completed and remains present today. The Site is currently owned by the Applicant.

2.1.2 Utilities

Based on observations made during the previous Site investigations, several utilities are present at the Site. For future construction at the Site, it is assumed that Consolidated Edison will continue to provide electric and natural gas service to the Site, and potable (drinking) water and sewer service will continue to be supplied to the Site by the City of New York.

2.1.3 Topography

A review of the United States Geological Survey (USGS) Central Park, New York 7.5-minute series topographic quadrangle map and Site-specific survey indicated that the topography of the Site and surrounding area slopes gently to the southeast toward the Harlem River. The elevation of the Site ranges from approximately 13 to 11 feet above mean sea level from the northwest to southeast portions of the Site, respectively.

2.1.4 Wetland Areas and Surface Water Bodies

Based on a review of the previous environmental reports, the Site is not located in, or adjacent to, regulated wetlands, however, the Site is within the 500-year flood zone. The nearest natural surface water body is the Harlem River, located approximately 580 feet to the east.

2.1.5 Soil and Underlying Formation

Based on the previous environmental reports and investigations completed by Roux and other consultants, the Site is underlain by fill (consisting of sand, gravel, brick, concrete, tile, and glass) to depths ranging from 5 to 9.5 feet below land surface (ft bls). Fill materials overlie native fine to coarse sand with some gravel and silt. A layer of peat was observed from 14 to 15 ft bls at location RX-26 completed by Roux in the northern area of the Site. Bedrock was encountered between 50 and 80 ft bls during the geotechnical investigation performed in conjunction with Roux’s 2018 subsurface investigation. Bedrock slopes downward toward the east.

2.1.6 Hydrogeology

Groundwater was encountered between 7 and 10 ft bls. Under natural, undisturbed conditions, shallow groundwater flow generally follows the topography of the land surface. Based on the surrounding topography, the presumed groundwater flow in the vicinity of the Site is in an east-southeasterly direction towards the Harlem River, located approximately 580 feet to the east of the Site. Groundwater flow direction is likely influenced by subsurface utilities, lithology, and other subsurface features.

2.2 Summary of Environmental Conditions

The following is a summary of environmental conditions at the Site.

2.2.1 Previous Environmental Sampling

The following previous environmental investigations that have been conducted at the Site:

- **Phase I ESA**, prepared by EBI Consulting (EBI), dated October 7, 2010.
- **Phase II ESA,** prepared by Stantec, dated December 8, 2011.

- **Subsurface Investigation Report (SIR),** prepared by Roux Environmental Engineering and Geology, D.P.C. (Roux), dated December 19, 2018.
- **Remedial Investigation Report (RIR),** prepared by Roux, dated June 12, 2019.
- New York State Department of Environmental Conservation (NYSDEC) Brownfields Cleanup Program (BCP) Eligibility Soil Sampling for 430 West 207th Street, New York, New York, performed by Roux Environmental Engineering and Geology, D.P.C, January/February 2021.

A summary of the findings from assessments of the Site is provided below. The reports are provided in Appendix A.

Phase I ESA, prepared by EBI, dated October 7, 2010

Several recognized environmental conditions (RECs) were identified in the EBI Phase I ESA. The portion of the Phase I ESA relating to Lot 21 is discussed below. The RECs are summarized as follows:

RECs

- The potential presence of fill material is a REC for Lot 21. Urban sites such as the Site have typically been filled with material imported from off-site sources during development. Such fill material may have unknown origins and has the potential to exhibit contaminant concentrations above regulatory cleanup criteria.
- According to historic records reviewed by EBI, a gasoline station occupied the northern portion of Lot 21 from 1947 until 1968 and an auto garage occupied the southern portion of Lot 21 from 1926 until 1968. The former operations are suspected to have included the on-site storage and use of petroleum products, automotive fluids, battery acids, solvents, and/or other hazardous materials. No additional documentation regarding closure of the former underground storage tank (UST) systems, or documentation regarding previous soil and/or groundwater investigation in this area, was identified during the ESA. Based upon the absence of closure documentation, the potential exists that the former UST systems and historical use have impacted subsurface conditions for Lot 21. This is considered a REC.

Phase II ESA, prepared by Stantec, dated December 8, 2011

Stantec performed a Phase II ESA in December 2011. The portion of the Phase II ESA relating to Lot 21 is discussed below. A summary of findings is provided below:

Soil/Fill

According to the Stantec Phase II ESA, photoionization detector (PID) field screening results for soil samples collected from borings indicated the presence of VOCs at concentrations elevated above background. Measured PID concentrations in the top four to five feet of overburden material were 0.0 to 187 ppmv at B-102, and 20.3 ppmv at B-103. PID readings in the soil samples collected from 5 to 16 ft bls ranged from 462 to 858 ppmv at B-102 and from 72 to 1,275 ppmv at B-103. VOC, SVOC, and metals exceedances of NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) and NYSDEC Part 375 Restricted Residential Soil Cleanup Objectives (RRSCOs) within the boundaries of the Site are depicted on Figure 2.

Groundwater

According to the Stantec Phase II ESA, VOCs including 1,2,4-trimethylbenzene (at 172 micrograms per liter [µg/L] within B-102), 1,3,5-trimethylbenzene (at 51.3 µg/L within B-102), 4-isopropylbenzene (at 10 µg/L within B-102), benzene (max. of 10.7 µg/L at B-103), ethylbenzene (max. of 46.6 µg/L within B-102), isopropylbenzene (max. of 129 µg/L at B-102), m+p-xylene (max. of 10.5 µg/L within B-102), naphthalene (max. of 182 µg/L within B-103), n-butylbenzene (max. of 56.1 µg/L within B-103), n-propylbenzene (max. of

383 µg/L within B-103), sec-butylbenzene (at 24.2 µg/L within B-103), and tert-butylbenzene (at 30.3 µg/L within B-103), were detected above their Ambient Water Quality Standards and Guidance Values (AWQSGVs). Naphthalene was the only SVOC detected above AWQSGVs (at 52.6 µg/L at B-102 and B-103). Metals analyzed in groundwater did not exceed NYSDEC AWQSGVs. Groundwater sample locations within the boundaries of the Site are depicted on Figure 3.

Remedial Investigation Report, prepared by Roux, dated June 12, 2019

Roux performed an investigation of soil, groundwater, and soil vapor at the Site in June 2019, which is described in the RIR prepared for the New York City Mayor's Office of Environmental Remediation (NYCOER). The portion of the RIR relating to Lot 21 is discussed below A summary of findings is provided below:

Soil/Fill

According to the RIR for the Site, the following analytes in soil exceeded NYSDEC Part 375 UUSCOs and RRSCOs:

VOCs

- Benzene, ethylbenzene, n-butylbenzene, n-propylbenzene, 1,2,4-trimethylbenzene, and xylenes exceeded the UUSCOs. Of these VOCs, 1,2,4-trimethylbenzene also exceeded the RRSCO.

Metals

- Arsenic, copper, lead, mercury, and zinc exceeded the UUSCOs. Of these metals, arsenic, copper, and mercury also exceeded the RRSCOs.

Exceedances of RRSCOs and UUSCOs within the boundaries of the Site are depicted on Figure 2.

Groundwater

According to the RIR for the Site, the following analytes in groundwater exceeded NYSDEC AWQSGVs:

VOCs

- Benzene, ethylbenzene, isopropylbenzene, m+p-xylene, toluene, and chloroform.

SVOCs

- Naphthalene.

Metals (total)

- Iron, lead, magnesium, manganese, selenium, and sodium.

Exceedances of AWQSGVs within the boundaries of the Site are depicted on Figure 3.

Soil Vapor

Soil vapor samples collected showed significant levels of petroleum related VOCs and low levels of CVOCs. According to the RIR for the Site, the following analytes were detected in soil vapor samples that were collected as part of the December 2018 SIR:

VOCs

- 1,1,1-trichloroethane, 1,3-butadiene, 2-butanone, n-hexane, benzene, butane, carbon disulfide, chloroform, cyclohexane, isopropylbenzene, n-heptane, n-propylbenzene, m+p-xylene, isooctane, styrene, tetrachloroethene (PCE), and toluene.

Detections of analytes in soil vapor within the boundaries of the Site are depicted on Figure 4. As a note, Category B data packages are available for this data and will be used during preparation of a RIR, including a Data Usability Summary Report (DUSR), for the Site.

NYSDEC Spill

Spill number 1902616 was assigned to the Site on June 12, 2019 after the NYCOER reviewed the Site data from 2011 and identified one soil boring (B-102) with evidence of petroleum contamination. No additional work has been required by NYSDEC in relation to this Spill Number.

NYSDEC BCP Eligibility Soil Sampling, performed by Roux, January 2021

Roux performed a subsurface soil investigation in January 2021. Four soil borings (RX-26 through RX-29) were advanced during the investigation of the Site. Similar to previous investigations, groundwater was encountered between 7 and 10 feet below ft bls. Subsurface materials generally contained fill materials (consisting of sand, gravel, brick, concrete, tile, and glass), to depths ranging from 5 to 9.5 feet ft bls. Fill materials overlie native fine to coarse sand with some gravel and silt. A layer of peat was observed from 14 to 15 ft bls at location RX-26.

A total of 10 soil samples including associated quality assurance/quality control (QA/QC) samples were collected in laboratory-supplied containers and submitted for analysis of VOCs, SVOCs, metals, pesticides, and polychlorinated biphenyls (PCBs). A summary of findings of detected compounds and comparison to NYSDEC Part 375 UUSCOS and RRSCOs for soil is provided below:

Soil Results

The following SVOCs and metals are the primary contaminants of concern and exceeded the NYSDEC Part 375 RRSCOs:

SVOCs:

- Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-c,d)pyrene exceeded the UUSCOs. Of these SVOCs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene exceeded the RRSCOs.

Metals:

- Arsenic, barium, cadmium, copper, lead, mercury, and zinc exceeded the UUSCOs. Of these metals, barium and mercury exceeded the RRSCOs.

Exceedances of the RRSCOs and UUSCOs within the boundaries of the proposed Site are graphically depicted on Figure 2. As a note, Category B data packages are available for this data and will be used during preparation of a RIR, including a DUSR, for the Site.

2.2.2 Summary of Subsurface Conditions

Based upon the investigation, the primary contaminants of concern for the Site found in the subsurface include benzene, toluene, ethylbenzene, and xylene (BTEX) compounds in soil and groundwater, polycyclic aromatic hydrocarbons (PAHs) and metals in soil, and VOCs in soil vapor. A geophysical survey of the Site was completed, including ground penetrating radar and electromagnetic detection, and no evidence of the former USTs or vaults were located by the study.

All data collected as part of the previous investigations completed by Roux is provided in Tables 1 through 11, Figures 2 through 4, and the sample locations are also shown on Figure 5. Note that the data collected as part of the previous investigations completed by Roux that are provided in Tables 1 through 11 has not been validated but will be validated as part of the RIR.

A summary of the results is provided below:

Soil

Soil was analyzed for VOCs, SVOCs, pesticides, PCBs, and metals and laboratory results were compared to the NYSDEC UUSCOs, and NYSDEC RRSCOs. The investigations revealed elevated concentrations of VOCs, PAHs, and metals in soil. More information on soil exceedances is provided below:

- VOCs including benzene (maximum of 0.45 mg/kg), n-butylbenzene (maximum 59.1 mg/kg), sec-butylbenzene (maximum 20.7 mg/kg), ethylbenzene (maximum of 15.4 mg/kg), naphthalene (maximum 140 mg/kg), n-propylbenzene (maximum 111 mg/kg), 1,2,4-trimethylbenzene (maximum 184 mg/kg), 1,3,5-trimethylbenzene (maximum 60.5 mg/kg), and xylenes (maximum of 2.7 mg/kg) were detected above their UUSCOs. Of these VOCs, naphthalene, n-propylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were detected above their respective RRSCOs predominantly in one sample at a depth of 6.5 to 7 ft bls.
- Several SVOCs, consisting of PAHs including benzo(a)anthracene (maximum 1.5 mg/kg), benzo(a)pyrene (maximum 1.5 mg/kg), benzo(b)fluoranthene (maximum 2 mg/kg), chrysene (1.3 mg/kg), indeno(1,2,3-c,d)pyrene (maximum 0.83 mg/kg), and naphthalene (maximum 56.3 mg/kg) were detected above their respective UUSCOs predominantly in intervals of fill on Site at depths ranging between 5 to 7 ft bls. Of these SVOCs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene were also present at concentrations above their RRSCOs.
- Metals including arsenic (maximum 46.2 mg/kg), barium (maximum 532 mg/kg), cadmium (maximum 3.3 mg/kg), chromium (maximum 37.1 mg/kg), copper (maximum 473 mg/kg), lead (maximum 307 mg/kg), mercury (maximum 6.4 mg/kg), and zinc (maximum 898 mg/kg) were detected above their UUSCOs. Of these metals, arsenic, barium, copper, and mercury were also present at concentrations above their RRSCOs.
- Total PCBs were detected above their UUSCOs with a maximum concentration of 0.39 mg/kg.
- Pesticides were not detected above their UUSCOs or RRSCOs.

Groundwater

Groundwater samples were analyzed for the same suite of analysis as described above in the soil results section. The majority of compounds analyzed were detected below the NYSDEC AWQSGVs with the exception of some VOCs, SVOCs, and metals. The following compounds were detected in exceedance of the AWQSGVs:

- VOCs including benzene (maximum 54 µg/L), n-butylbenzene (maximum 56.1 µg/L), tert-butylbenzene (maximum 30.3 µg/L), sec-butylbenzene (maximum 24.2 µg/L), chloroform (maximum 8.2 µg/L), ethylbenzene (maximum 46.6 µg/L), isopropylbenzene (maximum 280 µg/L), 4-isopropylbenzene (maximum 10 µg/L), naphthalene (maximum 182 E µg/L), n-propylbenzene (maximum 383 µg/L), toluene (maximum 5.5 µg/L), m+p-xylene (maximum 10.5 µg/L), 1,2,4-trimethylbenzene (maximum 172 E µg/L), and 1,3,5-trimethylbenzene (maximum 51.3 µg/L) were detected above their AWQSGVs.
- One SVOC, naphthalene (maximum 90 µg/L) was detected above its AWQSGV.
- Total metals including iron (maximum 19,400 µg/L), lead (maximum 209 µg/L), magnesium (maximum 46,900 µg/L), manganese (maximum 726 µg/L), selenium (maximum 11.7 µg/L), and sodium (maximum 615,000 µg/L) were detected above their AWQSGVs. The groundwater samples were collected from temporary monitoring wells and were not filtered. It is likely the detected metals are primarily due to suspended sediments present in the groundwater samples. Most of these metals

are considered to be naturally occurring and are not believed to be indicative of groundwater contamination present at the Site.

Soil Vapor

Two soil vapor samples were collected across the Site. Several petroleum-related VOCs, including BTEX (benzene, toluene, ethylbenzene, and xylenes), were detected in soil vapor samples throughout the Site during the Roux 2018 RI/Phase II ESA, however, there are no standards or guidance values for these compounds set by NYSDEC or New York State Department of Health (NYSDOH). Low levels of chlorinated VOCs (CVOCs) were also detected in the soil vapor samples. The NYSDOH October 2006 (updated in 2017) Guidance for Evaluating Soil Vapor Intrusion (NYSDOH Guidance) provides three matrices with guidance values for sub-slab and indoor air comparison for eight CVOCs. The concentrations of the CVOC detections were relatively low in the soil vapor samples across the Site and were below mitigate action levels.

Matrix A Compounds: carbon tetrachloride, cis-1,2-dichloroethene, 1,1-dichloroethene, TCE

- Carbon tetrachloride, cis-1,2-dichloroethene, 1,1- dichloroethene, and TCE were not detected in soil vapor.

Matrix B Compounds: PCE, 1,1,1-trichloroethane, methylene chloride:

- PCE was detected at V-5 at a concentration of 26 $\mu g/m^3$.
- 1,1,1-Trichloroethane was detected at V-5 at a concentration of 6.0 (estimated) $\mu g/m^3$.
- Methylene chloride was not detected in soil vapor.

Matrix C Compound: vinyl chloride:

- Vinyl chloride was not detected in soil vapor.

Based on the findings of the prior investigations, the following preliminary Areas of Concern (AOCs) that are to be further investigated and/or remediated as part of this IRM/RIWP:

- Presence of contaminated soil;
- Presence of soil and groundwater impacts due to the former gasoline filling station in the northern portion of the Site;
- Potential migration of contaminants of concern onto the Site in groundwater and soil vapor from surrounding properties.

3. Remedial Investigation Objectives, Scope of Work, and Rationale

Roux, on behalf of the Applicant, has developed the below RI scope of work that is intended to satisfy NYSDEC BCP requirements. Data collected during the RI, along with data collected during previous investigations, will determine the basis for future remedial actions for the Site. In the previous environmental investigations, Roux collected soil, groundwater and soil vapor data throughout the Site in a manner consistent with DER-10. In order to incorporate the prior data into the RIR, a DUSR will be prepared to validate that all data meets applicable data quality objectives. The 2011 Stantec Phase II ESA data was used at a preliminary screening level to select the locations of the eligibility investigation samples and proposed RI samples; however, since NYSDEC ASP Category B reports were not published in the 2011 Stantec Phase II ESA, this data will not be included in the DUSR submitted as part of the RIR/RAWP prepared for the Site.

Standards, Criteria, and Guidance (SCGs) for soil at BCP Sites are the numerical SCOs presented in 6 NYCRR Part 375. The SCOs are categorized into unrestricted use criteria and restricted use (residential, restricted-residential, commercial, or industrial) criteria, as well as criteria for protection of groundwater (PGW) and ecological resources. The applicability of each category of SCOs is determined based upon the current and reasonably anticipated future use of the Site, as well as cleanup tracks being evaluated. The Applicant intends an unrestricted use and the redevelopment will include mixed use affordable and market rate housing, retail/commercial space and parking. Further discussion of cleanup tracks will be provided in the Remedial Action Work Plan (RAWP) to be submitted once the RI is complete, but the intent is to pursue a Track 1 clean up.

Although the groundwater beneath the Site is not used as a drinking water source, based upon the evaluation of the current groundwater data discussed herein, the NYSDEC AWQSGVs – TOGS 1.1.1. will be considered.

Soil vapor data will be evaluated in accordance with the NYSDOH guidance.

3.1 Objectives

Based on the existing data for the Site and AOCs identified above, the following objectives have been identified for the RI portion of this IRM/RIWP:

- Further delineate the nature and extent of potential impacts to soil;
- Further delineate the nature and extent of impacts to groundwater within the Site and the potential for migration onto or off the Site;
- Further evaluate the nature and extent of soil vapor quality within the Site and the potential for migration onto or off the Site; and
- Collect sufficient data to perform a qualitative human health exposure assessment (QHHEA) for on-Site and off-Site receptors.

The RI will evaluate soil, groundwater, and soil vapor impacts on-Site and at the Site property boundaries to provide the basis for designing a Track 1 remedial action and to determine the general potential for off-Site impacts. Environmental data collected during the RI will be used to qualitatively assess the potential exposure of receptors to Site contaminants and develop the information necessary to support the development of a RAWP.

3.2 RI Scope

To accomplish the objectives stated above, the scope of work for the RI will include the following:

- The advancement of soil borings, installation of groundwater monitoring wells, and installation of temporary soil vapor points;
- The collection of soil, groundwater, and soil vapor samples sufficient to define the nature and extent of impacted media and current Site conditions;
- The collection of groundwater level measurements and land survey data as needed for developing a groundwater elevation contour map; and
- The performance of a QHHEA to identify existing and potential exposure pathways and evaluate contaminant fate and transport.

All investigation activity will be conducted in accordance with the applicable requirements of the NYSDEC DER-10. During the RI, Roux will conduct air monitoring in accordance with a Site-specific Community Air Monitoring Plan (CAMP), which has been prepared for the Site and is provided as Appendix B.

Quality Assurance/Quality Control (QA/QC) protocols will be followed to ensure that suitable and verifiable data results from sampling and analysis are obtained. To accomplish this, a Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) has been prepared and is provided as Appendix C.

A site-specific Health and Safety Plan (HASP) has been prepared for the Site and is provided in Appendix D.

All data will be produced in accordance with NYSDEC Analytical Services Protocol (ASP) Category B deliverables and will be reviewed and validated by Joshua Cope of Roux Associates, Inc., a party independent of the project team, in a DUSR before being incorporated into the RIR for the Site. All data will be submitted to NYSDEC in electronic format, in accordance with DER-10, Section 1.15.

The overall scope of each component of the RI is discussed in the following subsections. Detailed field sampling procedures are provided in the QAPP/FSP (Appendix C). The proposed sampling locations are shown on Figure 5 of this IRM/RIWP and additional information, including intervals to be sampled and sample rationale, is provided below.

3.2.1 Site Reconnaissance

Roux has performed a preliminary Site reconnaissance and has identified potential AOCs, described in Sections 2.2.2, which will be targeted during the RI. An inspection of the existing Site conditions will be conducted to determine final locations of soil borings and monitoring wells based on actual field conditions.

3.2.2 Soil Investigation

To further characterize the soil conditions and to delineate known contamination at the Site, a total of 6 soil borings will be completed. The proposed sample locations are shown in Figure 5 and discussed below. Downgradient samples will be used for the purpose of assisting with the QHHEA.

Boreholes will be pre-cleared to five ft bls using non-intrusive methods, such as hand tools and/or vacuum excavation, prior to advancement of soil borings to verify the absence of utilities and/or other subsurface features (i.e. obstructions). Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated as close as possible to the original location. Soil samples will be collected by hand or by utilizing a GeoProbe® Direct-Push Drill Rig. Soil will be collected continuously from land surface to the bottom of the boring. During installation of the soil borings, the lithology will be recorded in accordance with the Unified Soils Classification System (USCS), and soil will be inspected for evidence (visual or olfactory) of contamination, including staining and/or odors, and field screened continuously for VOCs using a PID containing a 10.6 eV lamp.

Analysis of soil samples will occur in a phased approach. Initially, the shallowest soil sample collected from each borehole will be analyzed for the parameters listed below, with the deeper samples placed on hold at the laboratory. If the result of that analysis for each borehole contains exceedances of UUSCOs, the next sample depth will be analyzed to provide additional vertical delineation, and the deepest sample will be analyzed following this strategy as necessary.

Six soil borings will be advanced to characterize soil conditions in the following locations at the Site:

Location	Sample Depth Intervals (in ft bls unless otherwise noted)	Rationale
SB-21-01	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-2 and B-102; sample SB-21-01 is co-located with monitoring well MW-21-01 and soil vapor point SV-21-01.
SB-21-02	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-29 and RX-8; sample SB-21-02 is co-located with monitoring well MW-21-02.
SB-21-03	12-14; Hold 14-16 and 16-18	To obtain additional soil and soil vapor coverage across the Site; sample SB-21-03 is co-located with soil vapor point SV-21-03.
SB-21-04	12-14; Hold 14-16 and 16-18	To obtain additional soil coverage across the Site.
SB-21-05	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-26.
SB-21-06	12-14; Hold 14-16 and 16-18	To obtain additional soil coverage across the Site.

Following sample collection, boreholes that will not be converted to monitoring wells or soil vapor sample points will be backfilled with soil cuttings with an upper bentonite plug and restored with like materials to surrounding grade to the extent possible to minimize drummed waste. Obviously contaminated soil cuttings will be placed into sealed and labeled NYS Department of Transportation (DOT) approved 55-gallon drums, pending characterization and off-Site disposal at a permitted facility. All soil borings will be surveyed by a licensed New York State surveyor to obtain horizontal and vertical coordinates.

3.2.3 Groundwater Investigation

Two permanent groundwater monitoring wells (MW-21-01 and MW-21-02) will be installed at co-located soil boring locations as discussed in the embedded table in Section 3.2.1. The proposed groundwater monitoring well locations are shown on Figure 5. The locations of the on-Site monitoring wells were chosen to extend general Site coverage based on the locations of previous groundwater sample locations. Additional monitoring well design details are provided in the QAPP/FSP in Appendix C.

Following installation, each proposed permanent monitoring well will be developed to ensure proper hydraulic connection with the aquifer and to reduce/eliminate turbidity of the groundwater. All monitoring wells will be surveyed by a licensed New York State surveyor to obtain horizontal and vertical coordinates. The depth to groundwater in each monitoring well will be measured using an electronic water/oil level meter and a groundwater contour map will be developed using the survey data utilizing data from permanent monitoring wells.

Following well development, each monitoring well will be purged consistent with USEPA low-flow sampling requirements and one round of groundwater samples will be collected no sooner than one week following their installation in accordance with the QAPP/FSP. Field parameters (e.g., pH, dissolved oxygen, oxidation-reduction potential [ORP], etc.) will be collected using a water quality meter during purging and prior to sampling. Additional details on sampling procedure are provided in the QAPP/FSP in Appendix C.

3.2.4 Soil Vapor Investigation

Two soil vapor samples will be collected during the RI. Soil vapor points SV-21-01 and SV-21-03 will be installed at co-located soil boring locations as discussed in the embedded table in Section 3.2.1.

The soil vapor samples will be collected from temporary soil vapor points installed by hand. The soil vapor samples will be installed approximately two feet above the water table. New Teflon®-lined polyethylene tubing will be attached to a 6-inch stainless steel sample screen. The soil vapor points will be backfilled with #2 Morie sand to approximately one foot above the screen. The remainder of the borehole will be backfilled with a concrete/bentonite slurry to grade.

The soil vapor samples will be collected using a pre-cleaned (batch-certified) 6-liter summa canister with a regulator calibrated to collect the sample over an eight-hour period. A helium tracer gas test will be performed on the vapor points to ensure the integrity of the vapor point seal prior to sampling in accordance with the procedures outlined in the NYSDOH Guidance. The proposed soil vapor sampling locations are shown on Figure 5. Additional details regarding soil vapor sampling methods are provided in the QAPP/FSP in Appendix C.

3.2.5 Laboratory Analysis

Soil and groundwater samples collected from the soil investigation described in detail below will be analyzed for the full Target Compound List (TCL) VOCs and SVOCs + 30 (10 VOCs and 20 SVOCs) highest concentration tentatively identified compounds (TICs), Target Analyte List (TAL) metals (including hexavalent chromium and total cyanide), TCL pesticides, TCL herbicides, TCL PCBs; TCL + 30/TAL, and the emerging contaminants (ECs) 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS). PFAS include the 21 compounds listed in accordance with the Sampling, Analysis, and Assessment of PFAS under NYSDEC’s Part 375 Remedial Programs guidance document dated January 2021 (NYSDEC January 2021 PFAS Guidance). To delineate and characterize groundwater quality beneath the Site, groundwater samples will be analyzed for total and dissolved TAL metals and SVOCs.

All soil vapor air samples will be analyzed using USEPA Method TO-15 for VOCs. All samples will be analyzed at a NYSDOH Environmental Laboratory Approval Program-certified (ELAP) laboratory. Additional details regarding laboratory analyses are included in the QAPP/FSP (Appendix C). All analytical data for the RI will be received with standard 5-day turn-around-time.

All RI data will be produced in accordance with NYSDEC ASP Category B deliverables and will be reviewed and validated by Joshua Cope, who is independent of the project team and who will prepare a DUSR before being incorporated into the final RIR for the Site. All data will be submitted to NYSDEC in electronic format, in accordance with DER-10, Section 1.15.

3.2.6 Qualitative Human Health Exposure Assessment

A QHHEA (on-Site and off-Site) will be performed following the collection of all RI data. The EA will be performed in accordance with Section 3.3(c)4 of DER-10 and the NYSDOH guidance for performing a qualitative EA (DER-10; Appendix 3B). The results of the QHHEA will be provided in the RIR.

According to Section 3.10 of DER-10, and the Fish and Wildlife Resources Impact Analysis Decision Key in DER-10 Appendix 3C, a Fish and Wildlife exposure assessment will be performed (if needed) based on the results of the RI results.

3.2.7 Surveying Assessment

All newly installed monitoring wells, soil borings, and soil vapor points will be surveyed by a New York Licensed Surveyor to obtain horizontal and vertical coordinates and grade elevations. Measuring point elevations from newly installed monitoring wells will also be surveyed to enable groundwater flow contouring. Horizontal coordinates will be based upon New York State Plane Coordinate System, Long Island Zone, North American Datum of 1983 (NAD 83) in US Survey Feet. Vertical elevations will be measured for top-of-casing (measuring point) and grade elevations referenced to North American Vertical Datum of 1988 (NAVD 88).

3.3 Investigation Derived Waste Disposal

All wastes generated during IRM/RI will be handled, transported and disposed of in a manner consistent with Federal, State and local laws and regulations.

4. Elements of the Interim Remedial Measure

4.1 Scope of Work

The scope of work for the IRM consists of the following tasks:

- Establish Site security measures (fencing);
- Demolition/removal of asphalt parking lot, surface features including light poles and fencing, and any foundation elements from prior site usage if encountered; and
- Localized remedial excavation and disposal of soil with contaminant concentrations known to be in excess of the UUSCOs and RRSCOs. Installation of a foundation pile and pile cap will occur in this remedial area (Figure 6).

The following sections provide additional details concerning the completion of the IRM objectives.

4.2 Mobilization and Site Preparation

The NYSDEC will be provided with at least five days advanced notice prior to intrusive activities. The selected Contractor will supply appropriately trained labor and materials required for the implementation of the IRM scope of work. In addition, necessary permits, insurance, bonds, and licenses required to complete the work will be obtained and fees necessary to obtain these permits will be paid. For the RI scope of work, this will include mobilization of equipment to the work area. Once demolition/removal commences, the mobilization and Site preparation activities include:

1. Mobilization of equipment to the work area;
2. Installation of construction fencing (in accordance with New York City Department of Buildings [NYCDOB] requirements) and traffic barricades surrounding the Site to delineate the work zone, act as a work Site security measure, and mark the truck loading and decontamination areas;
3. Implementation of erosion and sediment control measures in accordance with the New York Guidelines for Urban Erosion and Sediment Control, if required. Hay bales will be placed surrounding the excavation areas to control stormwater runoff and surface water from entering or exiting the excavation, as necessary. Catch basin inlets will be protected to prevent demolition/removal debris or disturbed soil from entering;
4. Set-up of staging areas for excavated soil, as necessary; and
5. Set-up of temporary facilities including decontamination pad in order to decontaminate trucks and other vehicles/equipment, as necessary.

4.3 Surface Feature Demolition/Removal

The asphalt pavement and all surface features at the Site, which includes lighting and chain-link fencing, will be removed. Demolition/removal will occur to remove drilling obstructions and facilitate completion of the RI, characterization of soil for disposal, and completion of the future remedy.

Roux will provide oversight of any limited soil disturbance activities and conduct air monitoring in accordance with the Site-specific CAMP. Oversight and CAMP will continue until the exposed soil surfaces are covered with a temporarily cover consisting of four inches of stone or other NYSDEC-approved material. Details of the CAMP requirements are provided in Section 5.12.

4.4 Localized Remedial Excavation

Localized remedial excavation will be performed in an approximately 900 square foot area of known contamination where installation of a foundation pile cap will occur within the limits shown in Figure 6. The volume of excavation is estimated to be approximately 500 CY. Soil will be managed in accordance with Section 5. Roux will provide oversight of excavation activities and conduct air monitoring in accordance with the Site-specific CAMP. One endpoint sample will be collected to confirm Track 1 UUSCOs are achieved. Oversight and CAMP will continue until the localized pile cap work is complete and the exposed soil surfaces are covered with a temporarily cover consisting of four inches of stone or other NYSDEC-approved material. Details of the CAMP requirements are provided in Section 5.12. Handling and disposal of the soil will be performed in accordance with the Soil/Materials Management Plan provided as Section 5.

4.5 Underground Storage Tank Removal

There are no known USTs at the Site. Based upon the scope of work, it is unlikely that USTs will be encountered during the IRM. If unknown USTs are encountered, they will be decommissioned and removed by a Fire Department of the City of New York (FDNY) licensed installer/remover. Upon completion of any potential UST removal, the area will be inspected for the presence of contamination in soil and groundwater. Excavation of impacted materials may be advanced to the extent possible without causing an unstable condition and disposed of off-Site in accordance with all applicable regulations at a permitted disposal facility. Endpoint sampling will be completed in accordance with Sections 5.5 of DER-10 prior to backfilling in accordance with Section 5.9 herein. Following removal of any potential USTs, any potential USTs will be registered and closed in the NYSDEC Petroleum Bulk Storage (PBS) database (if over 1,100 gallons) and FDNY affidavits of closure will be obtained by a licensed UST installer/remover.

4.6 IRM Oversight

The implementation of the IRM will be overseen by a field engineer, geologist, or scientist under the supervision of the Remediation Engineer (RE) as described in this Work Plan. The RE is responsible for documenting that the contractor performs the work as specified in this Work Plan and provides the proper documentation required by NYSDEC. These documents will be submitted to the NYSDEC in the Final Engineering Report (FER); which is described in Section 6.0.

5. Soils/Materials Management Plan

The following sections provide the Soil/Materials Management Plan (SoMP) to be implemented during the IRM/RIWP.

5.1 Soil Screening Methods

Visual, olfactory and PID soil screening and assessment will be performed during the IRM/RI activities under the supervision of Roux personnel.

5.2 Stockpile Methods

Soil excavated during the IRM will be stockpiled on and covered with polyethylene sheeting or placed in roll-off containers until properly disposed, as necessary. Stockpiles will be used only when necessary and will be removed as soon as practicable. While stockpiles are in place, they will be inspected at a minimum each week, and before and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. Excavated soils will be stockpiled on, at minimum, double layers of 6-mil minimum poly-sheeting, will be kept covered at all times (except when material is being added or removed) with appropriately anchored polyethylene sheeting, and will be routinely inspected. Broken or ripped sheeting will be promptly replaced. If used, roll-off containers for saturated materials will be lined.

Stockpile activities will be compliant with applicable laws and regulations. Stockpiles of excavated soils and other materials will be located a minimum of 20 feet from the property boundaries, where possible. Hay bales or equivalent will surround soil stockpiles as needed, except for areas where access by equipment is required. Hay bales will be used as needed near catch basins, surface waters, and other discharge points.

5.3 Characterization of Excavated Materials

If hotspots, gross contamination, or structures to be remediated (USTs, vaults and associated piping, etc.) are encountered, they will be removed and endpoint remedial performance sampling completed before excavations related to Site development commence proximal to the hotspot or structure. Soil/ fill or other excavated media that will be transported off-Site for disposal will be sampled in accordance with the Site-specific QAPP/FSP that is provided as Appendix C, and in a manner required by the receiving facility, and in compliance with applicable laws and regulations. Soils proposed for reuse on-Site will be managed as defined in this Work Plan.

5.4 Materials Excavation and Load-Out

Roux will oversee all invasive work and the remedial excavation and load-out of all excavated material.

The Applicant and its contractors are solely responsible for safe execution of all invasive and other work performed under this Work Plan. The selected contractor will be required to place a One-Call Dig Safe notification prior to mobilization. Existing private markout information, where available, will be consulted prior to excavation. Localized remedial excavation necessary for installation of the pile cap of the new building will have appropriate support of excavation (SOE) and will be permitted by NYCDOB.

The presence of easements on the Site has been investigated. It has been determined that no risk or impediment to the planned work under this IRM/RIWP is posed by easements on the Site. The presence of utilities within/adjacent to the proposed work area will be investigated prior to the work in order to determine if there are any impediments to the proposed scope of work. NYSDEC will be notified of any changes required to the scope of work based on the geophysical survey.

Loaded vehicles leaving the Site will be appropriately securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements). If grossly contaminated material is encountered, loaded vehicles will be lined and tarped, as appropriate.

Loaded outbound trucks will be inspected by Roux and cleaned by the Site contractor before leaving the Site.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-Site sediment tracking. Vehicles/trucks will either be staged on asphalt/concrete, where still existing, or in the event that the asphalt/concrete is removed, a stabilized construction entrance will be constructed at any vehicle egress points. Regardless, all egress points for truck and equipment transport from the Site will be clean of dirt and other materials derived from the Site during the implementation of the IRM. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

Mechanical processing of fill, asphalt, concrete and contaminated soil on-Site is prohibited.

5.5 Materials Transport Off-Site

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

The proposed inbound truck route to the Site is:

- Take the Major Deegan Expressway (I-87) to exit 9 to West Fordham Road/University Heights Bridge. Turn onto West Fordham Road and cross the University Heights Bridge. Continue onto West 207th Street and entrance to the Site will be on the left.

The proposed outbound truck route from the Site is:

- Turn right out of the Site and go southeast on West 207th Street. Cross the University Heights Bridge and continue onto West Fordham Road. Merge onto I-87 ramp.

These are the most appropriate routes and take into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport. To the extent possible, trucks loaded with Site materials will travel to/from the Site using these approved truck routes. West 207th Street and West Fordham Road are New York City Department of Transportation approved Local Truck Routes.

Trucks will avoid stopping and idling in the neighborhood outside the project Site, to the extent practicable. Queuing of trucks will be performed on-Site, when possible, in order to minimize off Site disturbance. Off-Site queuing will be minimized.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during the IRM implementation.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. If loads contain wet material capable of producing free liquid, truck liners will be used.

5.6 Materials Disposal Off-Site

All soil/fill/solid waste excavated and removed from the Site will be disposed of in accordance with regulatory requirements based on the levels of contamination found to be present in waste characterization samples collected. Uncontaminated concrete and asphalt pavement may be disposed of as construction and demolition debris at a registered New York State Construction and Demolition Debris Processing Facility.

The following documentation will be obtained and reported for each disposal location used in this project to demonstrate and document that the disposal of material derived from the Site conforms with all applicable laws: (1) a letter or facility-specific waste profile/application from Roux or the Applicant to the receiving facility describing the material to be disposed and requesting formal written acceptance of the material. This letter/profile/application will state that material to be disposed is contaminated material generated at an environmental remediation Site in New York State. The letter will provide the project identity and the name and phone number of the Roux or the Applicant. The letter will include as an attachment a summary of all chemical data for the material being transported (including Site characterization data); and (2) a letter from all receiving facilities stating it is in receipt of the correspondence (above) and is approved to accept the material. These documents will be included in the FER.

The FER will include an accounting of the destination of all material removed from the Site during this IRM summarized in text and tabulated. A Bill of Lading system or equivalent will be used for off-Site movement of non-hazardous wastes and contaminated soils and will also be reported in the FER.

Any potential hazardous wastes derived from on-Site will be stored, transported, and disposed of in compliance with applicable local, State, and Federal regulations.

Appropriately licensed haulers will be used for material removed from this Site and will be in compliance with all applicable local, State and Federal regulations.

Waste characterization will be performed for off-Site disposal in a manner suitable to the receiving facility and in conformance with applicable permits. All data available for soil/material to be disposed at a given facility must be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

5.7 Materials Reuse On-Site

Material removed for installation of the foundation pile cap may be reused to backfill the excavation if sampled in accordance with DER-10 and it is confirmed it meets UUSCOs. Any material with concentrations in excess of the UUSCOs will be disposed of offsite either under this IRM or as part of the Site-wide remediation to be described in a future RAWP.

Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing of the Site is prohibited for reuse on-Site.

5.8 Fluids Management

All liquids to be removed from the Site will be handled, transported and disposed in accordance with applicable laws and regulations. If any USTs are encountered, all liquids observed in the USTs will be removed prior to closure. All liquids removed from the USTs will be sampled in a manner required by the receiving facility and in compliance with applicable laws and regulations. Liquid waste manifests will be reported to NYSDEC in the FER.

Dewatering is not expected to be necessary during the IRM activities.

5.9 Backfill from Off-Site Sources

All materials proposed for import onto the Site will be approved by Roux and will be in compliance with provisions in this IRM/RIWP prior to receipt at the Site.

Material from industrial sites, spill sites, or other potentially contaminated sites will not be imported to the Site. Solid waste will not be imported onto the Site. Material from other environmental sites may be imported with prior approval from NYSDEC (i.e., through the NYCOER Clean Soil Bank or through a Beneficial Use Determination).

All imported soils will meet NYSDEC-approved backfill or cover soil quality objectives for this Site. These NYSDEC approved backfill or cover soil quality objectives are the lower of the Protection of Groundwater or the protection of public health soil cleanup objectives for unrestricted use as set forth in Table 375-6.8(b) of 6 NYCRR Part 375. Non-compliant soils will not be imported onto the Site without prior approval by NYSDEC. Nothing in the approved IRM or its approval by NYSDEC should be construed as an approval for this purpose.

Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Nothing in this IRM should be construed as an approval for this purpose.

In accordance with DER-10, the following material may be imported, without chemical testing, to be used as backfill beneath pavement, buildings or as part of the final site cover, provided that it contains less than 10% by weight material which would pass through a size 80 sieve and consists of:

- gravel, rock or stone, consisting of virgin material from a NYSDEC permitted mine or quarry; or
- recycled concrete or brick from a NYSDEC registered construction and demolition debris processing facility if the material conforms to the requirements of Section 304 of the New York State Department of Transportation *Standard Specifications Construction and Materials Volume 1* (2002).

5.10 Stormwater Pollution Prevention

Applicable laws and regulations pertaining to stormwater pollution prevention will be addressed during the IRM activities. Erosion and sediment control measures (silt fences and/or barriers, and/or hay bale checks) will be installed, as appropriate, around the entire perimeter of the remedial construction area and inspected once a week and after every storm event to ensure that they are operating appropriately. Discharge locations will be inspected to determine whether erosion control measures are effective in preventing significant impacts to receptors. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs to erosion and sediment controls shall be made immediately. Accumulated sediments will be removed as required to keep the barrier and hay bale check functional. Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

5.11 Contingency Plan

This contingency plan is developed for the remedial construction to address the discovery of unknown structures or contaminated media during implementation of the IRM.

If USTs or other previously unidentified contaminant sources are found during on-Site remedial excavation, sampling will be performed on potentially contaminated source material and surrounding soils and reported to NYSDEC. Chemical analytical work will be for the full suite of parameters (TAL/TCL + 30 and Emerging Contaminants). Analyses will not be otherwise limited without NYSDEC approval.

Identification of unknown or unexpected contaminated media identified by screening during invasive Site work will be promptly communicated by phone to NYSDEC's Project Manager. These findings will be also included in daily and monthly reports.

5.12 Community Air Monitoring Plan

CAMP monitoring will be implemented during all ground intrusive activities (i.e., during the RI Scope of Work and once the concrete slab or asphalt pavement are disturbed). The CAMP monitoring will be performed in accordance with the site-specific CAMP (Appendix B) and will include the real-time monitoring of VOCs and particulates at the upwind and downwind perimeter of the Site. Should monitoring results exceed action levels as noted in the CAMP, efforts will be made to mitigate/eliminate the exceedance and NYSDEC/NYSDOH will be notified.

5.13 Odor, Dust, and Nuisance Control Plan

5.13.1 Odor Control Plan

In addition to the CAMP monitoring, Roux will closely monitor the presence of any odors emanating from the work area.

Odor controls will be employed to prevent on- and off-Site odor nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) use of odor suppressants to cover exposed odorous soils. If nuisance odors develop and cannot otherwise be controlled, additional means to eliminate them will include: (d) direct load-out of soils to trucks for off-Site disposal; and (e) use of chemical odorants in spray or misting systems.

This odor control plan is capable of controlling emissions of nuisance odors. If nuisance odors are identified, the source of odors will be identified and corrected. If necessary, to identify or correct a nuisance odor source, work will be temporarily halted and will not resume until such nuisance odors have been identified and abated. NYSDEC will be notified of all odor complaint events.

5.13.2 Dust Control Plan

Dust management during invasive on-Site work will include, at a minimum:

- Use of properly anchored tarps to cover stockpiles;
- Exercising extra care during dry and high-wind periods; and
- Dust suppression will be achieved through the use of water for wetting excavation areas. Water will be available on-Site at suitable supply and pressure for use in dust control.

This dust control plan is capable of controlling emissions of dust. If nuisance dust emissions are identified, work will be halted, and the source of dusts will be identified and corrected. Work will not resume until all nuisance dust emissions have been abated. NYSDEC will be notified of all dust complaint events.

5.13.3 Other Nuisances

Noise control will be exercised during the remedial program. All remedial work will conform, at a minimum, to NYC noise control standards. Rodent control will be provided during demolition/removal and during the remedial program, as necessary, to prevent nuisances.

6. Reporting

6.1 Reporting During Site Activities

Daily reports to NYSDEC and NYSDOH containing photo-documentation will be submitted during the days when intrusive IRM/RI activities take place as indicated in the Work Plan (daily reports will not be provided during demolition/removal). Any change in reporting frequency will be pre-approved by NYSDEC. Daily reports will include a summary of all work completed that day; locations of work and quantities of material imported and exported from the Site; a summary of any and all complaints with relevant details (names, phone numbers); a summary of CAMP readings and an explanation of notable Site conditions; etc.

Monthly reports will be submitted to the NYSDEC on the 10th day of the following month. Monthly reports will provide an update of progress made during the reporting period, a summary of the daily reports, any analytical data received during the reporting period, any public participation activities, and a summary of activities scheduled for the next reporting period.

6.2 Final Engineering Report

Detailed information regarding the IRM (e.g., general description of the construction activities, waste disposal documentation, photos, etc.) will be included in the FER for the overall Site remediation once completed. FER will be certified by the Remedial Engineer, who is a Professional Engineer licensed in the State of New York, that the work was performed in accordance with the approved IRM/RIWP and any approved changes.

7. IRM/RI Implementation Schedule

This IRM/RIWP is anticipated to begin in August 2021 and will require approximately four months to complete. It is anticipated that the actual on-Site duration of major remedial construction tasks will be completed as described below. It is anticipated that there will be a gap between the removal of the asphalt pavement and redevelopment phases of the Site which was taken into consideration of the timeline below.

Timeframe	Description
May 2021	Submit BCP Application and IRM/RIWP to NYSDEC
August 2021	Begin demolition/removal under the IRM and conduct RI Field Work
October 2021	Submit combined Remedial Investigation Report (RIR)/Remedial Action Work Plan (RAWP) to NYSDEC
February 2022	Localized remedial excavation under the IRM
February 2022	Finalize and certify RIR/RAWP, NYSDEC prepares Decision Document and Approval and issues Fact Sheet approving Remediation
March 2022	Commence Remedial Construction Under the RIR/RAWP
December 2022	Targeted Certificate of Completion

TABLES

1. Summary of Volatile Organic Compounds in Soil
2. Summary of Semivolatile Organic Compounds in Soil
3. Summary of Metals in Soil
4. Summary of Polychlorinated Biphenyls in Soil
5. Summary of Pesticides and Herbicides in Soil
6. Summary of Volatile Organic Compounds in Groundwater
7. Summary of Semivolatile Organic Compounds in Groundwater
8. Summary of Metals in Groundwater
9. Summary of Polychlorinated Biphenyls in Groundwater
10. Summary of Pesticides and Herbicides in Groundwater
11. Summary of Volatile Organic Compounds in Soil Vapor

Notes Utilized Throughout Tables

Soil Tables

J - Estimated value
U - Indicates that the compound was analyzed for but not detected
B - The analyte was found in an associated blank as well as in the sample
T - Indicates that a quality control parameter has exceeded laboratory limits
ft bls - Feet below land surface
DUP - Duplicate sample
NA - Compound was not analyzed for by laboratory
mg/kg - Milligrams per kilogram
NYSDEC - New York State Department of Environmental Conservation
UUSCO - NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives
RRSCO - NYSDEC Part 375 Restricted Residential Soil Cleanup Objectives
-- No SCO available

Bold data indicates that parameter was detected above the NYSDEC Part 375 UUSCO

Shaded data indicates that parameter was detected above the NYSDEC Part 375 RRSCO

Groundwater Tables

NYSDEC - New York State Department of Environmental Conservation
AWQSGVs - Ambient Water-Quality Standards and Guidance Values
J - Estimated Value
U - Compound was analyzed for but not detected
T - Indicates that a quality control parameter has exceeded laboratory limits
DUP - Duplicate
-- No NYSDEC AWQSGV available
NA - Compound was not analyzed for by laboratory

Bold data indicates that parameter was detected above the NYSDEC AWQSGVs

Soil Vapor

J - Estimated value
U - Indicates that the compound was analyzed for but not detected
ug/m3 - Micrograms per cubic meter

Bold data indicates that parameter was detected

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-1	RX-1	RX-1
				Sample Date:	7/26/2018	7/26/2018	7/23/2018	7/23/2018	9/26/2018	9/26/2018	9/26/2018
				Sample Depth (ft bls):	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	0.5 - 2.5	5.0 - 7.0	8.0 - 10.0
1,1,1-Trichloroethane	0.68	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,1,2,2-Tetrachloroethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,1,2-Trichloroethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,1-Dichloroethane	0.27	26	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,1-Dichloroethene	0.33	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.00037 J	0.11 U	0.095 U	0.1 U
1,2,3-Trichlorobenzene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,2,4-Trichlorobenzene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,2,4-Trimethylbenzene	3.6	52	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	1	0.070 J	**82**
1,2-Dibromoethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,2-Dichlorobenzene	1.1	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,2-Dichloroethane	0.02	3.1	mg/kg		0.0012 U	0.001 U	0.0011 U	0.00040 J	0.11 U	0.095 U	0.1 U
1,2-Dichloropropane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,3,5-Trimethylbenzene	8.4	52	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.41	0.095 U	0.45
1,3-Dichlorobenzene	2.4	49	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,4-Dichlorobenzene	1.8	13	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
1,4-Dioxane	0.1	13	mg/kg		0.024 U	0.02 U	0.021 U	0.022 U	5.3 U	4.8 U	5.2 U
2-Butanone (MEK)	0.12	100	mg/kg		0.0061 U	0.0043 J	0.0054 U	0.0055 U	0.53 U	0.48 U	0.52 U
2-Hexanone	--	--	mg/kg		0.0061 U	0.005 U	0.0054 U	0.0055 U	0.53 U	0.48 U	0.52 U
4-Methyl-2-pentanone (MIBK)	--	--	mg/kg		0.0061 U	0.005 U	0.0054 U	0.0055 U	0.53 U	0.48 U	0.52 U
Acetone	0.05	100	mg/kg		0.014	0.023	0.0054 U	0.0066	0.53 U	0.48 U	0.52 U
Benzene	0.06	4.8	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0018	**0.45**	0.095 U	0.1 U
Bromochloromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Bromodichloromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Bromoform	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 UT	0.1 U
Bromomethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 UT	0.1 U
Carbon disulfide	--	--	mg/kg		0.0012 U	0.00074 J	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Carbon tetrachloride	0.76	2.4	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Chlorobenzene	1.1	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Chloroethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 UT	0.1 U
Chloroform	0.37	49	mg/kg		0.0012 U	0.001 U	0.0011 U	0.00057 J	0.11 U	0.095 U	0.1 U
Chloromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
cis-1,2-Dichloroethene	0.25	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
cis-1,3-Dichloropropene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Cyclohexane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.053 J	0.1 U
Dibromochloromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Dibromochloropropane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Dichlorodifluoromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

	NYSDEC	NYSDEC		**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-1	RX-1	RX-1
Parameter	Part 375	Part 376	Units	**Sample Date:**	7/26/2018	7/26/2018	7/23/2018	7/23/2018	9/26/2018	9/26/2018	9/26/2018
(Concentrations in mg/kg)	UUSCO	RRSCO		**Sample Depth (ft bls):**	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	0.5 - 2.5	5.0 - 7.0	8.0 - 10.0
Ethylbenzene	1	41	mg/kg		0.0012 U	0.001 U	0.0011 U	0.00071 J	**6.4**	0.12	**1.1**
Freon 113	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Isopropylbenzene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	1.9	0.71	7
m+p-Xylene	--	--	mg/kg		0.0012 U	0.001 U	0.00036 J	0.0016	2.4	0.22	0.11
Methyl acetate	--	--	mg/kg		0.0061 U	0.005 U	0.0054 U	0.0055 U	0.53 U	0.089 J	0.52 U
Methylcyclohexane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	5.9	0.33 T	2.8
Methylene chloride	0.05	100	mg/kg		0.0012 U	0.00032 BJ	0.0011 U	0.00057 BJ	0.11 U	0.095 U	0.1 U
MTBE	0.93	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
n-Butylbenzene	12	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	4.5	1.3	**14**
n-Propylbenzene	3.9	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	**4.4**	2	**19**
o-Xylene	--	--	mg/kg		0.0012 U	0.001 U	0.00026 J	0.00072 J	0.3	0.037 J	0.1 U
sec-Butylbenzene	11	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	1.8	0.61	4.6
Styrene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
tert-Butylbenzene	5.9	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.25	0.067 J	0.48
Tetrachloroethene	1.3	19	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Toluene	0.7	100	mg/kg		0.0012 U	0.0022	0.0011 U	0.0038	0.22	0.15	0.1 U
trans-1,2-Dichloroethene	0.19	100	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
trans-1,3-Dichloropropene	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Trichloroethene	0.47	21	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Trichlorofluoromethane	--	--	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Vinyl chloride	0.02	0.9	mg/kg		0.0012 U	0.001 U	0.0011 U	0.0011 U	0.11 U	0.095 U	0.1 U
Xylenes (total)	0.26	100	mg/kg		0.0024 U	0.002 U	0.00062 J	0.0023	**2.7**	0.26	0.11 J

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-1	RX-2	RX-2	RX-3	RX-3 DUP	RX-3	RX-5
				Sample Date:	9/26/2018	9/26/2018	9/26/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018
				Sample Depth (ft bls):	13.5 - 15.5	0.5 - 2.5	10 - 12	0.5 - 2.5	0.5 - 2.5	10 - 12	0.5 - 2.5
1,1,1-Trichloroethane	0.68	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,1,2,2-Tetrachloroethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,1,2-Trichloroethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,1-Dichloroethane	0.27	26	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,1-Dichloroethene	0.33	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2,3-Trichlorobenzene	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2,4-Trichlorobenzene	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2,4-Trimethylbenzene	3.6	52	mg/kg		1.1	0.0018	0.050 J	0.0013 U	0.0013 U	0.00024 J	0.0011 U
1,2-Dibromoethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2-Dichlorobenzene	1.1	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2-Dichloroethane	0.02	3.1	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,2-Dichloropropane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,3,5-Trimethylbenzene	8.4	52	mg/kg		0.11 U	0.00042 J	1.2	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,3-Dichlorobenzene	2.4	49	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,4-Dichlorobenzene	1.8	13	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
1,4-Dioxane	0.1	13	mg/kg		5.5 U	0.029 U	5.1 U	0.027 U	0.025 U	0.022 U	0.021 U
2-Butanone (MEK)	0.12	100	mg/kg		0.55 U	0.009	0.51 U	0.0033 J	0.0024 J	0.0049 J	0.0023 J
2-Hexanone	--	--	mg/kg		0.55 U	0.0072 U	0.51 U	0.0067 U	0.0063 U	0.0054 U	0.0053 U
4-Methyl-2-pentanone (MIBK)	--	--	mg/kg		0.55 U	0.0072 U	0.51 U	0.0067 U	0.0063 U	0.0054 U	0.0053 U
Acetone	0.05	100	mg/kg		0.55 U	0.039	0.51 U	0.017	0.013	0.028	0.018
Benzene	0.06	4.8	mg/kg		0.11 U	0.0098	0.047 J	0.0013 U	0.0013 U	0.00044 J	0.0011 U
Bromochloromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Bromodichloromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Bromoform	--	--	mg/kg		0.11 UT	0.0014 U	0.1 UT	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Bromomethane	--	--	mg/kg		0.11 UT	0.0014 U	0.1 UT	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Carbon disulfide	--	--	mg/kg		0.11 U	0.0019	0.1 U	0.0013 U	0.0013 U	0.0019	0.0011 U
Carbon tetrachloride	0.76	2.4	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Chlorobenzene	1.1	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Chloroethane	--	--	mg/kg		0.11 UT	0.0014 U	0.1 UT	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Chloroform	0.37	49	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Chloromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
cis-1,2-Dichloroethene	0.25	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
cis-1,3-Dichloropropene	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Cyclohexane	--	--	mg/kg		0.47	0.0014 U	11	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Dibromochloromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Dibromochloropropane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Dichlorodifluoromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-1	RX-2	RX-2	RX-3	RX-3 DUP	RX-3	RX-5
				Sample Date:	9/26/2018	9/26/2018	9/26/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018
				Sample Depth (ft bls):	13.5 - 15.5	0.5 - 2.5	10 - 12	0.5 - 2.5	0.5 - 2.5	10 - 12	0.5 - 2.5
Ethylbenzene	1	41	mg/kg		0.14	0.0037	**1.1**	0.0013 U	0.0013 U	0.00034 J	0.0011 U
Freon 113	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Isopropylbenzene	--	--	mg/kg		1.4	0.003	13	0.0013 U	0.0013 U	0.00074 J	0.0011 U
m+p-Xylene	--	--	mg/kg		0.11 U	0.0066	0.058 J	0.0013 U	0.0013 U	0.00033 BJ	0.0011 U
Methyl acetate	--	--	mg/kg		0.55 U	0.0072 U	0.51 U	0.0067 U	0.0063 U	0.0054 U	0.0053 U
Methylcyclohexane	--	--	mg/kg		2.4 T	0.0014 U	33 T	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Methylene chloride	0.05	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
MTBE	0.93	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
n-Butylbenzene	12	100	mg/kg		2.3	0.0075	**16**	0.0013 U	0.0013 U	0.0011 U	0.0011 U
n-Propylbenzene	3.9	100	mg/kg		3.9	0.0089	**43**	0.0013 U	0.0013 U	0.0011	0.0011 U
o-Xylene	--	--	mg/kg		0.11 U	0.00050 J	0.1 U	0.0013 U	0.0013 U	0.00017 J	0.0011 U
sec-Butylbenzene	11	100	mg/kg		0.76	0.0095	5.4	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Styrene	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
tert-Butylbenzene	5.9	100	mg/kg		0.066 J	0.0012 J	0.25	0.0013 U	0.0013 U	0.00043 J	0.0011 U
Tetrachloroethene	1.3	19	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Toluene	0.7	100	mg/kg		0.11 U	0.0025	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
trans-1,2-Dichloroethene	0.19	100	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
trans-1,3-Dichloropropene	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Trichloroethene	0.47	21	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.00094 BJ	0.0011 U
Trichlorofluoromethane	--	--	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Vinyl chloride	0.02	0.9	mg/kg		0.11 U	0.0014 U	0.1 U	0.0013 U	0.0013 U	0.0011 U	0.0011 U
Xylenes (total)	0.26	100	mg/kg		0.22 U	0.0071	0.058 J	0.0027 U	0.0025 U	0.00050 J	0.0021 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-5	RX-8	RX-8	RX-26	RX-26	RX-27	RX-27
				Sample Date:	9/27/2018	9/27/2018	9/27/2018	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	5 - 7	0.5 - 2.5	8 - 10	3 - 5	5 - 7	3 - 5	7 - 9
1,1,1-Trichloroethane	0.68	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,1,2,2-Tetrachloroethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,1,2-Trichloroethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,1-Dichloroethane	0.27	26	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,1-Dichloroethene	0.33	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2,3-Trichlorobenzene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2,4-Trichlorobenzene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2,4-Trimethylbenzene	3.6	52	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.00088 J	0.0012 U
1,2-Dibromoethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2-Dichlorobenzene	1.1	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2-Dichloroethane	0.02	3.1	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,2-Dichloropropane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,3,5-Trimethylbenzene	8.4	52	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,3-Dichlorobenzene	2.4	49	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,4-Dichlorobenzene	1.8	13	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
1,4-Dioxane	0.1	13	mg/kg		0.021 U	0.022 U	0.02 U	0.028 U	0.02 U	0.029 U	0.025 U
2-Butanone (MEK)	0.12	100	mg/kg		0.0052 U	0.0024 J	0.0024 J	0.0071 U	0.0049 U	0.0073 U	0.0067
2-Hexanone	--	--	mg/kg		0.0052 U	0.0054 U	0.0051 U	0.0071 U	0.0049 U	0.0073 U	0.0061 U
4-Methyl-2-pentanone (MIBK)	--	--	mg/kg		0.0052 U	0.0054 U	0.0051 U	0.0071 U	0.0049 U	0.0073 U	0.0061 U
Acetone	0.05	100	mg/kg		0.0052 U	0.0095	0.014	0.0085 U	0.0059 U	0.04	0.043
Benzene	0.06	4.8	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.00057 J	0.0012 U
Bromochloromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Bromodichloromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Bromoform	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Bromomethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0028 U	0.002 U	0.0029 U	0.0025 U
Carbon disulfide	--	--	mg/kg		0.001 U	0.0011 U	0.00067 J	0.0014 U	0.00099 U	0.0019	0.0006 J
Carbon tetrachloride	0.76	2.4	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 UT	0.00099 UT	0.0015 UT	0.0012 U
Chlorobenzene	1.1	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Chloroethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Chloroform	0.37	49	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Chloromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
cis-1,2-Dichloroethene	0.25	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
cis-1,3-Dichloropropene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Cyclohexane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Dibromochloromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Dibromochloropropane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Dichlorodifluoromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

	NYSDEC	NYSDEC		**Sample Designation:**	RX-5	RX-8	RX-8	RX-26	RX-26	RX-27	RX-27
Parameter	Part 375	Part 376	Units	**Sample Date:**	9/27/2018	9/27/2018	9/27/2018	01/12/2021	01/12/2021	01/12/2021	01/12/2021
(Concentrations in mg/kg)	UUSCO	RRSCO		**Sample Depth (ft bls):**	5 - 7	0.5 - 2.5	8 - 10	3 - 5	5 - 7	3 - 5	7 - 9
Ethylbenzene	1	41	mg/kg		0.001 U	0.0011 U	0.001 U	0.00054 J	0.00099 U	0.00053 J	0.0012 U
Freon 113	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Isopropylbenzene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
m+p-Xylene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0027	0.00099 U	0.0011 J	0.0012 U
Methyl acetate	--	--	mg/kg		0.0052 U	0.0054 U	0.0051 U	0.0071 U	0.0049 U	0.0073 U	0.0061 U
Methylcyclohexane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0047	0.0012 U
Methylene chloride	0.05	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0028 U	0.002 U	0.0029 U	0.0025 U
MTBE	0.93	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
n-Butylbenzene	12	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
n-Propylbenzene	3.9	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.00045 J	0.0012 U
o-Xylene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0015	0.00099 U	0.001 J	0.0012 U
sec-Butylbenzene	11	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.00063 J	0.0012 U
Styrene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.00046 J
tert-Butylbenzene	5.9	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Tetrachloroethene	1.3	19	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Toluene	0.7	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.00077 J	0.0012 U
trans-1,2-Dichloroethene	0.19	100	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
trans-1,3-Dichloropropene	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Trichloroethene	0.47	21	mg/kg		0.0010 B	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Trichlorofluoromethane	--	--	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Vinyl chloride	0.02	0.9	mg/kg		0.001 U	0.0011 U	0.001 U	0.0014 U	0.00099 U	0.0015 U	0.0012 U
Xylenes (total)	0.26	100	mg/kg		0.0021 U	0.0022 U	0.002 U	0.0043	0.002 U	0.0021 J	0.0025 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-27	RX-28	RX-28	RX-29	RX-29	RX-29 DUP
				Sample Date:	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	12 - 14	0 - 2	5 - 7	0 - 2	5 - 7	5 - 7
1,1,1-Trichloroethane	0.68	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,1,2,2-Tetrachloroethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,1,2-Trichloroethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,1-Dichloroethane	0.27	26	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,1-Dichloroethene	0.33	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2,3-Trichlorobenzene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2,4-Trichlorobenzene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2,4-Trimethylbenzene	3.6	52	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2-Dibromoethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2-Dichlorobenzene	1.1	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2-Dichloroethane	0.02	3.1	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,2-Dichloropropane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,3,5-Trimethylbenzene	8.4	52	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,3-Dichlorobenzene	2.4	49	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,4-Dichlorobenzene	1.8	13	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
1,4-Dioxane	0.1	13	mg/kg		0.02 U	0.026 U	0.025 U	0.032 U	0.024 U	0.02 U
2-Butanone (MEK)	0.12	100	mg/kg		0.0051 U	0.0064 U	0.0063 U	0.0079 U	0.0061 U	0.005 U
2-Hexanone	--	--	mg/kg		0.0051 U	0.0064 U	0.0063 U	0.0079 U	0.0061 U	0.005 U
4-Methyl-2-pentanone (MIBK)	--	--	mg/kg		0.0051 U	0.0064 U	0.0063 U	0.0079 U	0.0061 U	0.005 U
Acetone	0.05	100	mg/kg		0.022	0.0077 U	0.0075 U	0.016	0.0073 U	0.006 U
Benzene	0.06	4.8	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Bromochloromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Bromodichloromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Bromoform	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Bromomethane	--	--	mg/kg		0.002 U	0.0026 U	0.0025 U	0.0032 U	0.0024 U	0.002 U
Carbon disulfide	--	--	mg/kg		0.00055 J	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Carbon tetrachloride	0.76	2.4	mg/kg		0.001 UT	0.0013 UT	0.0013 UT	0.0016 UT	0.0012 UT	0.00099 UT
Chlorobenzene	1.1	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Chloroethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Chloroform	0.37	49	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Chloromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
cis-1,2-Dichloroethene	0.25	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
cis-1,3-Dichloropropene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Cyclohexane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Dibromochloromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Dibromochloropropane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Dichlorodifluoromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U

Table 1. Summary of Volatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-27	RX-28	RX-28	RX-29	RX-29	RX-29 DUP
				Sample Date:	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	12 - 14	0 - 2	5 - 7	0 - 2	5 - 7	5 - 7
Ethylbenzene	1	41	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Freon 113	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Isopropylbenzene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
m+p-Xylene	--	--	mg/kg		0.001 U	0.0012 J	0.0013 U	0.00043 J	0.0012 U	0.00099 U
Methyl acetate	--	--	mg/kg		0.0051 U	0.0064 U	0.0063 U	0.0079 U	0.0061 U	0.005 U
Methylcyclohexane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Methylene chloride	0.05	100	mg/kg		0.002 U	0.0026 U	0.0025 U	0.0032 U	0.0024 U	0.002 U
MTBE	0.93	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
n-Butylbenzene	12	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
n-Propylbenzene	3.9	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
o-Xylene	--	--	mg/kg		0.001 U	0.00062 J	0.0013 U	0.0016 U	0.0012 U	0.00099 U
sec-Butylbenzene	11	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Styrene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
tert-Butylbenzene	5.9	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Tetrachloroethene	1.3	19	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Toluene	0.7	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
trans-1,2-Dichloroethene	0.19	100	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
trans-1,3-Dichloropropene	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Trichloroethene	0.47	21	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Trichlorofluoromethane	--	--	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Vinyl chloride	0.02	0.9	mg/kg		0.001 U	0.0013 U	0.0013 U	0.0016 U	0.0012 U	0.00099 U
Xylenes (total)	0.26	100	mg/kg		0.002 U	0.0018 J	0.0025 U	0.0032 U	0.0024 U	0.002 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	Sample Designation:	MR-9	MR-9	MR-11	MR-11	RX-1	RX-1	RX-1	RX-2	RX-2
				Sample Date:	7/26/2018	7/26/2018	7/23/2018	7/23/2018	9/26/2018	9/26/2018	9/26/2018	9/26/2018	9/26/2018
				Sample Depth (ft bls):	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	0.5 - 2.5	8 - 10	13.5 - 15.5	0.5 - 2.5	10 - 12
1,1'-Biphenyl	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.027 J	0.12 J	0.4 U	0.5 U	0.040 J
1,2,4,5-Tetrachlorobenzene	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2,3,4,6-Tetrachlorophenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2,4,5-Trichlorophenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2,4,6-Trichlorophenol	--	--	mg/kg		0.15 U	0.14 U	0.16 U	0.16 U	0.14 U	0.31 U	0.16 U	0.2 U	0.16 U
2,4-Dichlorophenol	--	--	mg/kg		0.15 U	0.14 U	0.16 U	0.16 U	0.14 U	0.31 U	0.16 U	0.2 U	0.16 U
2,4-Dimethylphenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2,4-Dinitrophenol	--	--	mg/kg		0.3 U	0.29 U	0.32 U	0.31 U	0.29 U	0.62 U	0.33 U	0.41 U	0.32 U
2,4-Dinitrotoluene	--	--	mg/kg		0.075 U	0.072 U	0.08 U	0.079 U	0.072 U	0.16 U	0.082 U	0.1 U	0.081 U
2,6-Dinitrotoluene	--	--	mg/kg		0.075 U	0.072 U	0.08 U	0.079 U	0.072 U	0.16 U	0.082 U	0.1 U	0.081 U
2-Chloronaphthalene	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2-Chlorophenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2-Methylnaphthalene	--	--	mg/kg		0.034 J	0.35 U	0.029 J	0.39 U	2.1	9.7	0.66	0.16 J	4.2
2-Methylphenol	0.33	100	mg/kg		0.37 UT	0.35 UT	0.4 UT	0.39 UT	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2-Nitroaniline	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
2-Nitrophenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
3&4-Methylphenol	0.33	100	mg/kg		0.37 UT	0.35 UT	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
3,3'-Dichlorobenzidine	--	--	mg/kg		0.15 U	0.14 U	0.16 U	0.16 U	0.14 U	0.31 U	0.16 U	0.2 U	0.16 U
3-Nitroaniline	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4,6-Dinitro-2-methylphenol	--	--	mg/kg		0.3 U	0.29 U	0.32 U	0.31 U	0.29 U	0.62 U	0.33 U	0.41 U	0.32 U
4-Bromophenyl phenyl ether	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Chloro-3-methylphenol	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Chloroaniline	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Chlorophenyl phenyl ether	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Methylphenol	0.33	100	mg/kg		0.37 UT	0.35 UT	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Nitroaniline	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
4-Nitrophenol	--	--	mg/kg		0.75 U	0.72 U	0.8 U	0.79 U	0.72 U	1.6 U	0.82 U	1 U	0.81 U
Acenaphthene	20	100	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Acenaphthylene	100	100	mg/kg		0.044 J	0.35 U	0.4 U	0.011 J	0.010 J	0.77 U	0.4 U	0.5 U	0.011 J
Acetophenone	--	--	mg/kg		0.013 J	0.35 U	0.073 J	0.39 U	0.36 U	0.77 U	0.4 U	0.10 J	0.4 U
Anthracene	100	100	mg/kg		0.045 J	0.35 U	0.023 J	0.39 U	0.014 J	0.77 U	0.4 U	0.5 U	0.0071 J
Atrazine	--	--	mg/kg		0.15 U	0.14 U	0.16 U	0.16 U	0.14 U	0.31 U	0.16 U	0.2 U	0.16 U
Benzaldehyde	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Benzo[a]anthracene	1	1	mg/kg		0.25	0.035 U	0.027 J	0.038 J	0.078	0.077 U	0.04 U	0.05 U	0.015 J
Benzo[a]pyrene	1	1	mg/kg		0.31	0.024 J	0.025 J	0.041	0.11	0.077 U	0.04 U	0.05 U	0.04 U
Benzo[b]fluoranthene	1	1	mg/kg		0.45	0.045	0.039 J	0.052	0.15	0.077 U	0.04 U	0.018 J	0.04 U
Benzo[g,h,i]perylene	100	100	mg/kg		0.17 J	0.031 J	0.11 J	0.028 J	0.10 J	0.77 U	0.4 U	0.5 U	0.4 U
Benzo[k]fluoranthene	0.8	3.9	mg/kg		0.17	0.035 U	0.015 J	0.026 J	0.054	0.077 U	0.04 U	0.05 U	0.04 U
Bis(2-chloro-1-methylethyl)ether	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Bis(2-chloroethoxy)methane	--	--	mg/kg		0.37 UT	0.35 UT	0.4 UT	0.39 UT	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Bis(2-chloroethyl) ether	--	--	mg/kg		0.037 UT	0.035 UT	0.04 UT	0.039 UT	0.036 U	0.077 U	0.04 U	0.05 U	0.04 U
Bis(2-ethylhexyl) phthalate	--	--	mg/kg		0.26 J	1	0.41	0.12 J	0.068 J	0.77 U	0.4 U	0.5 U	0.4 U

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Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-1	RX-1	RX-1	RX-2	RX-2
				Sample Date:	7/26/2018	7/26/2018	7/23/2018	7/23/2018	9/26/2018	9/26/2018	9/26/2018	9/26/2018	9/26/2018
				Sample Depth (ft bls):	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	0.5 - 2.5	8 - 10	13.5 - 15.5	0.5 - 2.5	10 - 12
Butylbenzyl phthalate	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Caprolactam	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Carbazole	--	--	mg/kg		0.028 J	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Chrysene	1	3.9	mg/kg		0.28 J	0.35 U	0.037 J	0.045 J	0.12 J	0.77 U	0.4 U	0.020 J	0.0073 J
Dibenzo[a,h]anthracene	0.33	0.33	mg/kg		0.053	0.035 U	0.04 U	0.039 U	0.026 J	0.077 U	0.04 U	0.05 U	0.04 U
Dibenzofuran	7	59	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.0077 J	0.77 U	0.4 U	0.5 U	0.4 U
Diethyl phthalate	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Dimethyl phthalate	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Di-n-butyl phthalate	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Di-n-octyl phthalate	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Fluoranthene	100	100	mg/kg		0.34 J	0.028 J	0.028 J	0.037 J	0.16 J	0.014 J	0.011 J	0.023 J	0.018 J
Fluorene	30	100	mg/kg		0.012 J	0.35 U	0.4 U	0.39 U	0.021 J	0.039 J	0.0091 J	0.014 J	0.033 J
Hexachlorobenzene	0.33	1.2	mg/kg		0.037 U	0.035 U	0.04 U	0.039 U	0.036 U	0.077 U	0.04 U	0.05 U	0.04 U
Hexachlorobutadiene	--	--	mg/kg		0.075 U	0.072 U	0.08 U	0.079 U	0.072 U	0.16 U	0.082 U	0.1 U	0.081 U
Hexachlorocyclopentadiene	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Hexachloroethane	--	--	mg/kg		0.037 U	0.035 U	0.04 U	0.039 U	0.036 U	0.077 U	0.04 U	0.05 U	0.04 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	mg/kg		0.19	0.035 U	0.079	0.033 J	0.09	0.077 U	0.04 U	0.05 U	0.04 U
Isophorone	--	--	mg/kg		0.15 U	0.14 U	0.16 U	0.16 U	0.14 U	0.31 U	0.16 U	0.2 U	0.16 U
Naphthalene	12	100	mg/kg		0.035 J	0.35 U	0.023 J	0.39 U	3.2	11	0.91	0.31 J	4.3
Nitrobenzene	--	--	mg/kg		0.037 U	0.035 U	0.04 U	0.039 U	0.036 U	0.077 U	0.04 U	0.05 U	0.04 U
n-Nitrosodi-n-propylamine	--	--	mg/kg		0.037 U	0.035 U	0.04 U	0.039 U	0.036 U	0.077 U	0.04 U	0.05 U	0.04 U
n-Nitrosodiphenylamine	--	--	mg/kg		0.37 U	0.35 U	0.4 U	0.39 U	0.36 U	0.77 U	0.0085 J	0.5 U	0.037 J
Pentachlorophenol	0.8	6.7	mg/kg		0.3 U	0.29 U	0.32 U	0.31 U	0.29 U	0.62 U	0.33 U	0.41 U	0.32 U
Phenanthrene	100	100	mg/kg		0.14 J	0.018 J	0.039 J	0.020 J	0.068 J	0.067 J	0.016 J	0.031 J	0.055 J
Phenol	0.33	100	mg/kg		0.37 UT	0.35 UT	0.4 UT	0.39 UT	0.36 U	0.77 U	0.4 U	0.5 U	0.4 U
Pyrene	100	100	mg/kg		0.4	0.35 U	0.030 J	0.037 J	0.20 J	0.022 J	0.012 J	0.026 J	0.022 J

Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	Sample Designation:	RX-3	RX-3 DUP	RX-3	RX-5	RX-5	RX-8	RX-8	RX-26	RX-26
				Sample Date:	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	01/12/2021	01/12/2021
				Sample Depth (ft bls):	0.5 - 2.5	0.5 - 2.5	10 - 12	0.5 - 2.5	5 - 7	0.5 - 2.5	8 - 10	3 - 5	5 - 7
1,1'-Biphenyl	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
1,2,4,5-Tetrachlorobenzene	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2,3,4,6-Tetrachlorophenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2,4,5-Trichlorophenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2,4,6-Trichlorophenol	--	--	mg/kg		0.2 U	0.19 U	0.15 U	0.14 U	0.15 U	0.14 U	0.16 U	0.16 U	0.15 U
2,4-Dichlorophenol	--	--	mg/kg		0.2 U	0.19 U	0.15 U	0.14 U	0.15 U	0.14 U	0.16 U	0.16 U	0.15 U
2,4-Dimethylphenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2,4-Dinitrophenol	--	--	mg/kg		0.4 U	0.39 U	0.3 U	0.29 U	0.3 U	0.29 U	0.32 U	0.32 U	0.3 U
2,4-Dinitrotoluene	--	--	mg/kg		0.1 U	0.098 U	0.075 U	0.072 U	0.075 U	0.072 U	0.08 U	0.081 U	0.076 U
2,6-Dinitrotoluene	--	--	mg/kg		0.1 U	0.098 U	0.075 U	0.072 U	0.075 U	0.072 U	0.08 U	0.081 U	0.076 U
2-Chloronaphthalene	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2-Chlorophenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2-Methylnaphthalene	--	--	mg/kg		0.036 J	0.48 U	0.37 U	0.35 U	0.37 U	0.0088 J	0.4 U	0.012 J	0.37 U
2-Methylphenol	0.33	100	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2-Nitroaniline	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
2-Nitrophenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
3&4-Methylphenol	0.33	100	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
3,3'-Dichlorobenzidine	--	--	mg/kg		0.2 U	0.19 U	0.15 U	0.14 U	0.15 U	0.14 U	0.16 U	0.16 U	0.15 U
3-Nitroaniline	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4,6-Dinitro-2-methylphenol	--	--	mg/kg		0.4 U	0.39 U	0.3 U	0.29 U	0.3 U	0.29 U	0.32 U	0.32 U	0.3 U
4-Bromophenyl phenyl ether	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Chloro-3-methylphenol	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Chloroaniline	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Chlorophenyl phenyl ether	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Methylphenol	0.33	100	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Nitroaniline	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
4-Nitrophenol	--	--	mg/kg		1 U	0.98 U	0.75 U	0.72 U	0.75 U	0.72 U	0.8 U	0.81 U	0.76 U
Acenaphthene	20	100	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.012 J
Acenaphthylene	100	100	mg/kg		0.013 J	0.023 J	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.036 J
Acetophenone	--	--	mg/kg		0.011 J	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Anthracene	100	100	mg/kg		0.014 J	0.034 J	0.37 U	0.35 U	0.37 U	0.0084 J	0.4 U	0.4 U	0.037 J
Atrazine	--	--	mg/kg		0.2 U	0.19 U	0.15 U	0.14 U	0.15 U	0.14 U	0.16 U	0.16 U	0.15 U
Benzaldehyde	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.016 J	0.4 U	0.4 U	0.37 U
Benzo[a]anthracene	1	1	mg/kg		0.072	0.12	0.027 J	0.034 J	0.037 U	0.052	0.04 U	0.078	0.21
Benzo[a]pyrene	1	1	mg/kg		0.061	0.1	0.015 J	0.034 J	0.037 U	0.044	0.04 U	0.11 T	0.24 T
Benzo[b]fluoranthene	1	1	mg/kg		0.1	0.14	0.024 J	0.049	0.037 U	0.065	0.04 U	0.12	0.32
Benzo[g,h,i]perylene	100	100	mg/kg		0.052 J	0.098 J	0.011 J	0.044 J	0.37 U	0.031 J	0.4 U	0.13 J	0.087 J
Benzo[k]fluoranthene	0.8	3.9	mg/kg		0.034 J	0.059	0.0092 J	0.018 J	0.037 U	0.024 J	0.04 U	0.044	0.12
Bis(2-chloro-1-methylethyl)ether	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Bis(2-chloroethoxy)methane	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Bis(2-chloroethyl) ether	--	--	mg/kg		0.049 UT	0.048 UT	0.037 UT	0.035 UT	0.037 U	0.035 UT	0.04 UT	0.04 U	0.037 U
Bis(2-ethylhexyl) phthalate	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.036 J	0.37 U	0.35 U	0.4 U	0.031 J	0.37 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:**	RX-3	RX-3 DUP	RX-3	RX-5	RX-5	RX-8	RX-8	RX-26	RX-26
				Sample Date:	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	01/12/2021	01/12/2021
				Sample Depth (ft bls):	0.5 - 2.5	0.5 - 2.5	10 - 12	0.5 - 2.5	5 - 7	0.5 - 2.5	8 - 10	3 - 5	5 - 7
Butylbenzyl phthalate	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Caprolactam	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Carbazole	--	--	mg/kg		0.49 U	0.026 J	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.014 J
Chrysene	1	3.9	mg/kg		0.084 J	0.11 J	0.022 J	0.038 J	0.37 U	0.063 J	0.4 U	0.084 J	0.19 J
Dibenzo[a,h]anthracene	0.33	0.33	mg/kg		0.049 U	0.023 J	0.037 U	0.035 U	0.037 U	0.035 U	0.04 U	0.03 J	0.027 J
Dibenzofuran	7	59	mg/kg		0.49 U	0.012 J	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Diethyl phthalate	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Dimethyl phthalate	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Di-n-butyl phthalate	--	--	mg/kg		0.12 J	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Di-n-octyl phthalate	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Fluoranthene	100	100	mg/kg		0.11 J	0.21 J	0.031 J	0.035 J	0.37 U	0.088 J	0.4 U	0.11 J	0.32 J
Fluorene	30	100	mg/kg		0.49 U	0.019 J	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Hexachlorobenzene	0.33	1.2	mg/kg		0.049 U	0.048 U	0.037 U	0.035 U	0.037 U	0.035 U	0.04 U	0.04 U	0.037 U
Hexachlorobutadiene	--	--	mg/kg		0.1 U	0.098 U	0.075 U	0.072 U	0.075 U	0.072 U	0.08 U	0.081 U	0.076 U
Hexachlorocyclopentadiene	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Hexachloroethane	--	--	mg/kg		0.049 UT	0.048 UT	0.037 UT	0.035 UT	0.037 U	0.035 UT	0.04 UT	0.04 U	0.037 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	mg/kg		0.054	0.095	0.037 U	0.028 J	0.037 U	0.031 J	0.04 U	0.09	0.11
Isophorone	--	--	mg/kg		0.2 U	0.19 U	0.15 U	0.14 U	0.15 U	0.14 U	0.16 U	0.16 U	0.15 U
Naphthalene	12	100	mg/kg		0.038 J	0.48 U	0.37 U	0.35 U	0.37 U	0.010 J	0.4 U	0.4 U	0.37 U
Nitrobenzene	--	--	mg/kg		0.049 UT	0.048 UT	0.037 UT	0.035 UT	0.037 U	0.035 UT	0.04 UT	0.04 U	0.037 U
n-Nitrosodi-n-propylamine	--	--	mg/kg		0.049 U	0.048 U	0.037 U	0.035 U	0.037 U	0.035 U	0.04 U	0.04 U	0.037 U
n-Nitrosodiphenylamine	--	--	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Pentachlorophenol	0.8	6.7	mg/kg		0.4 U	0.39 U	0.3 U	0.29 U	0.3 U	0.29 U	0.32 U	0.32 U	0.3 U
Phenanthrene	100	100	mg/kg		0.067 J	0.17 J	0.020 J	0.015 J	0.37 U	0.058 J	0.4 U	0.071 J	0.14 J
Phenol	0.33	100	mg/kg		0.49 U	0.48 U	0.37 U	0.35 U	0.37 U	0.35 U	0.4 U	0.4 U	0.37 U
Pyrene	100	100	mg/kg		0.11 J	0.20 J	0.033 J	0.048 J	0.37 U	0.090 J	0.4 U	0.13 J	0.32 J

Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:**	RX-27	RX-27	RX-27	RX-28	RX-28	RX-29	RX-29	RX-29 DUP
				Sample Date:	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	3 - 5	7 - 9	12 - 14	0 - 2	5 - 7	0 - 2	5 - 7	5 - 7
1,1'-Biphenyl	--	--	mg/kg		0.034 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.037 J	0.037 J
1,2,4,5-Tetrachlorobenzene	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2,3,4,6-Tetrachlorophenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2,4,5-Trichlorophenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2,4,6-Trichlorophenol	--	--	mg/kg		0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U
2,4-Dichlorophenol	--	--	mg/kg		0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U
2,4-Dimethylphenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2,4-Dinitrophenol	--	--	mg/kg		0.35 U	0.29 U	0.31 U	0.29 U	0.3 U	0.29 U	0.3 U	0.3 U
2,4-Dinitrotoluene	--	--	mg/kg		0.088 U	0.074 U	0.078 U	0.073 U	0.076 U	0.072 U	0.075 U	0.074 U
2,6-Dinitrotoluene	--	--	mg/kg		0.088 U	0.074 U	0.078 U	0.073 U	0.076 U	0.072 U	0.075 U	0.074 U
2-Chloronaphthalene	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.036 J	0.37 U
2-Chlorophenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2-Methylnaphthalene	--	--	mg/kg		0.18 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.077 J	0.1 J
2-Methylphenol	0.33	100	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2-Nitroaniline	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
2-Nitrophenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
3&4-Methylphenol	0.33	100	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
3,3'-Dichlorobenzidine	--	--	mg/kg		0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U
3-Nitroaniline	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4,6-Dinitro-2-methylphenol	--	--	mg/kg		0.35 U	0.29 U	0.31 U	0.29 U	0.3 U	0.29 U	0.3 U	0.3 U
4-Bromophenyl phenyl ether	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Chloro-3-methylphenol	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Chloroaniline	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Chlorophenyl phenyl ether	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Methylphenol	0.33	100	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Nitroaniline	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
4-Nitrophenol	--	--	mg/kg		0.88 U	0.74 U	0.78 U	0.73 U	0.76 U	0.72 U	0.75 U	0.74 U
Acenaphthene	20	100	mg/kg		0.014 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.17 J	0.31 J
Acenaphthylene	100	100	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.012 J	0.11 J	0.067 J
Acetophenone	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Anthracene	100	100	mg/kg		0.026 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.36 J	0.66
Atrazine	--	--	mg/kg		0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U
Benzaldehyde	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Benzo[a]anthracene	1	1	mg/kg		0.074	0.036 U	0.038 U	0.09	0.037 U	0.036 U	0.76	**1.5**
Benzo[a]pyrene	1	1	mg/kg		0.074 T	0.036 UT	0.038 UT	0.12 T	0.022 J	0.026 JT	0.78	**1.5**
Benzo[b]fluoranthene	1	1	mg/kg		0.11	0.036 U	0.038 U	0.14	0.041	0.033 J	1	**2**
Benzo[g,h,i]perylene	100	100	mg/kg		0.054 J	0.36 U	0.38 U	0.085 J	0.37 U	0.049 J	0.37	0.75
Benzo[k]fluoranthene	0.8	3.9	mg/kg		0.031 J	0.036 U	0.038 U	0.048	0.016 J	0.036 U	0.4	0.67
Bis(2-chloro-1-methylethyl)ether	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Bis(2-chloroethoxy)methane	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Bis(2-chloroethyl) ether	--	--	mg/kg		0.043 U	0.036 U	0.038 U	0.036 U	0.037 U	0.036 U	0.037 U	0.037 U
Bis(2-ethylhexyl) phthalate	--	--	mg/kg		0.061 J	0.36 U	0.38 U	0.041 J	0.37 U	0.11 J	0.37 U	0.37 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:**	RX-27	RX-27	RX-27	RX-28	RX-28	RX-29	RX-29	RX-29 DUP
				Sample Date:	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	3 - 5	7 - 9	12 - 14	0 - 2	5 - 7	0 - 2	5 - 7	5 - 7
Butylbenzyl phthalate	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Caprolactam	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Carbazole	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.2 J	0.38
Chrysene	1	3.9	mg/kg		0.087 J	0.36 U	0.38 U	0.077 J	0.032 J	0.066 J	0.72	**1.3**
Dibenzo[a,h]anthracene	0.33	0.33	mg/kg		0.043 U	0.036 U	0.038 U	0.024 J	0.037 U	0.036 U	0.11	0.24
Dibenzofuran	7	59	mg/kg		0.059 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.13 J	0.24 J
Diethyl phthalate	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Dimethyl phthalate	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Di-n-butyl phthalate	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Di-n-octyl phthalate	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Fluoranthene	100	100	mg/kg		0.16 J	0.36 U	0.38 U	0.12 J	0.028 J	0.018 J	1.6	3.1
Fluorene	30	100	mg/kg		0.023 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.17 J	0.31 J
Hexachlorobenzene	0.33	1.2	mg/kg		0.043 U	0.036 U	0.038 U	0.036 U	0.037 U	0.036 U	0.037 U	0.037 U
Hexachlorobutadiene	--	--	mg/kg		0.088 U	0.074 U	0.078 U	0.073 U	0.076 U	0.072 U	0.075 U	0.074 U
Hexachlorocyclopentadiene	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Hexachloroethane	--	--	mg/kg		0.043 U	0.036 U	0.038 U	0.036 U	0.037 U	0.036 U	0.037 U	0.037 U
Indeno[1,2,3-cd]pyrene	0.5	0.5	mg/kg		0.045	0.036 U	0.038 U	0.068	0.022 J	0.036 U	0.39	**0.83**
Isophorone	--	--	mg/kg		0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U
Naphthalene	12	100	mg/kg		0.17 J	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.39	0.35 J
Nitrobenzene	--	--	mg/kg		0.043 U	0.036 U	0.038 U	0.036 U	0.037 U	0.036 U	0.037 U	0.037 U
n-Nitrosodi-n-propylamine	--	--	mg/kg		0.043 U	0.036 U	0.038 U	0.036 U	0.037 U	0.036 U	0.037 U	0.037 U
n-Nitrosodiphenylamine	--	--	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Pentachlorophenol	0.8	6.7	mg/kg		0.35 U	0.29 U	0.31 U	0.29 U	0.3 U	0.29 U	0.3 U	0.3 U
Phenanthrene	100	100	mg/kg		0.11 J	0.36 U	0.38 U	0.04 J	0.02 J	0.019 J	1.5	2.8
Phenol	0.33	100	mg/kg		0.43 U	0.36 U	0.38 U	0.36 U	0.37 U	0.36 U	0.37 U	0.37 U
Pyrene	100	100	mg/kg		0.16 J	0.36 U	0.38 U	0.12 J	0.031 J	0.026 J	1.4	2.6

Table 3. Summary of Metals in Soil, 408 West 207th Street, New York, New York

Parameter	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-1	RX-1	RX-2	RX-2	RX-3
				Sample Date:	7/26/2018	7/26/2018	7/23/2018	7/23/2018	9/26/2018	9/26/2018	9/27/2018	9/27/2018	9/27/2018
				Sample Depth (ft bls):	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	0.5 - 2.5	8 - 10	0.5 - 2.5	10 - 12	0.5 - 2.5
Aluminum	--	--	mg/kg		6940	4960	5630	9740	4550	15700	8590	6580	7660
Antimony	--	--	mg/kg		0.86 U	0.84 U	1.1 U	1.1 U	0.38 J	1.1 U	0.86 J	1 U	1.3 U
Arsenic	13	16	mg/kg		10.5	1.8	6.5	3.4	**15**	0.95 J	**46.2**	2.1	7.2
Barium	350	400	mg/kg		130	53.5	89.3	306	75	34.1	150	28.8	118
Beryllium	7.2	72	mg/kg		0.36	0.14 J	0.23 J	0.40 J	0.6	0.48	1.4	0.42	0.43 J
Cadmium	2.5	4.3	mg/kg		0.84 J	0.84 U	0.41 J	1.1 U	0.93 J	1.1 U	0.77 J	1 U	1.9
Calcium	--	--	mg/kg		69800	141000	27300	21900	21700	149000	27700	9660	24300
Chromium	30	180	mg/kg		18.4	10.7	15.6	15.7	12.1	17.4	21.5	11.3	16.4
Cobalt	--	--	mg/kg		5.6	3.2	3.9	5.9	4.1	4	6.6	5.1	7
Copper	50	270	mg/kg		**58.6**	15.6	24	20.2	**55.2**	8.6	**78.2**	9.1	**192**
Cyanide	27	27	mg/kg		0.071 J	0.094 J	0.29 U	0.32	NA	NA	NA	NA	NA
Iron	--	--	mg/kg		16600	7230	10700	15000	13400	9250	24200	10800	17100
Lead	63	400	mg/kg		**134**	34	**70.4**	**95.3**	**127**	13.1	**307**	9.8	**175**
Magnesium	--	--	mg/kg		22000	64500	11900	16300	10400	87600	6870	8320	15000
Manganese	1600	2000	mg/kg		194	129	139	206	121	137	123	137	268
Mercury	0.18	0.81	mg/kg		**0.2**	0.033	0.053	0.13	**1.7**	0.026	**0.26**	0.02 U	**0.55**
Nickel	30	310	mg/kg		19.6	8.4	11.2	12.1	13	10.1	18.4	11.1	20
Potassium	--	--	mg/kg		1860	2290	941	1840	793	5930	1000	1250	1270
Selenium	3.9	180	mg/kg		0.61 J	4.2 U	0.56 J	5.6 U	1.1 J	5.4 U	3.0 J	5.1 U	0.58 J
Silver	2	180	mg/kg		0.86 U	0.84 U	1.1 U	1.1 U	0.97 U	1.1 U	1.3 U	1 U	1.3 U
Sodium	--	--	mg/kg		745	611	245	337	249	746	406	260	423
Thallium	--	--	mg/kg		0.30 J	0.34 U	0.24 J	0.16 J	0.49	0.43 U	1.8	0.13 J	0.33 J
Vanadium	--	--	mg/kg		32.7	17.8	18.1	22.3	27.2	18.8	39.1	14.7	24.9
Zinc	109	10000	mg/kg		**144**	54.8	**178**	**351**	**305**	36.8	**200**	25.7	**693**

Table 3. Summary of Metals in Soil, 408 West 207th Street, New York, New York

Parameter	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-3 DUP	RX-3	RX-5	RX-5	RX-8	RX-8	RX-26	RX-26	RX-27
				Sample Date:	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	9/27/2018	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	0.5 - 2.5	8 - 10	0.5 - 2.5	5 - 7	0.5 - 2.5	8 - 10	3 - 5	5 - 7	3 - 5
Aluminum	--	--	mg/kg		11500	8190	5610	8240	7090	7380	6130	5350	8680
Antimony	--	--	mg/kg		1.4 U	1.1 U	0.96 U	0.99 U	0.79 J	1 U	0.52 J	0.42 J	0.46 J
Arsenic	13	16	mg/kg		8.9	1.0 J	3.7	2	5.7	2.6	**15.9**	7.6	11.2
Barium	350	400	mg/kg		157	24.1	60.4	29.8	185	48.7	77.2	67.8	**532**
Beryllium	7.2	72	mg/kg		0.59	0.24 J	0.26 J	0.33 J	0.25 J	0.26 J	0.47	0.29 J	0.47 J
Cadmium	2.5	4.3	mg/kg		1.3 J	1.1 U	0.66 J	0.99 U	2.3	1 U	0.85 J	0.55 J	**3.3**
Calcium	--	--	mg/kg		40100	182000 B	63700 B	39000	38400 B	33600 B	38900	8330	51300
Chromium	30	180	mg/kg		23.7	10.7	10.4	11.1	14.2	13.2	13.3	17.1	17.3
Cobalt	--	--	mg/kg		8.9	2.3	4.2	5	4	6	6	4.2	7.3
Copper	50	270	mg/kg		**194**	7	22.7	10.8	**473**	26.1	**77.2**	43.4	**68.9**
Cyanide	27	27	mg/kg		NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	--	--	mg/kg		19600	6690	11100	11500	17100	11600	18900	11900	17700
Lead	63	400	mg/kg		**207**	23.9	52.2	4.8	**263**	30.1	**134**	**148**	**204**
Magnesium	--	--	mg/kg		22600	94300	23700	27800	14500	18600	20200	4170	16700
Manganese	1600	2000	mg/kg		355	167	185	315	177	146	132	176	229
Mercury	0.18	0.81	mg/kg		**0.76**	0.036	0.086	0.019 U	**0.22**	0.012 J	**6.4**	**1.1**	**0.44**
Nickel	30	310	mg/kg		25.2	6.1	11.6	10.9	15	12.9	16.5	12	23.9
Potassium	--	--	mg/kg		2000	2340	866	913	913	1260	1010	506	1250
Selenium	3.9	180	mg/kg		0.75 J	5.3 U	4.8 U	4.9 U	0.46 J	0.38 J	1.2 J	0.59 J	0.93 J
Silver	2	180	mg/kg		1.4 U	1.1 U	0.96 U	0.99 U	0.96 U	1 U	0.24 J	0.17 J	0.28 J
Sodium	--	--	mg/kg		631	1010	311	1050	314	429	352	120	1010
Thallium	--	--	mg/kg		0.42 J	0.42 U	0.38 U	0.39 U	0.13 J	0.41 U	1.4	0.31 J	0.36 J
Vanadium	--	--	mg/kg		35.7	11.5	21.1	14.3	20.4	16.1	41.7	23.5	44.2
Zinc	109	10000	mg/kg		**718**	38.2	75.5	33.9	**898**	**138**	**163**	**266**	**575**

Table 3. Summary of Metals in Soil, 408 West 207th Street, New York, New York

Parameter	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:**	RX-27	RX-27	RX-28	RX-28	RX-29	RX-29	RX-29 DUP
				Sample Date:	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	7 - 9	12 - 14	0 - 2	5 - 7	0 - 2	5 - 7	5 - 7
Aluminum	--	--	mg/kg		9080	579	4140	11500	1670	6370	10000
Antimony	--	--	mg/kg		0.94 U	0.94 U	0.97 U	0.98 U	0.91 U	0.17 J	0.26 J
Arsenic	13	16	mg/kg		2.2	0.15 J	3.7	2.4	5	2.9	5.5
Barium	350	400	mg/kg		41.4	3.3	39.2	51.2	18.8	51.7	65.5
Beryllium	7.2	72	mg/kg		0.34 J	0.37 U	0.18 J	0.52	0.15 J	0.23 J	0.36
Cadmium	2.5	4.3	mg/kg		0.18 J	0.94 U	0.19 J	0.11 J	0.58 J	0.63 J	0.64 J
Calcium	--	--	mg/kg		23900	257000	64200	9120	92400	20000	19100
Chromium	30	180	mg/kg		16.8	1.1 J	6.6	15.6	4.3	10.5	19.6
Cobalt	--	--	mg/kg		5.3	0.3 J	3	6.7	1.8	5.1	6.4
Copper	50	270	mg/kg		19.4	0.28 J	11.7	16.3	15.6	33.3	24
Cyanide	27	27	mg/kg		NA	NA	NA	NA	NA	NA	NA
Iron	--	--	mg/kg		13000	1910	7930	15200	4970	11400	16100
Lead	63	400	mg/kg		26.8	1.7	39.6	8.2	15.5	42	**74**
Magnesium	--	--	mg/kg		19100	151000	16100	13000	42400	3930	5390
Manganese	1600	2000	mg/kg		217	97.3	129	299	85.8	158	211
Mercury	0.18	0.81	mg/kg		0.024	0.034	0.075	0.018	0.071	0.17	0.15
Nickel	30	310	mg/kg		13	0.77 J	11	13.5	9.7	15.6	16.4
Potassium	--	--	mg/kg		1090	457	646	598	466	918	994
Selenium	3.9	180	mg/kg		0.18 J	1.2 U	0.23 J	0.21 J	1.1 U	0.2 J	0.27 J
Silver	2	180	mg/kg		0.94 U	0.94 U	0.97 U	0.98 U	0.91 U	0.93 U	0.1 J
Sodium	--	--	mg/kg		1210	74.6 J	197	747	146	165	181
Thallium	--	--	mg/kg		0.11 J	0.37 U	0.052 J	0.096 J	0.071 J	0.077 J	0.12 J
Vanadium	--	--	mg/kg		20.2	2.3	38.1	28.5	32.7	19	29.6
Zinc	109	10000	mg/kg		47.7	3.2 J	42.6	53.4	46.1	**191**	**116**

Table 4. Summary of Polychlorinated Biphenyls in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-12	RX-26	RX-26	RX-27	RX-27	RX-27	RX-28
				Sample Date:	7/26/2018	7/26/2018	7/23/2018	7/23/2018	10/1/2018	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
				Sample Depth (ft bls):	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	2.5 - 4.0	3 - 5	5 - 7	3 - 5	7 - 9	12 - 14	0 - 2
Aroclor-1016	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1221	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1232	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1242	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.26	0.074 U	0.078 U	0.073 U
Aroclor-1248	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1254	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1260	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.13	0.074 U	0.078 U	0.073 U
Aroclor-1262	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
Aroclor-1268	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U
PCBs, Total	0.1	1	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.072 U	0.081 U	0.076 U	**0.39**	0.074 U	0.078 U	0.073 U

Table 4. Summary of Polychlorinated Biphenyls in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDE Part 375 UUSCO	NYSDE Part 376 RRSCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	RX-28 01/12/2021 5 - 7	RX-29 01/12/2021 0 - 2	RX-29 01/12/2021 5 - 7	RX-29 DUP 01/12/2021 5 - 7
Aroclor-1016	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1221	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1232	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1242	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1248	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1254	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1260	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1262	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
Aroclor-1268	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U
PCBs, Total	0.1	1	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U

Table 5. Summary of Pesticides and Herbicides in Soil, 408 West 207th Street, New York, New York

Parameter	NYSDEC	NYSDEC		**Sample Designation:**	MR-9	MR-9	MR-11	MR-11	RX-26	RX-26	RX-27	RX-27	RX-27	RX-28
Parameter	Part 375	Part 376	Units	**Sample Date:**	7/26/2018	7/26/2018	7/23/2018	7/23/2018	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021	01/12/2021
(Concentrations in mg/kg)	UUSCO	RRSCO		**Sample Depth (ft bls):**	1 - 1.5	8 - 9	0.25 - 0.75	5 - 6.5	3 - 5	5 - 7	3 - 5	7 - 9	12 - 14	0 - 2
2,4,5-T	--	--	mg/kg		0.037 U	0.036 U	0.04 U	0.039 U	NA	NA	NA	NA	NA	NA
2,4,5-TP	3.8	100	mg/kg		0.037 U	0.036 U	0.04 U	0.039 U	NA	NA	NA	NA	NA	NA
2,4-D	--	--	mg/kg		0.037 U	0.036 U	0.04 U	0.039 U	NA	NA	NA	NA	NA	NA
4,4'-DDD	0.0033	13	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
4,4'-DDE	0.0033	8.9	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
4,4'-DDT	0.0033	7.9	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Aldrin	0.005	0.097	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
alpha-BHC	0.02	0.48	mg/kg		0.0022 U	0.0021 U	0.0024 U	0.0023 U	0.0024 U	0.0023 U	0.0026 U	0.0022 U	0.0023 U	0.0022 U
alpha-Chlordane	0.094	4.2	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
beta-BHC	0.036	0.36	mg/kg		0.0022 U	0.0021 U	0.0024 U	0.0023 U	0.0024 U	0.0023 U	0.0026 U	0.0022 U	0.0023 U	0.0022 U
Chlordane	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
delta-BHC	0.04	100	mg/kg		0.0022 U	0.0021 U	0.0024 U	0.0023 U	0.0024 U	0.0023 U	0.0026 U	0.0022 U	0.0023 U	0.0022 U
Dieldrin	0.005	0.2	mg/kg		0.0022 U	0.0021 U	0.0024 U	0.0023 U	0.0024 U	0.0023 U	0.0026 U	0.0022 U	0.0023 U	0.0022 U
Endosulfan I	2.4	24	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Endosulfan II	2.4	24	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Endosulfan sulfate	2.4	24	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Endrin aldehyde	--	--	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Endrin ketone	--	--	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Endrin	0.014	11	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
gamma-BHC (Lindane)	0.1	1.3	mg/kg		0.0022 U	0.0021 U	0.0024 U	0.0023 U	0.0024 U	0.0023 U	0.0026 U	0.0022 U	0.0023 U	0.0022 U
Heptachlor epoxide	--	--	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Heptachlor	0.042	2.1	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Methoxychlor	--	--	mg/kg		0.0075 U	0.0072 U	0.0081 U	0.0079 U	0.0081 U	0.0076 U	0.0088 U	0.0074 U	0.0078 U	0.0073 U
Toxaphene	--	--	mg/kg		0.075 U	0.072 U	0.081 U	0.079 U	0.081 U	0.076 U	0.088 U	0.074 U	0.078 U	0.073 U

Table 5. Summary of Pesticides and Herbicides in Soil, 408 West 207th Street, New York, New York

Parameter (Concentrations in mg/kg)	NYSDEC Part 375 UUSCO	NYSDEC Part 376 RRSCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	RX-28 01/12/2021 5 - 7	RX-29 01/12/2021 0 - 2	RX-29 01/12/2021 5 - 7	RX-29 DUP 01/12/2021 5 - 7
2,4,5-T	--	--	mg/kg		NA	NA	NA	NA
2,4,5-TP	3.8	100	mg/kg		NA	NA	NA	NA
2,4-D	--	--	mg/kg		NA	NA	NA	NA
4,4'-DDD	0.0033	13	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
4,4'-DDE	0.0033	8.9	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
4,4'-DDT	0.0033	7.9	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Aldrin	0.005	0.097	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
alpha-BHC	0.02	0.48	mg/kg		0.0023 U	0.0022 U	0.0022 U	0.0022 U
alpha-Chlordane	0.094	4.2	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
beta-BHC	0.036	0.36	mg/kg		0.0023 U	0.0022 U	0.0022 U	0.0022 U
Chlordane	--	--	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
delta-BHC	0.04	100	mg/kg		0.0023 U	0.0022 U	0.0022 U	0.0022 U
Dieldrin	0.005	0.2	mg/kg		0.0023 U	0.0022 U	0.0022 U	0.0022 U
Endosulfan I	2.4	24	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Endosulfan II	2.4	24	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Endosulfan sulfate	2.4	24	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Endrin aldehyde	--	--	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Endrin ketone	--	--	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Endrin	0.014	11	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
gamma-BHC (Lindane)	0.1	1.3	mg/kg		0.0023 U	0.0022 U	0.0022 U	0.0022 U
Heptachlor epoxide	--	--	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Heptachlor	0.042	2.1	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Methoxychlor	--	--	mg/kg		0.0076 U	0.0072 U	0.0075 U	0.0074 U
Toxaphene	--	--	mg/kg		0.076 U	0.072 U	0.075 U	0.074 U

Table 6. Summary of Volatile Organic Compounds in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MR-9	RX-2
		Sample Date:	8/2/2018	9/27/2018
1,1,1-Trichloroethane	5		1 U	1 U
1,1,2,2-Tetrachloroethane	5		1 U	1 UT
1,1,2-Trichloroethane	1		1 U	1 U
1,1-Dichloroethane	5		1 U	1 U
1,1-Dichloroethene	5		1 U	1 U
1,2,3-Trichlorobenzene	5		1 U	1 U
1,2,4-Trichlorobenzene	5		1 U	1 U
1,2-Dibromoethane	--		1 U	1 U
1,2-Dichlorobenzene	3		1 U	1 U
1,2-Dichloroethane	0.6		1 U	1 U
1,2-Dichloropropane	1		1 U	1 U
1,3-Dichlorobenzene	3		1 U	1 U
1,4-Dichlorobenzene	3		1 U	1 U
1,4-Dioxane	--		50 U	50 U
2-Butanone (MEK)	50		5 U	14
2-Hexanone	50		5 U	5 U
4-Methyl-2-pentanone (MIBK)	--		5 U	5 U
Acetone	50		5 U	21
Benzene	1		1 U	**54 T**
Bromochloromethane	5		1 U	1 U
Bromodichloromethane	50		1 U	1 U
Bromoform	50		1 U	1 U
Bromomethane	5		1 U	1 U
Carbon disulfide	60		1 U	1 U
Carbon tetrachloride	5		1 U	1 U
Chlorobenzene	5		1 U	1 U
Chloroethane	5		1 U	0.97 J
Chloroform	7		**8.2**	1 U
Chloromethane	--		1 U	1 U
cis-1,2-Dichloroethene	5		1 U	1 U
cis-1,3-Dichloropropene	5		1 U	1 U
Cyclohexane	--		1 U	36
Dibromochloromethane	50		1 U	1 U
Dibromochloropropane	0.04		1 U	1 U
Dichlorodifluoromethane	5		1 U	1 U
Ethylbenzene	5		1 U	**28**
Freon 113	--		1 U	1 U

Table 6. Summary of Volatile Organic Compounds in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MR-9	RX-2
		Sample Date:	8/2/2018	9/27/2018
Isopropylbenzene	5		1 U	**280**
m+p-Xylene	5		1 U	**7.1**
Methyl acetate	--		5 U	5 U
Methylcyclohexane	--		1 U	72
Methylene chloride	5		0.52 J	1 U
MTBE	10		1 U	1 U
o-Xylene	5		1 U	1.5
Styrene	5		1 U	1 U
Tetrachloroethene	5		1 U	1 U
Toluene	5		1 U	**5.5**
trans-1,2-Dichloroethene	5		1 U	1 U
trans-1,3-Dichloropropene	--		1 U	1 U
Trichloroethene	5		1 U	1 U
Trichlorofluoromethane	5		1 U	1 U
Vinyl chloride	2		1 U	1 U

Table 7. Summary of Semivolatile Organic Compounds in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	Sample Designation: / Sample Date:	MR-9 8/2/2018	RX-2 9/27/2018
1,1'-Biphenyl	--		10 U	10 U
1,2,4,5-Tetrachlorobenzene	--		10 U	10 U
2,3,4,6-Tetrachlorophenol	--		10 U	10 U
2,4,5-Trichlorophenol	--		10 U	10 U
2,4,6-Trichlorophenol	--		10 U	10 U
2,4-Dichlorophenol	5		10 U	10 UT
2,4-Dimethylphenol	50		10 U	10 U
2,4-Dinitrophenol	10		20 U	20 U
2,4-Dinitrotoluene	5		2 U	2 U
2,6-Dinitrotoluene	5		2 U	2 U
2-Chloronaphthalene	10		10 U	10 U
2-Chlorophenol	--		10 U	10 U
2-Methylnaphthalene	--		10 U	62
2-Methylphenol	--		10 U	10 U
2-Nitroaniline	5		10 U	10 U
2-Nitrophenol	--		10 U	10 UT
3,3'-Dichlorobenzidine	5		10 UT	10 U
3-Nitroaniline	5		10 U	10 U
4,6-Dinitro-2-methylphenol	--		20 U	20 U
4-Bromophenyl phenyl ether	--		10 U	10 U
4-Chloro-3-methylphenol	--		10 U	10 U
4-Chloroaniline	5		10 UT	10 U
4-Chlorophenyl phenyl ether	--		10 U	10 U
4-Methylphenol	--		10 U	10 U
4-Nitroaniline	5		10 U	10 U
4-Nitrophenol	--		20 U	20 UT
Acenaphthene	20		10 U	10 U
Acenaphthylene	20		10 U	10 UT
Acetophenone	--		10 U	10 U
Anthracene	50		10 U	10 U
Atrazine	--		2 U	2 UT
Benzaldehyde	--		10 UT	10 U
Benzo[a]anthracene	0.002		1 U	1 U
Benzo[a]pyrene	0		1 U	1 U
Benzo[b]fluoranthene	0.002		2 U	2 U
Benzo[g,h,i]perylene	--		10 U	10 U
Benzo[k]fluoranthene	0.002		1 U	1 U

Table 7. Summary of Semivolatile Organic Compounds in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MR-9	RX-2
		Sample Date:	8/2/2018	9/27/2018
Bis(2-chloro-1-methylethyl)ether	5		10 U	10 U
Bis(2-chloroethoxy)methane	5		10 U	10 U
Bis(2-chloroethyl) ether	--		1 U	1 U
Bis(2-ethylhexyl) phthalate	5		2 U	2 U
Butylbenzyl phthalate	50		10 U	10 U
Caprolactam	--		10 UT	10 UT
Carbazole	--		10 U	10 U
Chrysene	0.002		2 U	2 U
Dibenzo[a,h]anthracene	--		1 U	1 U
Dibenzofuran	--		10 U	10 U
Diethyl phthalate	50		10 U	10 U
Dimethyl phthalate	50		10 U	10 U
Di-n-butyl phthalate	50		10 U	10 U
Di-n-octyl phthalate	--		10 U	10 UT
Fluoranthene	50		10 U	10 U
Fluorene	50		10 U	10 U
Hexachlorobenzene	0.04		1 U	1 U
Hexachlorobutadiene	0.5		1 U	1 U
Hexachlorocyclopentadiene	5		10 U	10 U
Hexachloroethane	5		2 U	2 U
Indeno[1,2,3-cd]pyrene	0.002		2 U	2 U
Isophorone	50		10 U	10 UT
Naphthalene	10		10 U	**90**
Nitrobenzene	0.4		1 U	1 U
n-Nitrosodi-n-propylamine	--		1 U	1 U
n-Nitrosodiphenylamine	50		10 U	10 U
Pentachlorophenol	1		20 U	20 U
Phenanthrene	50		10 U	10 U
Phenol	1		10 U	10 UT
Pyrene	50		10 U	10 U

Table 8. Summary of Metals in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:** **Sample Date:**	MR-9 8/2/2018	RX-2 9/27/2018
Aluminum	--		149	8870
Antimony	3		2.1	1.3 J
Arsenic	25		2.2	16.1
Barium	1000		182	258
Beryllium	3		0.8 U	0.86
Cadmium	5		2 U	2 U
Calcium	--		101000	173000
Chromium	50		4 U	23.4
Cobalt	--		4 U	5.4
Copper	200		2.4 J	41.2
Cyanide	200		5.5 BJ	NA
Iron	300		**857**	**19400**
Lead	25		0.73 J	**209**
Magnesium	35000		**40500**	**46900**
Manganese	300		**424**	**726**
Mercury	0.7		0.2 U	0.2 U
Nickel	100		2.9 J	15.1
Potassium	--		34900	28500
Selenium	10		**11.7**	10 U
Silver	50		2 U	2 U
Sodium	20000		**615000**	**335000**
Thallium	0.5		0.8 U	0.38 J
Vanadium	--		1.4 J	20.8
Zinc	2000		6.4 J	101

Table 9. Summary of Polychlorinated Biphenyls in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:** **Sample Date:**	MR-9 8/2/2018
Aroclor-1016	--		0.4 U
Aroclor-1221	--		0.4 U
Aroclor-1232	--		0.4 U
Aroclor-1242	--		0.4 U
Aroclor-1248	--		0.4 U
Aroclor-1254	--		0.4 U
Aroclor-1260	--		0.4 U
Aroclor-1262	--		0.4 U
Aroclor-1268	--		0.4 U
PCBs, Total	0.09		0.4 U

Table 10. Summary of Pesticides and Herbicides in Groundwater, 408 West 207th Street, New York, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:** **Sample Date:**	MR-9 8/2/2018
2,4,5-T	--		1.2 U
2,4,5-TP	0.26		1.2 U
2,4-D	50		1.2 U
4,4'-DDD	0.3		0.02 U
4,4'-DDE	0.2		0.02 U
4,4'-DDT	0.2		0.02 U
Aldrin	0		0.02 U
alpha-BHC	--		0.02 U
beta-BHC	--		0.02 U
Chlordane	0.05		0.5 U
delta-BHC	--		0.02 U
Dieldrin	0.004		0.02 U
Endosulfan I	--		0.02 U
Endosulfan II	--		0.02 U
Endosulfan sulfate	--		0.02 U
Endrin aldehyde	5		0.02 U
Endrin ketone	--		0.02 U
Endrin	0		0.02 U
gamma-BHC (Lindane)	--		0.02 U
Heptachlor epoxide	0.03		0.02 U
Heptachlor	0.04		0.02 U
Methoxychlor	35		0.02 U
Toxaphene	0.06		0.5 U

Table 11. Summary of Volatile Organic Compounds in Soil Vapor, 408 West 207th Street, New York, New York

Parameter	**Sample Designation:**	V-3	V-5
(Concentrations in ug/m^3)	**Sample Date:**	8/2/2018	8/2/2018
1,1,1-Trichloroethane		13000 U	**6.0 J**
1,1,2,2-Tetrachloroethane		16000 U	19 U
1,1,2-Trichloroethane		13000 U	15 U
1,1-Dichloroethane		9300 U	11 U
1,1-Dichloroethene		1600 U	1.9 U
1,2,4-Trichlorobenzene		43000 U	52 U
1,2,4-Trimethylbenzene		11000 U	14 U
1,2-Dibromoethane		18000 U	22 U
1,2-Dichlorobenzene		14000 U	17 U
1,2-Dichloroethane		9300 U	11 U
1,2-Dichloroethene (total)		18000 U	22 U
1,2-Dichloropropane		11000 U	13 U
1,3,5-Trimethylbenzene		11000 U	14 U
1,3-Butadiene		5100 U	**13**
1,3-Dichlorobenzene		14000 U	17 U
1,4-Dichlorobenzene		14000 U	17 U
1,4-Dioxane		210000 U	250 U
2-Butanone (MEK)		17000 U	**11 J**
2-Hexanone		24000 U	29 U
3-Chloropropene		18000 U	22 U
4-Ethyltoluene		11000 U	14 U
4-Methyl-2-pentanone (MIBK)		24000 U	29 U
Acetone		140000 U	170 U
Benzene		**5400 J**	**8.6 J**
Benzyl chloride		12000 U	14 U
Bromodichloromethane		15000 U	19 U
Bromoethene		10000 U	12 U
Bromoform		24000 U	29 U
Bromomethane		8900 U	11 U
Butane		**24000**	**170**
Carbon disulfide		18000 U	**21 J**
Carbon tetrachloride		2500 U	3.1 U
Chlorobenzene		11000 U	13 U
Chlorodifluoromethane		20000 U	25 U
Chloroethane		15000 U	18 U
Chloroform		11000 U	**27**
Chloromethane		12000 U	14 U
cis-1,2-Dichloroethene		1600 U	1.9 U
cis-1,3-Dichloropropene		10000 U	13 U

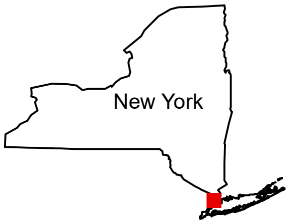
Table 11. Summary of Volatile Organic Compounds in Soil Vapor, 408 West 207th Street, New York, New York

Parameter (Concentrations in ug/m^3)	**Sample Designation:** **Sample Date:**	V-3 8/2/2018	V-5 8/2/2018
Cyclohexane		**11000**	**14**
Dibromochloromethane		20000 U	24 U
Dichlorodifluoromethane		28000 U	35 U
Ethylbenzene		10000 U	12 U
Freon 113		18000 U	21 U
Freon 114		16000 U	20 U
Hexachlorobutadiene		24000 U	30 U
Isooctane		**1100000**	**39**
ISOPROPANOL		140000 U	170 U
Isopropylbenzene		**5300 J**	14 U
m+p-Xylene		25000 U	**4.9 J**
Methyl Methacrylate		24000 U	29 U
Methylene chloride		20000 U	24 U
MTBE		8300 U	10 U
Naphthalene		30000 U	37 U
n-Butylbenzene		13000 U	15 U
N-HEPTANE		**24000**	**160**
n-Hexane		**20000**	**84**
n-Propylbenzene		**4500 J**	14 U
o-Chlorotoluene		12000 U	14 U
o-Xylene		10000 U	12 U
p-Isopropyltoluene		13000 U	15 U
sec-Butylbenzene		13000 U	15 U
Styrene		9800 U	12 U
t-Butyl Alcohol		170000 U	210 U
tert-Butylbenzene		13000 U	15 U
Tetrachloroethene		16000 U	**26**
Tetrahydrofuran		170000 U	210 U
Toluene		8700 U	**1300**
trans-1,2-Dichloroethene		9100 U	11 U
trans-1,3-Dichloropropene		10000 U	13 U
Trichloroethene		2200 U	2.6 U
Trichlorofluoromethane		13000 U	16 U
Vinyl chloride		1000 U	1.3 U
Xylenes (total)		35000 U	43 U

FIGURES

1. Site Location Map
2. Soil Sample Locations and Exceedances
3. Groundwater Sample Locations and Exceedances
4. Soil Vapor Sample Locations and Detections
5. Proposed Remedial Investigation Sampling Locations
6. Proposed IRM Activity Locations

QUADRANGLE LOCATION



N

1,000 0 1,000'

Title:

SITE LOCATION MAP

408 WEST 207TH STREET
MANHATTAN, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.
Date: 05/05/21
Prepared by: M.S.R.
Scale: AS SHOWN
Project Mgr: V.S.
Project: 2477.0008Y000
File: 2477.0008Y113.1.mxd

FIGURE
1

V:\GIS\PROJECTS\2477Y\0008Y\113\2477.0008Y113.1.MXD

RX-26	01/12/2021	01/12/2021
Depth (ft bls)	3 - 5	5 - 7
VOCs	NE	NE
SVOCs	NE	NE
Metals		
Arsenic	**15.9**	NE
Copper	**77.2**	NE
Lead	**134**	**148**
Mercury	**6.4**	**1.1**
Zinc	**163**	**266**
PCBs, Total	ND	ND
Pesticides	NE	NE

RX-1	9/26/18	9/26/18	9/26/18	9/26/18
Depth (ft bls)	0.5 - 2.5	5.0 - 7.0	8.0 - 10.0	13.5 - 15.5
VOCs				
Benzene	**0.45**	ND	ND	ND
Ethylbenzene	**6.4**	NE	**1.1**	NE
n-Butylbenzene	NE	NE	**14**	NE
n-Propylbenzene	**4.4**	NE	**19**	NE
1,2,4-Trimethylbenzene	NE	NE	**82**	NE
Xylenes (total)	**2.7**	NE	NE	ND
SVOCs	NE	NS	NE	NE
Metals				
Arsenic	**15**	NS	NE	NS
Copper	**55.2**	NS	NE	NS
Lead	**127**	NS	NE	NS
Mercury	**1.7**	NS	NE	NS
Zinc	**305**	NS	NE	NS

B-102	7/9/11
Depth (ft bls)	6.5 - 7.0
VOCs	
n-Butylbenzene	**59.1**
sec-Butylbenzene	**20.7**
Ethylbenzene	**15.4**
Naphthalene	**140**
n-Propylbenzene	**111**
1,2,4-Trimethylbenzene	**184**
1,3,5-Trimethylbenzene	**60.5**
SVOCs	
Naphthalene	**56.3**
Metals	
Cadmium	**2.67**
Chromium	**37.1**
Lead	**175**

RX-2	9/26/18	9/26/18
Depth (ft bls)	0.5 - 2.5	10 - 12
VOCs		
Ethylbenzene	NE	**1.1**
n-Butylbenzene	NE	**16**
n-Propylbenzene	NE	**43**
SVOCs	NE	NE
Metals		
Arsenic	**46.2**	NE
Copper	**78.2**	NE
Lead	**307**	NE
Mercury	**0.26**	ND
Zinc	**200**	NE

Parameter	NYSDEC Part 375 UUSCOs	NYSDEC Part 375 RRSCOs
(Concentrations in mg/kg)	(mg/kg)	(mg/kg)
VOCs		
Benzene	**0.06**	**4.8**
Ethylbenzene	**1**	**41**
n-Butylbenzene	**12**	**100**
n-Propylbenzene	**3.9**	**100**
1,2,4-Trimethylbenzene	**3.6**	**52**
1,3,5-Trimethylbenzene	**8.4**	**52**
Xylenes (total)	**0.26**	**100**
SVOCs		
Naphthalene	**12**	**100**
Benzo(A)Anthracene	**1**	**1**
Benzo(A)Pyrene	**1**	**1**
Benzo(B)Fluoranthene	**1**	**1**
Chrysene	**1**	**3.9**
Indeno(1,2,3-C,D)Pyrene	**0.5**	**0.5**
Metals		
Arsenic	**13**	**16**
Barium	**350**	**400**
Cadmium	**2.5**	**4.3**
Chromium	**30**	**180**
Copper	**50**	**270**
Lead	**63**	**400**
Mercury	**0.18**	**0.81**
Zinc	**109**	**10000**
PCBs, Total	**0.1**	**1**
Pesticides	**NE**	**NE**

RX-3	9/27/18	**9/27/18**	9/27/18
Depth (ft bls)	0.5 - 2.5	**0.5 - 2.5 DUP**	8 - 10
VOCs	NE	NE	NE
SVOCs	NE	NE	NE
Metals			
Copper	**192**	**194**	NE
Lead	**175**	**207**	NE
Mercury	**0.55**	**0.76**	NE
Zinc	**693**	**718**	NE

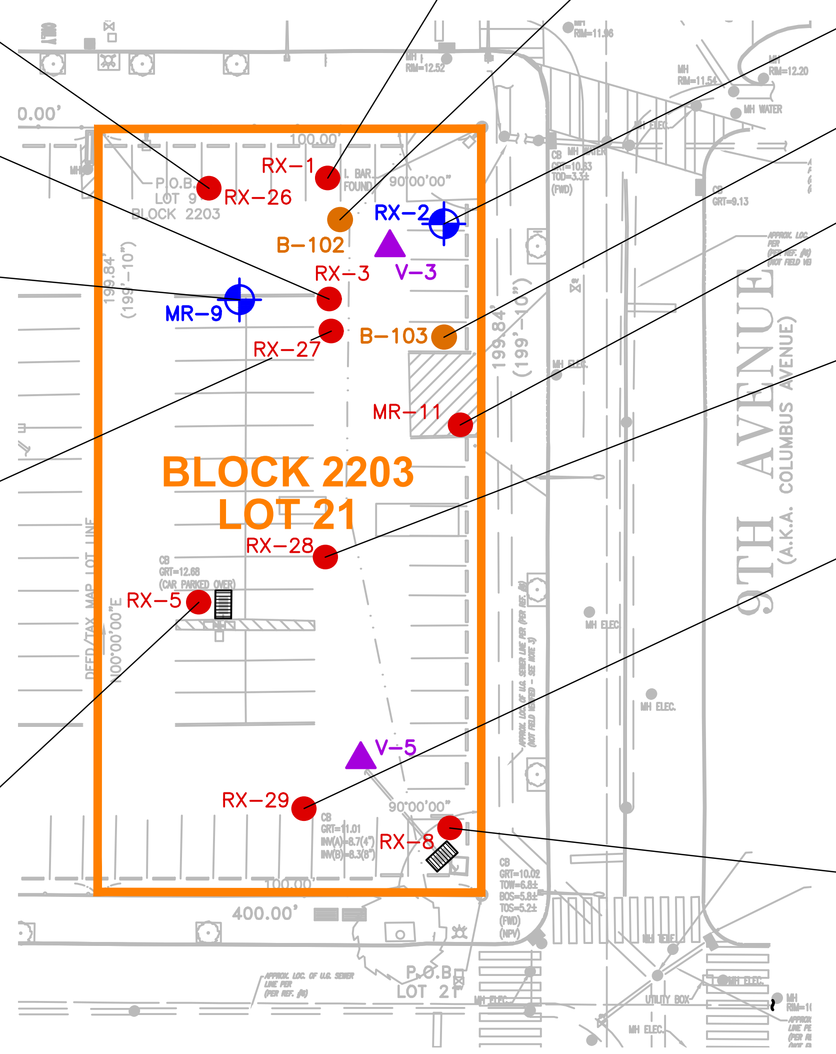
B-103	7/9/11
Depth (ft bls)	6.5-7.3
VOCs	NE
SVOCs	NE
Metals	NE

MR-11	7/23/18	**7/23/18**
Depth (ft bls)	0.25 - 0.75	**5 - 6.5**
VOCs	NE	NE
SVOCs	NE	NE
Metals		
Lead	**70.4**	**95.3**
Zinc	**178**	**351**

MR-9	7/26/18	7/26/18
Depth (ft bls)	1 - 1.5	8 - 9
VOCs	NE	NE
SVOCs	NE	NE
Metals		
Copper	**58.6**	NE
Lead	**134**	NE
Mercury	**0.2**	NE
Zinc	**144**	NE

RX-28	01/12/2021	01/12/2021
Depth (ft bls)	0 - 2	5 - 7
VOCs	NE	NE
SVOCs	NE	NE
Metals	NE	NE
PCBs, Total	ND	ND
Pesticides	NE	NE

RX-27	01/12/2021	01/12/2021	01/12/2021
Depth (ft bls)	3 - 5	7 - 9	12 - 14
VOCs	NE	NE	NE
SVOCs	NE	NE	NE
Metals			
Barium	**532**	NE	NE
Cadmium	**3.3**	NE	ND
Copper	**68.9**	NE	NE
Lead	**204**	NE	NE
Mercury	**0.44**	NE	NE
Zinc	**575**	NE	NE
PCBs, Total			
Polychlorinated Biphenyl (PCBs)	**0.39**	ND	ND
Pesticides	NE	NE	NE



RX-29	01/12/2021	01/12/2021	01/12/2021
Depth (ft bls)	0 - 2	5 - 7	5 - 7 DUP
VOCs	NE	NE	NE
SVOCs			
Benzo(A)Anthracene	ND	NE	**1.5**
Benzo(A)Pyrene	NE	NE	**1.5**
Benzo(B)Fluoranthene	NE	NE	**2**
Chrysene	NE	NE	**1.3**
Indeno(1,2,3-C,D)Pyrene	ND	NE	**0.83**
Metals			
Lead	NE	NE	**74**
Zinc	NE	**191**	**116**
PCBs, Total	ND	ND	ND
Pesticides	NE	NE	NE

RX-5	9/27/18	9/27/18
Depth (ft bls)	0.5 - 2.5	5 - 7
VOCs	NE	NE
SVOCs	NE	NE
Metals	NE	NE

RX-8	9/27/18	9/27/18
Depth (ft bls)	0.5 - 2.5	8 - 10
VOCs	NE	NE
SVOCs	NE	NE
Metals		
Copper	**473**	NE
Lead	**263**	NE
Mercury	**0.22**	NE
Zinc	**898**	**138**

mg/kg – MILLIGRAMS PER KILOGRAM
UUSCOs – NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES
RRSCOs – NYSDEC PART 375 RESTRICTED RESIDENTIAL SOIL CLEANUP OBJECTIVES
NYSDEC – NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
-- – NO NYSDEC PART 375 SOIL CLEANUP OBJECTIVES AVAILABLE
DUP – DUPLICATE SAMPLE
VOCs – VOLATILE ORGANIC COMPOUNDS
SVOCs – SEMIVOLATILE ORGANIC COMPOUNDS
NE – NO EXCEEDANCE
ND – NO DETECTION
NS – NOT SAMPLED
ft bls – FEET BELOW LAND SURFACE

50' 0 50'

LEGEND

MR-12 ⌖	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION
B-101 ●	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION (INSTALLED BY STANTEC, 2011)
RX-18 ●	SOIL BORING LOCATION AND DESIGNATION (INSTALLED BY ROUX, 2018 AND 2021)
V-4 ▲	SOIL VAPOR SAMPLING LOCATION AND DESIGNATION
▥	CATCH BASIN
—	SITE

TYPICAL DATA BOX INFORMATION

SAMPLE ID# →
ANALYTES

RX-5	9/27/18	9/27/18
Depth (ft bls)	0.5 - 2.5	5 - 7
VOCs	NE	NE
SVOCs	NE	NE
Metals	NE	NE

← SAMPLE DATE
← SAMPLE DEPTH (FT)
CONCENTRATION (mg/kg)

RESULTS SHOWN IN **BOLD** TYPE EXCEED NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES

RESULTS WITH GRAY BACKGROUND EXCEED NYSDEC PART 375 RESTRICTED RESIDENTIAL SOIL CLEANUP OBJECTIVES

Title:

SOIL SAMPLE LOCATIONS AND EXCEEDANCES

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:
HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 16MAR21	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	2
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y113.02.DWG		

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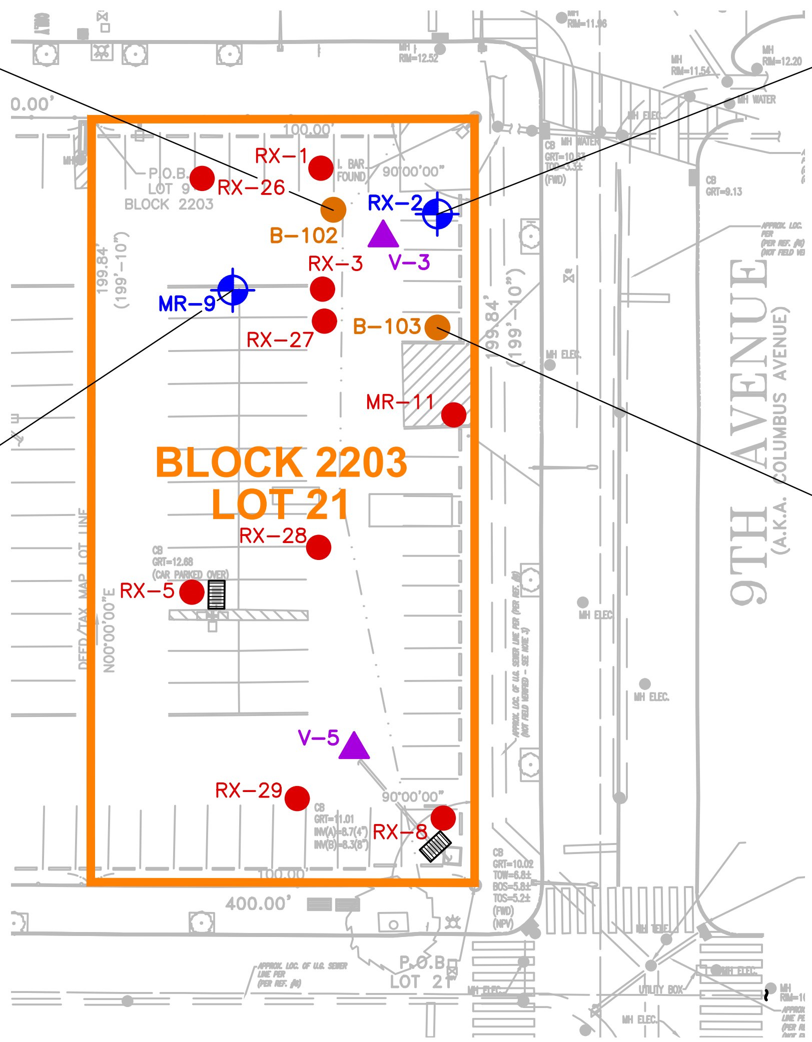
B-102	7/19/11
VOCs	
Benzene	**3.6**
n-Butylbenzene	**54.2**
tert-butylbenzene	**30.3**
Ethylbenzene	**46.6**
Isopropylbenzene	**129 E**
4-Isopropyltoluene	**10**
Naphthalene	**182 E**
n-Propylbenzene	**311 E**
1,2,4-Trimethylbenzene	**172 E**
1,3,5-Trimethylbenzene	**51.3**
m+p-Xylene	**10.5**
SVOCs	
Naphthalene	**52.6**
Metals	NE



RX-2	9/27/18
VOCs	
Benzene	**54 T**
Ethylbenzene	**28**
Isopropylbenzene	**280**
m+p-Xylene	**7.1**
Toluene	**5.5**
SVOCs	
Naphthalene	**90**
Metals	
Iron	**19400**
Lead	**209**
Magnesium	**46900**
Manganese	**726**
Sodium	**335000**

MR-9	8/2/18
VOCs	
Chloroform	**8.2**
SVOCs	NE
Metals	
Iron	**857**
Magnesium	**40500**
Manganese	**424**
Selenium	**11.7**
Sodium	**615000**

B-103	7/19/11
VOCs	
Benzene	**10.7**
n-Butylbenzene	**56.1**
sec-Butylbenzene	**24.2**
Ethylbenzene	**12.3**
Isopropylbenzene	**128**
Naphthalene	**133**
n-Propylbenzene	**383**
SVOCs	
Naphthalene	**52.6**
Metals	NE

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)
VOCs	
Chloroform	**7**
Benzene	**1**
Ethylbenzene	**5**
tert-Butylbenzene	**5**
n-Butylbenzene	**5**
sec-Butylbenzene	**5**
Isopropylbenzene	**5**
n-Propylbenzene	**5**
1,2,4-Trimethylbenzene	**5**
1,3,5-Trimethylbenzene	**5**
4-Isopropyltoluene	**5**
Toluene	**5**
m+p-Xylene	**5**
Xylenes (total)	**5**
SVOCs	
Naphthalene	**10**
Metals	
Iron	**300**
Magnesium	**35,000**
Manganese	**300**
Sodium	**20,000**
Lead	**25**
Selenium	**10**

µg/L – MICROGRAMS PER LITER
NYSDEC – NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AWQSGVs – AMBIENT WATER–QUALITY STANDARDS AND GUIDANCE VALUES
T – INDICATES THAT A QUALITY CONTROL PARAMETER HAS EXCEEDED LABORATORY LIMITS
J – ESTIMATED VALUE
DUP – DUPLICATE SAMPLE
VOCs – VOLATILE ORGANIC COMPOUNDS
SVOCs – SEMIVOLATILE ORGANIC COMPOUNDS
NE – NO EXCEEDANCES
ND – NO DETECTION

RESULTS SHOWN IN **BOLD** TYPE EXCEED NYSDEC PART 375 AWQSGVs

LEGEND

MR–12 ⊕	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION
B–101 ●	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION (INSTALLED BY STANTEC, 2011)
RX–18 ●	SOIL BORING LOCATION AND DESIGNATION (INSTALLED BY ROUX, 2018 AND 2021)
V–4 ▲	SOIL VAPOR SAMPLING LOCATION AND DESIGNATION
▥	CATCH BASIN
━	SITE

TYPICAL DATA BOX INFORMATION

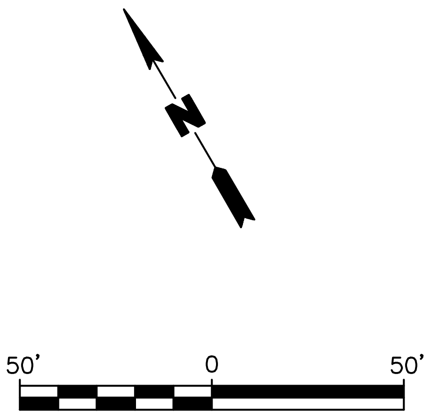
SAMPLE ID# →

MR-9	8/2/18
VOCs	
Chloroform	**8.2**
SVOCs	NE
Metals	
Iron	**857**
Magnesium	**40500**
Manganese	**424**
Selenium	**11.7**
Sodium	**615000**

← SAMPLE DATE

ANALYTES

CONCENTRATION (µg/L)



Title:
GROUNDWATER SAMPLE LOCATIONS AND EXCEEDANCES

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:
HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 30APR21	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	3
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y113.02.DWG		

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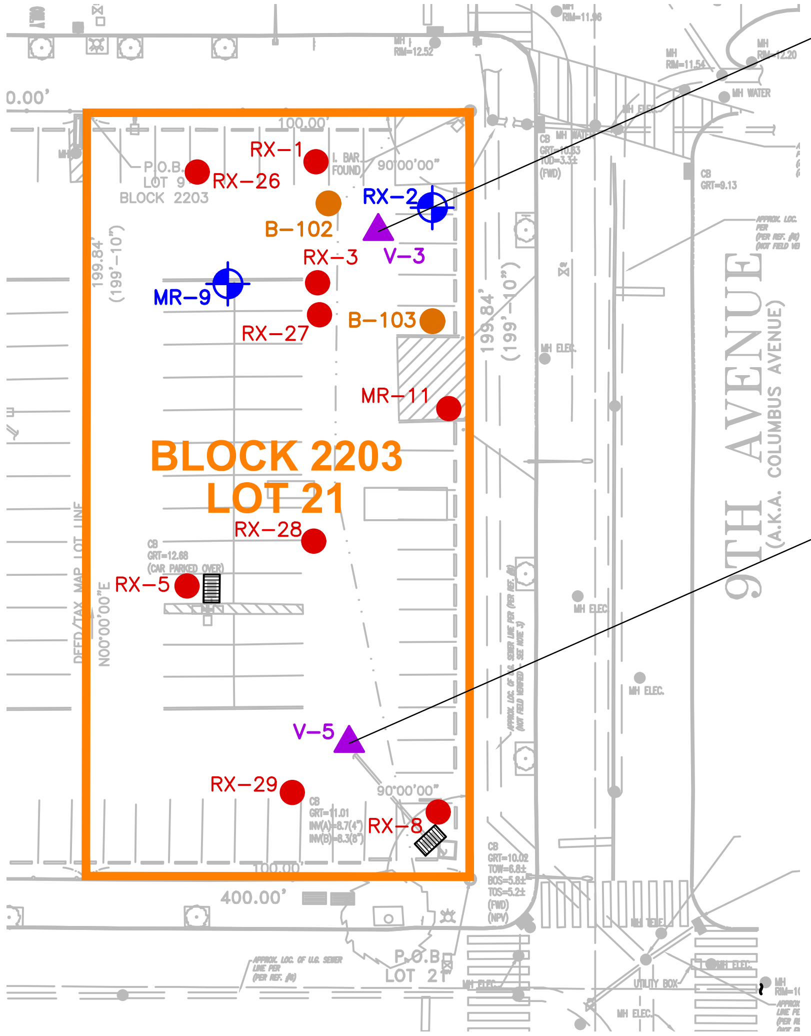
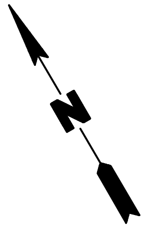
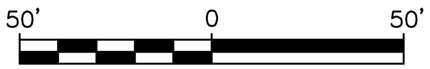


V-3	8/2/18
VOCs	
Benzene	5400 J
Butane	24000
Cyclohexane	11000
Isooctane	1100000
Isopropylbenzene	5300 J
N-HEPTANE	24000
n-Hexane	20000
n-Propylbenzene	4500 J

V-5	8/2/18
VOCs	
1,1,1-Trichloroethane	6.0 J
1,3-Butadiene	13
2-Butanone (MEK)	11 J
Benzene	8.6 J
Butane	170
Carbon disulfide	21 J
Chloroform	27
Cyclohexane	14
Isooctane	39
m+p-Xylene	4.9 J
N-HEPTANE	160
n-Hexane	84
Tetrachloroethene	26
Toluene	1300





LEGEND

MR-12 ⌖	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION
B-101 ●	SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION (INSTALLED BY STANTEC, 2011)
RX-18 ●	SOIL BORING LOCATION AND DESIGNATION (INSTALLED BY ROUX, 2018 AND 2021)
V-4 ▲	SOIL VAPOR SAMPLING LOCATION AND DESIGNATION
▥	CATCH BASIN
▬	SITE

TYPICAL DATA BOX INFORMATION

SAMPLE ID# → ← SAMPLE DATE

ANALYTES — — CONCENTRATION (µg/L)

V-3	8/2/18
VOCs	
Benzene	5400 J
Butane	24000
Cyclohexane	11000
Isooctane	1100000
Isopropylbenzene	5300 J
N-HEPTANE	24000
n-Hexane	20000
n-Propylbenzene	4500 J

CONCENTRATIONS IN $\mu g/m^3$

$\mu g/m^3$ — MICROGRAMS PER CUBIC METER
VOCs — VOLATILE ORGANIC COMPOUNDS
J — ESTIMATED VALUE

Title:

SOIL VAPOR SAMPLE LOCATIONS AND DETECTIONS

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX	Compiled by: D.M.	Date: 30APR21	FIGURE
	Prepared by: G.M.	Scale: AS SHOWN	4
	Project Mgr: V.S.	Project: 2477.0008Y000	
	File: 2477.0008Y113.02.DWG		

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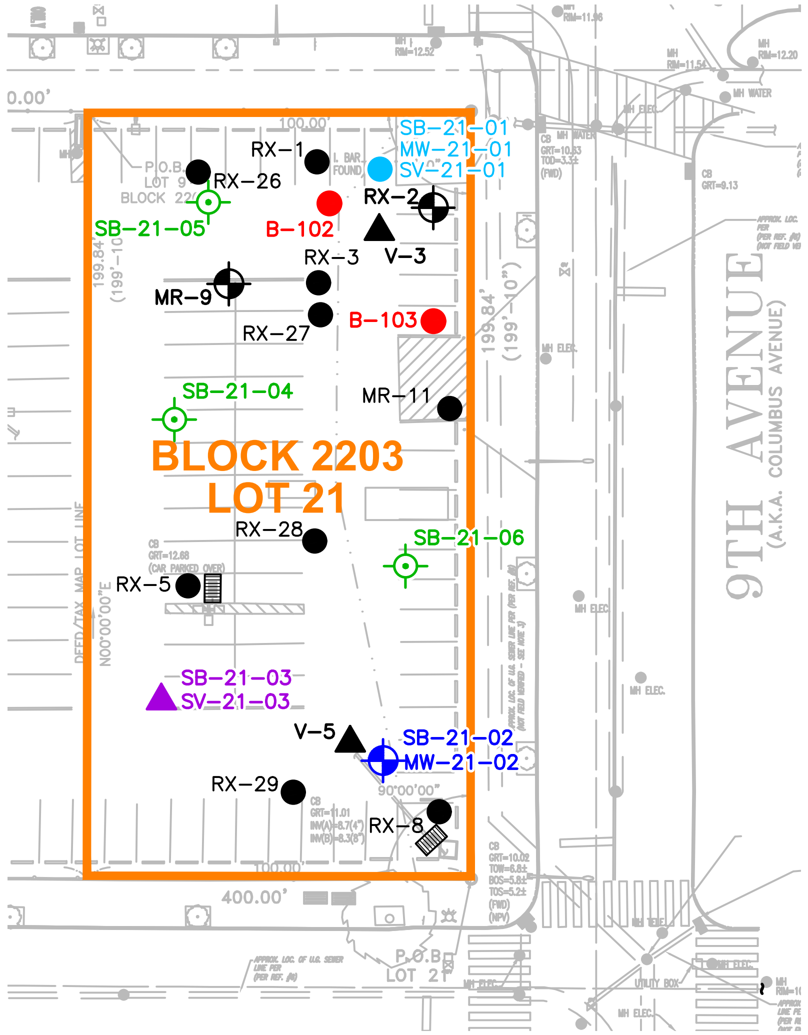

N

50' 0 50'

LEGEND

SB-21-02 MW-21-02 ⌖ PROPOSED SOIL BORING AND MONITORING WELL LOCATION AND DESIGNATION

SB-21-04 ⌖ PROPOSED SOIL BORING LOCATION AND DESIGNATION

SB-21-03 SV-21-03 ▲ PROPOSED SOIL BORING AND SOIL VAPOR SAMPLING LOCATION AND DESIGNATION

SB-21-01 MW-21-01 SV-21-01 ● PROPOSED SOIL BORING, MONITORING WELL AND SOIL VAPOR SAMPLING LOCATION AND DESIGNATION

B-102 ● SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION (INSTALLED BY STANTEC, 2011)

MR-09 ⌖ SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION PREVIOUSLY INSTALLED

V-5 ▲ SOIL VAPOR SAMPLING LOCATION AND DESIGNATION PREVIOUSLY INSTALLED BY ROUX

RX-5 ● SOIL BORING LOCATION AND DESIGNATION PREVIOUSLY INSTALLED BY ROUX

▥ CATCH BASIN

— SITE BOUNDARY

Title:

LOT 21 PROPOSED SAMPLING LOCATIONS

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 30APR21	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	5
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y113.01.DWG		

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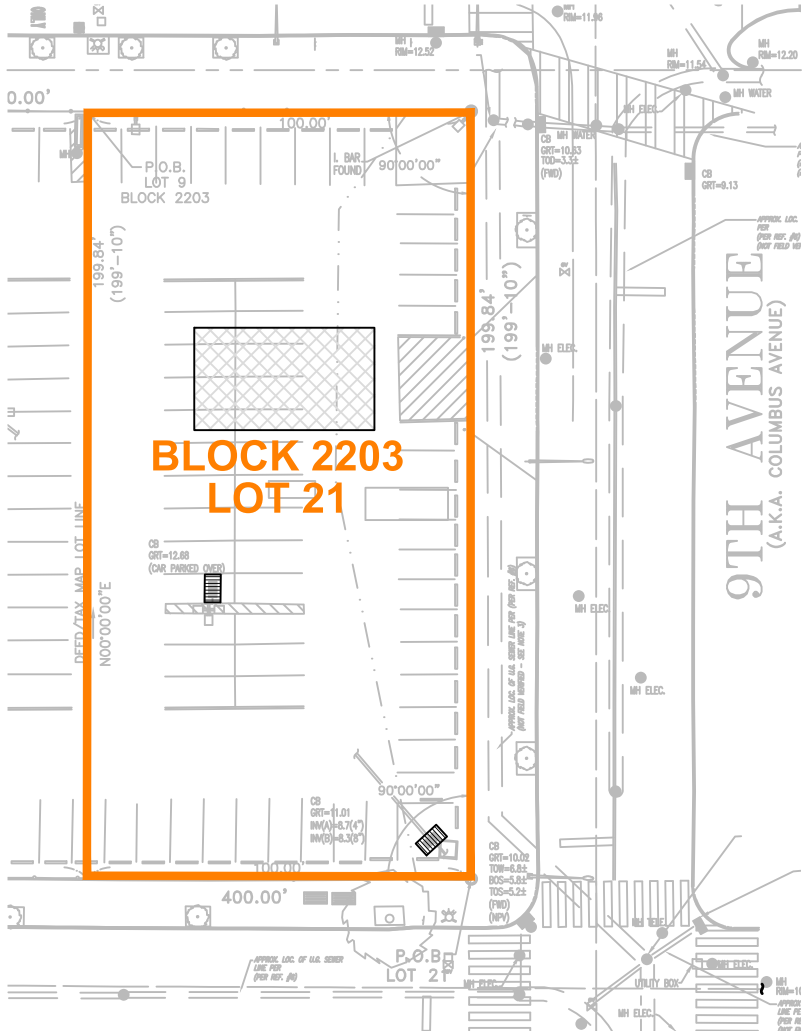

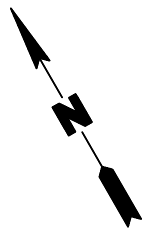

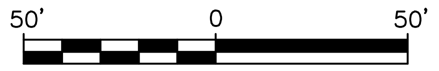

LEGEND

▨	FOUNDATION PILES AND PILE CAP TO BE INSTALLED WITHIN THIS AREA
▥	CATCH BASIN
—	SITE BOUNDARY AND LIMITS OF DEMOLITION/REMOVAL OF ASPHALT AND SURFACE FEATURES

Title:

PROPOSED IRM ACTIVITY LOCATIONS

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 30APR21	FIGURE
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APPENDICES

A. Previous Environmental Investigations
B. Community Air Monitoring Plan
C. Quality Assurance Project Plan/Field Sampling Plan
D. Site-Specific Health and Safety Plan

APPENDIX A

Previous Environmental Investigations

APPENDIX B

Community Air Monitoring Plan

Community Air Monitoring Plan

408 West 207th Street
Block 2203 Lot 21
New York, New York 10034

May 7, 2021

Prepared for:

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Prepared by:

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A. Action Limit Report

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux) on behalf of Harlem River Ninth Avenue Development LLC, (the “Requestor”), has developed a project specific Community Air Monitoring Plan (CAMP) to implement real time monitoring at the property located at 408 W 207th Street, Inwood, New York (Site), which occupies Tax Lot 21 of Tax Block 2203, during remedial investigation activities.

The monitoring program will be implemented at all times during which earth disturbance activities are occurring. The CAMP is designed to provide a measure of protection for the downwind community and on-Site workers not directly involved with the subject work activities from potential airborne contaminant releases as a direct result of remedial and construction activities. This plan is consistent with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan guidance document.

The specifics of the CAMP are presented in the following four (4) sections:

- 1.1 Volatile Organic Compound (VOC) Monitoring Approach
- 1.2 Particulate Monitoring Approach
- 1.3 Meteorological Monitoring Approach
- 1.4 Available Suppression Techniques

1.1 VOC Monitoring Approach

Total VOC concentrations in air will be monitored continuously at a location downwind of the investigation activities during all ground intrusive activities. An upwind monitoring station will be set up adjacent to where the intrusive activities are occurring. The VOC monitoring equipment will be located at temporary monitoring stations that will be established daily based on Site logistics and weather conditions. The monitoring work will be conducted using MiniRAE 3000 (or equivalent) portable VOC monitors, or similar type monitors, for all VOC monitoring. The equipment will be calibrated at least once daily using isobutylene as the calibration gas. One (1) upwind and one (1) downwind monitor will be deployed each day. Each monitoring unit is equipped with an audible alarm to indicate exceedance of the action levels (as defined below and summarized in Table 1).

The equipment is capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total VOCs at the downwind perimeter of the Site 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 the ambient air concentration of total VOCs at the downwind perimeter of the Site persists at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of VOCs identified, suppression techniques employed to abate emissions, and monitoring continued. After these steps, work activities can resume if the total organic vapor level at the Site perimeter is below 5 ppm over the background concentration for the 15-minute average. If levels are in excess of 25 ppm above background, identified contributing ground-intrusive activities will be halted and vapor suppression techniques will be evaluated and modified until monitoring indicates VOC levels at the Site perimeter are below 5 ppm over background. Once VOC levels are below 5 ppm at the Site perimeter, work will resume with continued monitoring.

- All 15-minute readings will be recorded and be available for State Regulator (New York State Department of Environmental Conservation [NYSDEC] and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will be recorded. If an exceedance of the action level occurs, an Action Limit Report (ALR) will be completed, identifying the monitoring device location, the measured VOC level, the activity causing the exceedance, meteorological conditions, and the corrective actions taken, as provided in Appendix A. Additionally, the NYSDEC and NYSDOH will be notified within 24 hours of the VOC ALR generation. Daily monitoring equipment locations and meteorological conditions will also be documented on the daily CAMP Monitoring Location Plan. All documentation will be kept on file at the Site.

1.2 Particulate Monitoring, Response Levels and Actions

Particulate concentrations will be monitored continuously at temporary particulate monitoring stations set up at the sidewalk at upwind and downwind locations. The particulate monitoring will 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 levels (as defined below and summarized in Table 1). Monitoring equipment will be TSI DustTrak II monitors or equivalent. A minimum of one (1) upwind and one (1) downwind monitor will be deployed each day, equipped with an omni-directional sampling inlet and a PM-10 sample head. The data logging averaging period will be set to 15-minutes with time and date stamp recording. Alarm averaging will be set at 90 micrograms per cubic meter (µg/m^3) per 15-minute period. This setting will allow proactive evaluation of Site conditions prior to reaching Action Levels of 100 µg/m^3 above background. The equipment will be outfitted with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. The monitoring will be used to compare values to the following:

- If the downwind PM-10 particulate level is 100 µg/m^3 greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the Site, 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 µg/m^3 above the upwind level and provided that no visible dust is migrating from the Site.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work must be stopped, a re-evaluation of activities initiated, and dust suppression techniques modified. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

All 15-minute readings will be recorded and be available for State Regulator (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will be recorded. If an exceedance of the action level occurs, an ALR will be completed, identifying the monitoring device location, the measured particulate concentration, the activity causing the exceedance, meteorological conditions, and the corrective actions taken, as provided in Appendix A. Daily monitoring equipment locations will also be documented on the daily CAMP Monitoring Location Plan. All documentation will be kept on file at the Site.

1.3 Meteorological Monitoring

Wind speed (estimated) and wind direction, will be approximated based on field observations of on-Site personnel. Meteorological data consisting of temperature, barometric pressure, and relative humidity will be recorded in the field book based upon publically available information from local weather stations.

1.4 Available Suppression Techniques

Odor Control

Due to the nature of the project, with intrusive activities occurring, the potential for generation of nuisance odors and the need for odor control may be necessary. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. Both NYSDEC and NYSDOH will be notified of all nuisance odor events and of all other complaints about the project.

All necessary means will be employed to prevent on- and off-Site nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) use of chemical odorants in spray or misting systems; and, (e) use of staff to monitor odors in surrounding neighborhoods.

Dust Control

Due to the nature of the project, the potential for generation of nuisance dust and the need for dust control may be necessary. Dust suppression will be achieved through the use of water for wetting excavation areas, if required. Water will be available on-Site at suitable supply and pressure for use in dust control.

1.5 Reporting

All recorded monitoring data will be downloaded, and field logged periodically, including action limit reports (if any) and daily CAMP monitoring location plans. All records will be maintained on-Site and available for NYSDEC/NYSDOH review. A summary of CAMP findings, including excursions, will be provided in the Daily and Monthly Reports. All CAMP monitoring records will be included in the overall Final Engineering Report (FER) that will be submitted to the NYSDEC and NYSDOH and will include all of the CAMP data collected, daily monitoring station location maps, and copies of the ALRs (if any). If an ALR is generated due to VOC exceedances, the NYSDEC and NYSDOH will be notified within 24 hours of the exceedance.

TABLE

1. Action Limit Summary for VOCs and Particulates

Table 1. Action Limit Summary for VOCs and Particulates

Contaminant	Downwind Action Levels*	Action/Response
Volatile Organic Compounds (VOCs) (Monitoring Via Photoionization Detector and Odor Observation)	< 5 ppm	1. Resume work with continuing monitoring.
	5 ppm < level < 25 ppm	1. Work activities must be temporarily halted, source vapors must be identified, suppression techniques employed to abate emissions and monitoring continued. 2. After these steps, if VOC levels (200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or structure, whichever is less) is below 5 ppm over background, resume work.
	> 25 ppm	1. Identified contributing ground intrusive activities must be halted and vapor suppression techniques must be evaluated and modified until monitoring indicates VOC levels below the action level. 2. After these steps, if VOC levels (half the distance to the nearest potential receptor or structure) are below 5 ppm over background, resume work.
Particulates (Monitoring Via Particulate Meter and Observation)	< 100 ug/m^3	1. If dust is observed leaving the work area, then dust control techniques must be implemented or additional controls used.
	100 ug/m3 < level < 150 ug/m^3	1. Employ dust suppression techniques. 2. Work may continue with dust suppression techniques provided that downwind PM-10 particulate concentration do not exceed 150 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
	> 150 ug/m^3	1. STOP work 2. Re-evaluate activities, modify dust suppression techniques. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

* Instantaneous readings above background. Particulate readings are based on the respirable (PM-10) fraction. Background readings are taken at upwind locations relative to Work Areas or Exclusion Zones.

APPENDICES

A. Action Limit Report

APPENDIX A

Action Limit Report

ACTION LIMIT REPORT

Project Location: 408 West 207th St, Inwood, NY
Tax Block 2203 Lot 21

Date: ______________________ Time: ______________________

Name: ____

Contaminant: PM-10: ______________ VOC: ______________________

Wind Speed: ______________ Wind Direction: ______________________

Temperature: ______________ Barometric Pressure: ______________________

DOWNWIND DATA

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

UPWIND DATA

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

BACKGROUND CORRECTED LEVELS

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

ACTIVITY DESCRIPTION

____

____

____

____

CORRECTIVE ACTION TAKEN

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APPENDIX C

Quality Assurance Project Plan/Field Sampling Plan

ROUX

Quality Assurance Project Plan/ Field Sampling Plan

408 West 207th Street
Block 2203 Lot 21
New York, New York 10034

May 7, 2021

Prepared for:

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3. Laboratory's Standard Operating Procedures and Detection/Reporting Limits for Emerging Contaminants
4. Roux's Standard Operating Procedures

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux), on behalf of Harlem River Ninth Avenue Development LLC (The Applicant), has prepared this Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) to describe the measures that will be taken to ensure the data generated during performance of the Remedial Investigation (RI) for the site located at 408 W 207th Street, Inwood, New York (Site, Figure 1) are of quality sufficient to meet project-specific data quality objectives (DQOs). This QAPP/FSP also includes field sampling procedures.

This QAPP/FSP was prepared in accordance with the guidance provided in NYSDEC Technical Guidance DER-10 Technical Guidance for Site Investigation and Remediation (DER-10), the NYSDEC BCP Guide, and the United States Environmental Protection Agency's (USEPA's) Guidance for the Data Quality Objectives Process (EPA QA/G 4).

1.1 Purpose

The QAPP/FSP describes in detail the field sampling and quality assurance/quality control (QA/QC) methods to be used during soil, soil vapor, and groundwater sampling tasks performed during the RI.

This QAPP/FSP provides guidelines and procedures to be followed by field personnel during performance of sampling during the RI. Information contained in this QAPP/FSP relates to:

- Sampling objectives (Section 2);
- Project organization (Section 3);
- Sample media, sampling locations, analytical suites, sampling frequencies and analytical laboratory (Section 4);
- Field sampling procedures (Section 5);
- Sample handling, sample analysis, and quality assurance/quality control (Section 6); and
- Site control procedures and decontamination (Section 7).

2. Sampling Objectives

The objective of the proposed sampling is to determine the nature and extent of the known contamination at the Site, to evaluate any additional areas of concern (AOCs), and to obtain a current representation of the environmental conditions at the Site.

Roux, as well as a previous consultant, have performed a preliminary Site reconnaissance and investigation and have identified AOCs. These areas will be further investigated as part of the RI. An inspection of the existing Site conditions will be conducted to determine final locations of soil borings, monitoring wells, and soil vapor sampling points based on actual field conditions.

Sampling procedures are discussed in Section 5 of this QAPP/FSP. A discussion of the DQOs and quality assurance/quality control is provided in Section 6.

3. Project Organization

A general and generic summary of the overall management structure and responsibilities of project team members are presented below. Professional profiles for the team are provided in Attachment 1.

Project Principal

Jessica Taylor, P.G. will serve as Project Principal. The Project Principal is responsible for defining project objectives and bears ultimate responsibility for the successful completion of the investigation.

Remedial Engineer

The Remedial Engineer for this project will be Ms. Noelle Clarke, P.E. The Remedial Engineer is a registered professional engineer licensed by the State of New York. The Remedial Engineer will have primary direct responsibility for implementation of the RI and future remedial program for the Site. The Remedial Engineer will certify remedial documents, as necessary.

Project Manager

Valerie Sabatasso of Roux will serve as Project Manager. The Project Manager will provide overall management for the implementation of the scope of work and will coordinate all field activities. The Project Manager is also responsible for data review/interpretation and report preparation.

Field Team Leader

The Field Team Leader will be Daniel Miserendino. The Field Team Leader bears the responsibility for the successful execution of the field program. The Field Team Leader will direct the activities of the technical staff in the field, as well as all subcontractors. The Field Team Leader will also assist in the interpretation of data and in report preparation. The Field Team Leader reports to the Project Manager.

Laboratory Project Manager

Laboratory analysis will be completed by Eurofins/Test America Laboratories of Edison, New Jersey, and Burlington, Vermont, both NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratories (11452 and 10391). The Laboratory Project Manager is Melissa Haas. The Laboratory Project Manager is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Project Manager will ensure that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Project Manager reports to the Project Principal and Project Manager.

Quality Assurance Officer

David Kaiser, P.E. of Roux will serve as the Quality Assurance Officer (QAO) for this project. The QAO is responsible for conducting reviews, inspections, and audits to ensure the data collection is conducted in accordance with the FSP and QAPP. The QAO's responsibilities range from ensuring effective field equipment decontamination procedures and proper sample collection to the review of all laboratory analytical data for completeness and usefulness. The QAO reports to the Project Manager and makes independent recommendations to the Field Team Leader.

4. Sample Media, Locations, Analytical Suites, and Frequency

The media to be sampled during the RI include soil, groundwater, and soil vapor. Sampling locations, analytical suites, and frequency may vary by medium. A discussion of the sampling schedule for each medium is provided below, while the assumed number of field samples to be collected for each medium, including quality control (QC) samples, is shown in Tables 1 and 2. Specifics regarding the collection of samples at each location and for each task are provided in Section 5 of this QAPP/FSP.

4.1 Soil Sampling

Soil samples are to be used to characterize the soil conditions for the AOCs at the Site, provide vertical delineation of contamination, and to collect the data sufficient to define the nature and extent of impacted soils. All samples previously collected by Roux were done so in a manner consistent with this QAPP/FSP. As part of this RIWP, 5 soil borings are proposed to be installed at the locations shown on Figure 2.

The summary table below provides details for the soil sampling locations that are proposed as part of this RIWP:

Location	Sample Depth Intervals (in ft bls unless otherwise noted)	Rationale
SB-21-01	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-2 and B-102; sample SB-21-01 is co-located with monitoring well MW-21-01 and soil vapor point SV-21-01.
SB-21-02	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-29 and RX-8; sample SB-21-02 is co-located with monitoring well MW-21-02.
SB-21-03	12-14; Hold 14-16 and 16-18	To obtain additional soil and soil vapor coverage across the Site; sample SB-21-03 is co-located with soil vapor point SV-21-03.
SB-21-04	12-14; Hold 14-16 and 16-18	To obtain additional soil coverage across the Site.
SB-21-05	12-14; Hold 14-16 and 16-18	To delineate vertical extent of contamination near RX-26.
SB-21-06	12-14; Hold 14-16 and 16-18	To obtain additional soil coverage across the Site.

Samples will be analyzed for Total Compound List (TCL) plus 30/ Target Analyte List (TAL) (TCL + 30/TAL) which includes:

- TCL Volatile Organic Compounds (VOCs) + 10 tentatively identified compounds (TICs);
- TCL base neutral acids (BNA)/Semivolatile Organic Compounds (SVOCs) + 20 TICs;
- TCL Pesticides;
- TCL Herbicides;
- TCL Polychlorinated biphenyls (PCBs);
- TAL) Metals (including hexavalent chromium); and
- Total Cyanide.

Samples will also be analyzed for the Emerging Contaminants (ECs) list including 1,4-Dioxane and the 21 Per- and Polyfluoroalkyl Substances (PFAS), which include the 21 compounds listed in the January 2021 NYSDEC guidance Sampling, Analysis, and Assessment of Per-and Polufluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs (NYSDEC January 2021 Guidance), that is included as Attachment 2. PFAS in soil will be analyzed Modified USEPA Method 537 via LC-MS/MS isotope dilution. 1,4-Dioxane in soil will be analyzed by USEPA Method 8270D. The 21 PFAS are:

- Perfluorobutanesulfonic acid
- Perfluorohexanesulfonic acid
- Perfluoroheptanesulfonic acid
- Perfluorooctancessulfonic acid
- Perfluorodecanesulfonic acid
- Perfluorobutanoics acid
- Perfluoropentanoic acid
- Perfluorohexanoic acid
- Perfluoroheptanoic acid
- Perfluorooctanoic acid
- Perfluorononanoic acid
- Perfluorodecanoic acid
- Perfluoroundecanoic acid
- Perfluorododecanoic acid
- Perfluorotridecanoic acid
- Perfluorotetradecanoic acid
- 6:2 Fluorotelomer sulfonate
- 8:2 Fluorotelomer sulfonate
- Perfluroroctanesulfonamide
- N-methyl perfluorooctanesulfonamidoacetic acid
- N-ethyl perfluorooctanesulfonamidoacetic acid

The Test America Standard Operating Procedures (SOPs) for completing ECs analysis and reporting limits/minimum detection limits for EC compounds are included in Attachment 3. If odor/ visual evidence of contamination or elevated photoionization detector (PID) readings are noted, additional samples may be collected from the interval that exhibits the highest contamination.

4.2 Groundwater Sampling

To characterize on-Site groundwater flow and quality conditions, three permanent groundwater monitoring wells will be installed across the Site. Based on data from previous environmental investigations conducted by Roux, the average depth to groundwater is approximately 7-10 ft bls. The two permanent groundwater monitoring wells (MW-21-01 and MW-21-02) will be installed to a maximum depth of approximately 17 feet below land surface (ft bls). All permanent monitoring wells will be installed with a ten-foot well screen bridging the water table (i.e., three feet of screen above the water table and seven feet of well screen below). The proposed permanent groundwater monitoring well locations are shown on Figure 2 and permanent monitoring well installation and groundwater sampling procedures are outlined below in Section 5.2.

Groundwater samples will be collected from the permanent wells and submitted for laboratory analysis for TCL + 30/TAL analysis (including filtered and unfiltered metals and SVOCs). The proposed permanent monitoring wells will also be sampled for the emerging contaminants (ECs) 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS), which include the 21 compounds listed in the NYSDEC January 2021 Guidance. PFAS in groundwater will be analyzed Modified USEPA Method 537 via LC-MS/MS isotope dilution. 1,4-Dioxane in groundwater will be analyzed by USEPA Method 8270D SIM. The Test America Standard Operating Procedures (SOPs) for completing ECs analysis and reporting limits/minimum detection limits for EC compounds are included in Attachment 3. Field parameters (e.g., pH, dissolved oxygen, oxidation-reduction potential [ORP], etc.) will also be collected in the field using a water quality meter during purging prior to sample collection.

4.3 Soil Vapor Sampling

Two soil vapor samples (SV-21-01 and SV-21-03) will be collected during the RI to evaluate soil vapor conditions at the Site. The proposed soil vapor sampling locations are shown on Figure 2. All soil vapor samples will be collected in accordance with the October 2006 New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH Guidance). All soil vapor samples will be collected from a depth of approximately 2 ft above the water table. All soil vapor samples will be analyzed for VOCs using USEPA Method TO-15. Soil vapor point installation and soil vapor sampling procedures are outlined below is Section 5.3.

5. Field Sampling Procedures

This section provides a detailed discussion of the field procedures to be used during sampling of the various media being evaluated as part of the RI (i.e., soil, groundwater, and soil vapor). As discussed, the sample locations are shown on Figure 2 and additional information including intervals to be sampled and sample rationale is provided in section 4.1. Additional details regarding sampling procedures and protocols are described in Roux's relevant SOPs, which are provided in Attachment 4.

5.1 Soil Sampling and Permanent Monitoring Well Installation

Details for the collection of soil samples and the installation of permanent monitoring wells are provided below. Boreholes will be pre-cleared to five ft bls using non-intrusive methods (i.e., hand auger, vacuum technology, etc.) prior to advancement of soil borings to verify the absence of potential underground utilities. Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated to no greater than ten feet away from the original proposed location.

5.1.1 Soil Sampling

Soil borings will be advanced using a GeoProbe® Direct-Push drill rig. Samples of the soil profile will be collected continuously from land surface to a maximum depth of approximately 18 ft bls, as shown in Section 4.1.

The soil from each five-foot interval will be observed for lithology and evidence of contamination (e.g., staining, odors, and/or visible free product) and placed immediately thereafter into large Ziploc® bags for recording headspace using a PID. After a minimum of 15 minutes for equilibration with the headspace in the Ziploc® bag, each sample will be screened for organic vapors using a PID equipped with a 10.6 eV lamp. Samples for possible VOC analysis will be placed in a laboratory-supplied jar or encore sampler prior to screening, due to the potential for loss of VOCs through volatilization. Soil samples will be collected accordance with the table in section 4.1. These samples will be placed in the laboratory-supplied containers and shipped to the laboratory under chain of custody procedures in accordance with Roux's SOPs in Attachment 4.

Additional necessary precautions will be taken when sampling for ECs in the field including, but not limited to:

- Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex or Tyvek);
- Avoid using sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene materials;
- Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon and using permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
- Utilizing regular ice for sample presevation and only Alconox or Liquinox for decontamination.

Following sample collection, boreholes will be backfilled with soil cuttings with a bentonite plug near the top and capped with concrete. Contaminated soil cuttings, if encountered, will be placed in sealed and labeled U.S. Department of Transportation (DOT) approved 55-gallon drums pending characterization and off-site disposal at a permitted facility.

5.1.2 Permanent Monitoring Well Installation

Permanent monitoring wells will be installed bridging the water table and to a maximum depth of approximately 17 ft bls. Monitoring wells will be constructed of 2 inch inside diameter, Schedule 40 polyvinyl chloride (PVC) casing and, 0.020-inch slot screen. Well screens will be 10 feet long and will be installed with three feet above and seven feet below the water table. A sand pack will be placed around the well screen, extending two feet above the top of the screened zone. Once the driller confirms the depth of the sand pack, a minimum two-foot-thick bentonite pellet seal will be placed above the sand pack. Once the pellets have been allowed to hydrate, a cement bentonite grout will be placed into the remaining annular space from the bottom up to just above the bentonite seal. The wells will be completed using locking well plugs, and flush mounted, bolt down, watertight, manhole covers cemented into place.

Each newly installed monitoring well will be developed to remove any fine-grained material in the vicinity of the well screen and to promote a hydraulic connection with the aquifer. The wells will be developed using a submersible pump, which will be surged periodically until well yield is consistent and has a turbidity below 50 Nephelometric turbidity units (NTUs).

5.2 Groundwater Sampling

Groundwater samples from the proposed permanent monitoring wells will be collected no sooner than one (1) week following development of the wells. Prior to sampling, depth to water will be measured at each newly installed temporary and newly installed and existing permanent well using an electronic water level meter with an accuracy of +/ 0.01 feet. All wells will then be purged and sampled using a submersible pump or low-flow method, or an alternative method, depending on the observed depth to groundwater and logistical issues. Purging and sampling will be performed consistent with USEPA low-flow sampling requirements. Field parameters (i.e., pH, dissolved oxygen, ORP, etc. as described in the USEPA low-flow sampling requirements) will be collected using a water quality meter with flow-through cell until parameters stabilized before samples are collected. Samples will be analyzed for TCL + 30/TAL and ECs as shown on Table 2.

Similar to the collection of soil samples for ECs, additional necessary precautions will be taken when groundwater sampling for ECs in the field including, but not limited to:

- Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex or Tyvek);
- Avoid using pumps and sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene materials;
- Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon and using permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
- Utilizing regular ice for sample presevation and only Alconox or Liquinox for decontamination.

All groundwater samples will be collected and placed in the laboratory-supplied containers and shipped to the laboratory under chain of custody procedures in accordance with Roux’s field sampling SOPs included as Attachment 4.

5.3 Soil Vapor Sampling

Two soil vapor samples will be collected during the RI to evaluate soil vapor concentrations at the Site. The soil vapor samples, SV-21-01 and SV-21-03 will be installed at approximately two feet above the water table. New Teflon®-lined tubing will be attached to an expendable soil vapor sampling point with a 6-inch stainless steel screen inside the rods, to prevent infiltration of ambient air. The soil vapor points will be backfilled with #2 Morie sand to approximately one foot above the screen. The remainder of the borehole will be backfilled with a cement/bentonite slurry to grade.

Prior to sample collection, the Teflon®-lined tubing will be purged of approximately two volumes of the tubing using a vacuum pump set at a rate of 0.2 liters per minute. A tracer gas (i.e., helium) will be used to enrich the atmosphere in the immediate vicinity of the sampling location in order to test the borehole seal and verify that ambient air is not being drawn into the sample in accordance with the procedures outlined in the NYSDOH Guidance. Following purging and verification with the tracer gas, the tubing will be connected to the pre-cleaned (batch-certified) laboratory supplied six-liter summa canister. All soil vapor samples will be collected using the canisters with regulators calibrated to collect samples over an 8-hour period and analyzed using USEPA Method TO-15 for VOCs.

6. Sample Handling and Analysis

To ensure quality data acquisition and collection of representative samples, there are selective procedures to minimize sample degradation or contamination. These include procedures for preservation of the samples, as well as sample packaging, shipping procedures, and QA/QC.

6.1 Field Sample Handling

A discussion of the proposed number and types of samples to be collected during each task, as well as the analyses to be performed, can be found in Section 4 of this QAPP/FSP. The types of containers, volumes, and preservation techniques for the aforementioned testing parameters are presented in Table 3.

6.2 Sample Custody Documentation

The purpose of documenting sample custody is to ensure that the integrity and handling of the samples is not subject to question. Sample custody will be maintained from the point of sampling through the analysis (and return of unused sample portion, if applicable).

Each individual collecting samples is personally responsible for the care and custody of the samples. All sample labels should be pre-printed or filled out using waterproof ink. The technical staff will review all field activities with the Field Team Leader to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

All samples being shipped off-site for analysis must be accompanied by a properly completed chain of custody form. The sample numbers will be listed on the chain of custody form. When transferring the possession of samples, individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to/from a secure storage area, and to the laboratory.

Samples will be packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and/or secured with strapping tape in at least two locations for shipment to the designated laboratory.

6.3 Sample Shipment

If sample shipment is necessary, sample packaging and shipping procedures are based upon USEPA specifications, as well as DOT regulations. The procedures vary according to potential sample analytes, concentration, and matrix and are designed to provide optimum protection for the samples and the public. Sample packaging and shipment must be performed using the general outline described below.

All samples will be shipped within 24 hours of collection and will be preserved appropriately from the time of sample collection. A description of the sample packing and shipping procedures is presented below:

1. Prepare cooler(s) for shipment:
   - tape drain(s) of cooler shut;
   - affix “This Side Up” arrow labels and “Fragile” labels on each cooler; and
   - place mailing label with laboratory address on top of cooler(s).
2. Arrange sample containers in groups by sample number.

3. Ensure that all bottle labels are completed correctly. Place clear tape over bottle labels to prevent moisture accumulation from causing the label to peel off.
4. Arrange containers in front of assigned coolers.
5. Place packaging material approximately at the bottom of the cooler to act as a cushion for the sample containers.
6. Arrange containers in the cooler so that they are not in contact with the cooler or other samples.
7. Fill remaining spaces with packaging material.
8. Ensure all containers are firmly packed in packaging material.
9. If ice is required to preserve the samples, ice cubes should be repackaged in Ziploc® bags and placed on top of the packaging material.
10. Sign chain of custody form (or obtain signature) and indicate the time and date it was relinquished to courier as appropriate.
11. Separate chain of custody forms. Seal proper copies within a large Ziploc® bag and tape to inside cover of cooler. Retain copies of all forms.
12. Close lid and latch.
13. Secure each cooler using custody seals.
14. Tape cooler shut on both ends.
15. Relinquish to overnight delivery service as appropriate. Retain air bill receipt for project records. (Note: All samples will be shipped for “NEXT A.M.” delivery).

6.4 Quality Assurance/Quality Control

The primary intended use for the RI data is to characterize Site conditions and determine if remediation needs to be undertaken at the Site. The primary DQO of the soil, groundwater, and soil vapor programs, therefore, is that data be accurate and precise, and hence representative of the actual Site conditions. Accuracy refers to the ability of the laboratory to obtain a true value (i.e., compared to a standard) and is assessed through the use of laboratory quality control (QC) samples, including laboratory control samples and matrix spike samples, as well as through the use of surrogates, which are compounds not typically found in the environment that are injected into the samples prior to analysis. Precision refers to the ability to replicate a value and is assessed through both field and laboratory duplicate samples.

Sensitivity is also a critical issue in generating representative data. Laboratory equipment must be of sufficient sensitivity to detect target compounds and analytes at levels below NYSDEC standards and guidelines whenever possible. Equipment sensitivity can be decreased by field or laboratory contamination of samples, and by sample matrix effects. Assessment of instrument sensitivity is performed through the analysis of reagent blanks, near-detection-limit standards, and response factors. Potential field and/or laboratory contamination is assessed through use of trip blanks, method blanks, and equipment rinse blanks (also called “field blanks”). Equipment blanks for PFAS will be collected at a minimum frequency of one per day. A laboratory SOP for analysis of PFAS is included in Attachment 3.

Table 1 lists the requirements for field and laboratory QC samples that will be analyzed to assess data accuracy and precision, as well as to determine if equipment sensitivity has been compromised. Table 2 lists the number/type of field and QA/QC samples that will be collected during the RI. Table 3 lists the preservation, holding times and sample container information.

All RI “assessment” analyses will be performed in accordance with the NYSDEC Analytical Services Protocol (ASP), using USEPA SW 846 methods.

All laboratory data are to be reported in NYSDEC ASP Category B deliverables and will be delivered to NYSDEC in electronic data deliverable (EDD) format as described on NYSDEC’s website (http://www.dec.ny.gov/chemical/62440.html). A Data Usability Summary Report (DUSR) will be prepared meeting the requirements in Section 2.2(a)1.ii and Appendix 2B of DER-10 for all data packages generated for the RI.

7. Site Control Procedures

Site control procedures, including decontamination and waste handling and disposal, are discussed below. Site control procedures have been developed to minimize both the risk of exposure to contamination and the spread of contamination during field activities at the Site. All personnel who come into designated work areas, including contractors and observers, will be required to adhere strictly to the conditions imposed herein and to the provisions of a Site-Specific Health and Safety Plan (HASP). The HASP is included as Appendix D to the RIWP.

7.1 Decontamination

In an attempt to avoid the spread of contamination, all drilling and sampling equipment must be decontaminated at a reasonable frequency in a properly designed and located decontamination area. Detailed procedures for the decontamination of field and sampling equipment are included in Roux's SOPs for the Decontamination of Field Equipment located in Attachment 4. The location of the decontamination area will be determined prior to the start of field operations. The decontamination area will be constructed to ensure that all wash water generated during decontamination can be collected and containerized for proper disposal. As mentioned above, only Alconox or Liquinox will be used during decontamination procedures when groundwater sampling is underway.

7.2 Waste Handling and Disposal

All waste materials (drill cuttings, decontamination water, etc.) generated during the RI will be consolidated, and stored in appropriate labeled bulk containers (drums, etc.), and temporarily staged at an investigation derived waste storage area onsite. Roux will then coordinate waste characterization and disposal by appropriate means.

TABLES

1. Field and Laboratory QC Summary
2. Remedial Investigation Sampling Summary
3. Preservation, Holding Times, and Sample Containers

Table 1. Field and Laboratory QC Summary

QC Check Type	Minimum Frequency	Use
<u>Field QC</u>		
Duplicate	1 per matrix per 20 samples or SDG	Precision
Trip Blank	1 per VOC cooler	Sensitivity
Field Blank	1 per matrix per 20 samples, 1 per day when sampling for PFAS	Sensitivity
Equipment Blank	1 per day when sampling for PFAS	Sensitivity
<u>Laboratory QC</u>		
Laboratory Control Sample	1 per matrix per SDG	Accuracy
Matrix Spike/Matrix Spike Duplicate/Matrix Duplica	1 per matrix per SDG	Accuracy/Precision
Surrogate Spike	All organics samples	Accuracy
Laboratory Duplicate	1 per matrix per SDG	Precision
Method Blank	1 per matrix per SDG	Sensitivity

* SDG - Sample Delivery Group - Assumes a single extraction or preparation
** Provided to lab by field sampling personnel
PFAS - Per- and Polyfluoroalkyl Substances

Table 2. Remedial Investigation Sampling Summary

Sample Medium	Target Analytes	Field Samples	Replicates[1]	Trip Blanks[2]	Field Blanks[1]	Equipment Blanks[3]	Matrix Spikes[1]	Spike Duplicates[1]	Total No. of Samples
Soil	TCL VOCs +10	6	1	1	1	-	1	1	11
	TCL VOCs	6	1	-	1	-	1	1	10
	TCL SVOCs +20	6	1	-	1	-	1	1	10
	TCL SVOCs	6	1	-	1	-	1	1	10
	TCL Pesticides	6	1	-	1	-	1	1	10
	TCL Herbicides	6	1	-	1	-	1	1	10
	TCL PCBs	6	1	-	1	-	1	1	10
	TAL Metals	6	1	-	1	-	1	1	10
	Total Cyanide	6	1	-	1	-	1	1	10
	PFAS	6	1	-	1	-	1	1	10
	1,4-Dioxane	6	1	-	1	-	1	1	10
Groundwater	TCL VOCs +10	2	1	1	1	-	1	1	7
	TCL SVOCs +20	2	1	-	1	-	1	1	6
	TCL Pesticides	2	1	-	1	-	1	1	6
	TCL Herbicides	2	1	-	1	-	1	1	6
	TCL PCBs	2	1	-	1	-	1	1	6
	TAL Metals*	2	1	-	1	-	1	1	6
	PFAS	2	1	-	1	1	1	1	7
	1,4-Dioxane	2	1	-	1	1	1	1	7
Soil Vapor	TO-15 VOCs	2	1	-	-	-	-	-	3

Totals are estimated based on scope of work as written, actual sample quantities may vary based on field conditions.
Additional samples will be collected and held, as described in the RIWP. QA/QC sample quantities will be adjusted accordingly.

[1] Based on 1 per 20 samples

[2] Based on 1 VOC cooler per day

[3] Based on 1 per day PFAS sampling occurs

TCL - USEPA Contract Laboratory Program Target Compound List
USEPA - United States Environmental Protection Agency
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
EPH - Extractable Petroleum Hydrocarbons
RCRA - Resource Conservation and Recovery Act
TCLP - Toxicity Characteristic Leaching Procedure
PFAS - Per- and Polyfluoroalkyl Substances
TAL - USEPA Contract Laboratory Program Target Analyte List
*All groundwater samples will be analyzed for both filtered and unfiltered metals.

Table 3. Preservation, Holding Times and Sample Containers

Analysis	Matrix	Bottle Type	Preservation(a)	Holding Time(b)
TAL Metals (total) SW-846 6010/7471	Soil Water	8 oz wide mouth glass, teflon lined cap 250 mL plastic, teflon lined cap	Cool to 4°C Nitric acid	180 days, Hg 28 days
Total Cyanide	Soil	4 oz glass	Cool to 4°C	14 days
PFAA vis EPA 537(M)-Isotope Dilution (WATER)	Water	Three 250 mL HDPE bottles	Trizma	14 days to extraction, 28 days to analysis
1,4-Dioxane via 8270SIM	Water	500 mL amber glass	Cool to 4°C	7 days to extraction, 40 days to analysis
TO-15	Air	2.7 liter Summa Canister	None	14 days from sample collection
Target Compound List (TCL)				
TCL Volatile Organic Compounds (VOCs) SW-846 8260B	Soil Water	Encore 40mL voa vial, teflon lined cap	Cool to 4°C Hydrochloric Acid	48 hours from sample collection, 14 days if frozen to -7°C or extruded into methanol 14 days from sample collection
TCL Semivolatile Organic Compounds (SVOCs) SW-846 8270C	Soil Water	8 oz wide mouth glass, teflon lined cap 1 liter amber glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis 7 days to extract, 40 days to analysis
TCL Pesticides SW-846 8081A	Soil Water	8 oz wide mouth glass, teflon lined cap 1 liter amber glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis 7 days to extract, 40 days to analysis
TCL Herbicides SW-846 8051A	Soil Water	8 oz wide mouth glass, teflon lined cap 1 liter amber glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis 7 days to extract, 40 days to analysis
TCL Polychlorinated biphenyls (PCBs) SW-846 8082/TCLP	Soil Water	8 oz wide mouth glass, teflon lined cap 1 liter amber glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis 7 days to extract, 40 days to analysis

(a) All soil and groundwater samples to be preserved in ice during collection and transport

(b) Days from date of sample collection.

TAL - Target Analyte List

TCL - USEPA Contract Laboratory Program Target Compound List

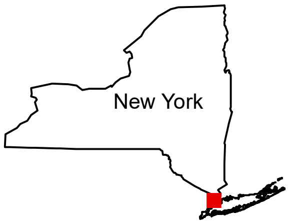
USEPA - United States Environmental Protection Agency

HDPE - High Density Polyethylene

FIGURES

1. Site Location Map
2. Proposed Remedial Action Sampling Locations

QUADRANGLE LOCATION



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1,000 0 1,000'

Title:

SITE LOCATION MAP

408 WEST 207TH STREET
MANHATTAN, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 05/05/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	1
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y117.1.mxd		

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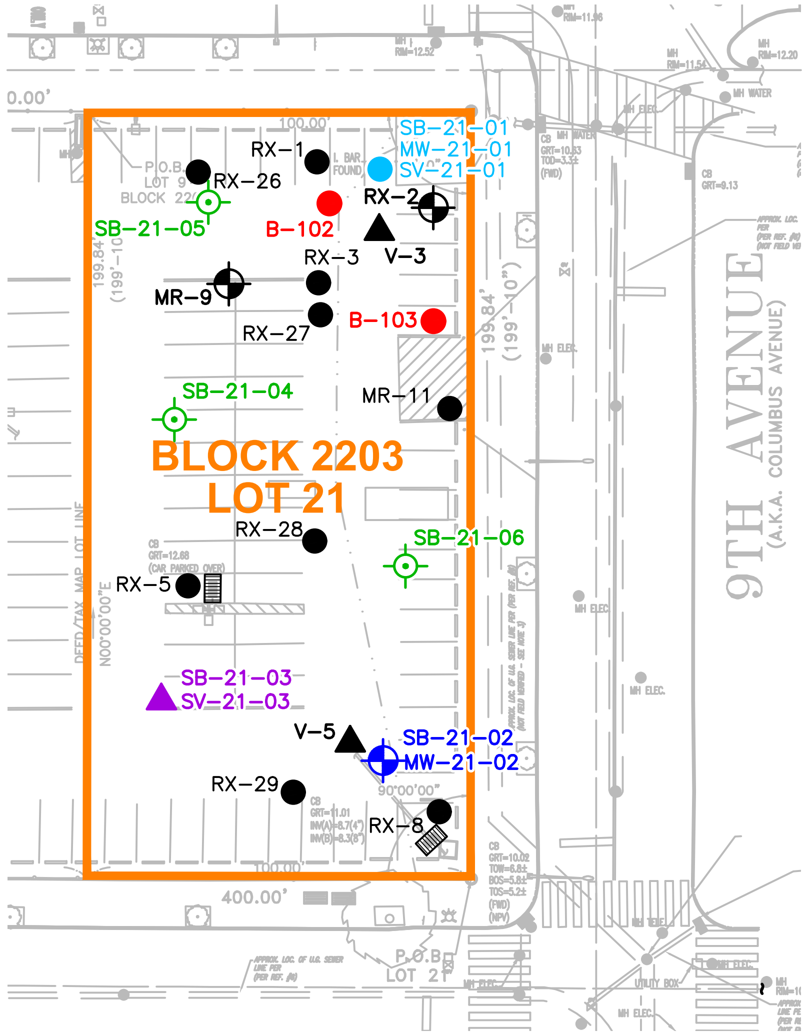

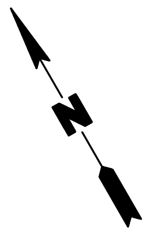

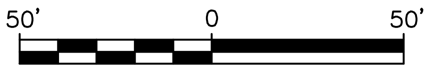

LEGEND

- SB–21–02 MW–21–02 ⊕ PROPOSED SOIL BORING AND MONITORING WELL LOCATION AND DESIGNATION
- SB–21–04 ⊙ PROPOSED SOIL BORING LOCATION AND DESIGNATION
- SB–21–03 SV–21–03 ▲ PROPOSED SOIL BORING AND SOIL VAPOR SAMPLING LOCATION AND DESIGNATION
- SB–21–01 MW–21–01 SV–21–01 ● PROPOSED SOIL BORING, MONITORING WELL AND SOIL VAPOR SAMPLING LOCATION AND DESIGNATION
- B–102 ● SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION (INSTALLED BY STANTEC, 2011)
- MR–09 ⊕ SOIL BORING AND TEMPORARY MONITORING WELL LOCATION AND DESIGNATION PREVIOUSLY INSTALLED
- V–5 ▲ SOIL VAPOR SAMPLING LOCATION AND DESIGNATION PREVIOUSLY INSTALLED BY ROUX
- RX–5 ● SOIL BORING LOCATION AND DESIGNATION PREVIOUSLY INSTALLED BY ROUX
- ▥ CATCH BASIN
- ▬ SITE BOUNDARY

Title:

PROPOSED SAMPLING LOCATIONS

408 WEST 207TH STREET
NEW YORK, NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: D.M.	Date: 30APR21	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	2
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y117.02.DWG		

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ATTACHMENTS

1. Professional Profiles
2. NYSDEC January 2021 PFAS Sampling Guidance
3. Laboratory’s Standard Operating Procedures and Detection/Reporting Limits for Emerging Contaminants
4. Roux’s Standard Operating Procedures

ATTACHMENT 1

Professional Profiles

Noelle M. Clarke, P.E.
Principal Engineer

TECHNICAL SPECIALTIES

Feasibility studies, pilot testing, remedial design, implementation, construction management, and startup evaluations for remediation of soil, groundwater, and sediment. Phase I/Phase II Environmental Site Assessments (ESA). Extensive experience at brownfields redevelopment sites, former industrial facilities, and public works facilities. Evaluation and design of storm water drainage systems. Evaluation, design, and construction management for new and existing wastewater treatment processes.

EXPERIENCE SUMMARY

Thirty years' experience: Principal Engineer/Senior Engineer at Remedial Engineering, P.C./Roux Associates; Project Engineer at Camp Dresser & McKee.

CREDENTIALS

B.S. – Civil Engineering, Manhattan College, 1991
M.E. – Environmental Engineering, Manhattan College, 1994

PAPERS AND PRESENTATIONS

Sparging Targets Submerged Residual Saturation Contamination, written with D. Bennett and L. Buchanan. Presented at the 66th New York Water Environment Federation Association Annual Meeting, New York, New York, February 1994.

Suffolk County Wetlands – Flow Augmentation Needs Study, written with M. A. Taylor and R. Southard. In Proceedings of the Annual Meeting, Hydrology and Hydrogeology of Urban and Urbanizing Areas. American Institute of Hydrology, April 1996.

KEY PROJECTS

- Principal Engineer providing due diligence support for real estate transactions on multiple projects in the New York metropolitan area. Projects have included multi-family housing (both affordable and market rate), retail/ commercial, community services and industrial properties. Services have included Phase I and Phase II ESAs.

- Principal Engineer for a Brownfield redevelopment of a property adjacent to a dry cleaning solvent distribution facility in Brooklyn, New York under the NYSDEC BCP. The site was previously a warehouse built on a former freight railyard that serviced the dry cleaning solvent facility. Offloading spillage on site and migration from the offsite facility resulted in significant soil, groundwater, and vapor contamination with chlorinated VOCs. The site was developed into multifamily housing with first floor retail use. Pre-remediation and posts-remediation Phase I ESAs were prepared by Roux Associates. The remedy, as summarized in the Remedial Action Work Plan (RAWP), consisted of soil hot spot removal, a physical barrier to limit on site migration, a permeable reactive wall to mitigate offsite migration, and a sub slab depressurization system. Roux Associates, under the direction of Ms. Clarke provided full time oversight of the remediation and prepared the Final Engineering Report and Site management Plan. The Certificate of Completion for the Site was obtained in October 2015 and Roux Associates is currently providing post-remediation monitoring services.

- Principal Engineer for a Brownfield redevelopment in Brooklyn, New York at a mixed-use multifamily housing/neighborhood retail complex with a former onsite dry cleaner under the NYSDEC BCP. There is soil, groundwater, and vapor contamination from chlorinated VOCs from the former onsite dry cleaner, as well as groundwater contamination from offsite dry cleaners. The remedy, described in the Remedial Action Work Plan prepared by Roux, consisted of hot spot soil removal, *in situ* groundwater treatment and a sub slab depressurization system for vapor mitigation in the existing buildings. The NYSDEC accepted the Final Engineering Report prepared by Roux Associates and the Site received a Certificate of Completion from NYSDEC in 2016.

- Principal Engineer for a complex dredging project for a major petroleum company on the Allegheny River in New York. The goal of the project is to remove 1,000 tons petroleum impacted sediments from the river. Work includes Site investigation, remedial investigation, alternatives evaluation, remedial design, planning and extensive regulatory permitting with multiple federal, state and local agencies.

- Principal Engineer for the alternatives evaluation, remedy selection, regulatory negotiation, preparation of design documents (drawings, specifications and permit applications) and permitting for all remedial components in support of redevelopment at a former metals manufacturing site in Staten Island, New York under the NYSDEC Voluntary Cleanup Program (VCP). The remedy included dredging and onsite disposal of stream sediments; consolidation and capping of fill material across the site; in-place abandonment of the Site's former sewer system; installation of drainage swales for storm water management; and wetland bank stabilization and mitigation/restoration. The work included a significant permitting component from multiple federal, state, and New York City regulatory agencies, including USACE, National Marine Fisheries, NYSDEC, NYSDOS, New York City Department of Environmental Protection, and Department of City Planning.

- Principal Engineer for the design, bidding, contractor selection, and remedial construction phase at a former metals manufacturing facility in Staten Island under the NYSDEC VCP. Responsibilities included finalizing biddable construction documents, issuing to bidders, preparing addenda and evaluating bids for presentation to the client. Following contractor selection Roux was heavily involved in coordinating with the client, regulators and contractor for mobilization to the site in late 2006.

During the construction Ms. Clarke provided support to the onsite construction manager regarding field changes, design revisions to account for unexpected conditions and contractor questions. The Final Engineering Report summarizing the construction activities was accepted by NYSDEC.

- Principal engineer for permitting of remedial activities at a metals manufacturing site in Staten Island, New York under the NYSDEC VCP. Required permits and regulatory approvals for the project included a Joint Permit from the USACE and NYSDEC for dredging of Mill Creek, bank stabilization and construction activities in the wetlands; a NYSDEC SPDES equivalency permit for discharge of treated water to the Arthur Kill, a New York State Department of State Coastal Management Program (CMP) Federal Consistency Assessment; a New York City Waterfront Revitalization Program Consistency Assessment, a modification of topography authorization from New York City Department of City Planning; and a New York City Department of Environmental Protection permit for temporary discharge to a combined sewer. Also required by the USACE and National Marine Fisheries, was preparation of an Essential Fish Habitat Study, in support of the Joint Permit application. Permitting activities included preparation of the various permit applications, forms and supporting documentation, as well as follow up meetings and correspondence to finalize the authorizations.
- Principal-in-Charge of an investigation and remediation project at a former petroleum refinery and current distribution facility located in Buffalo, New York. The site entered the NYSDEC BCP in 2006. Roux Associates completed the BCP application and supported the application process. The work included assessing and remediating the potential environmental impacts associated with historical Site operations. These activities have included preparing multiple work plans and directing the activities of another consultant performing the fieldwork and preparing reports of results for field investigations including soil boring and sampling, well installation and groundwater sampling, aquifer pump testing, and groundwater/separate phase modeling. An *in situ* chemical oxidation system was designed, installed and was operated as an IRM to remediate and area of free product and impacted groundwater discharging to the Buffalo River in OU-4.
- For the same petroleum Site in Buffalo, New York, multiple Alternatives Analysis Reports (to document analysis of engineering options and remedy recommendation), Remedial Action Work Plans and remedial design documents have been prepared to address the environmental impacts associated with the five Operable Units (OU) on the Site. Remedial construction for OU-1 was completed in 2007 and included excavation and disposal of impacted soil. The Final Construction Certification Report for OU-1 was accepted by the NYSDEC. The Alternatives Analysis Report and Remedial Design for OU-4 were submitted and approved by NYSDEC. The remedy for OU-4 included excavation and onsite consolidation of river sediments and site soil, stabilization of 1,400 linear feet of river embankment using tiered slopes, rip rap, and reinforced bioengineering, slurry wall groundwater containment, low permeability capping, a stormwater collection system and constructed wetland treatment for stormwater. Various vegetative measures were incorporated into the design in order to promote vegetative growth and enhance wildlife habitats. The remedial construction was completed in 2013 and 2014 and preparation of the Final Construction Completion Report was competed in 2015. The Alternatives Analysis Reports for OU-2 and OU-3 were submitted to NYSDEC. For OU-2, bench scale studies of stabilization/solidification agents were completed and evaluated for treatment of lead and petroleum impacted soil. In addition, field pilot studies of multiple options to treat petroleum impacted soils were completed and evaluated. Design of a stormwater collection system for portions of OU-2 and OU-3 was completed in 2010 and construction was completed in 2014 under the direction of Ms. Clarke.
- For the same petroleum terminal in Buffalo, New York, the work also included performing activities related to the operation of the remediation systems at the Site. These activities have included preparing a feasibility study work plan for improving water management systems at the site; preparing a work plan, directing the field work and preparing an evaluation summary report for startup and testing of a portion of the groundwater extraction system at the Site; and assisting in preparation of plans to upgrade the existing treatment facilities at the Site.
- For the same petroleum terminal in Buffalo, New York, the work also included preparation of design documents and a completion report for in-place closure of the site's former in-ground oil water separator. In addition, a vapor enhanced extraction pilot study work plan was prepared and implemented at the site for recovery of separate-phase product in one portion of the site located adjacent to the Buffalo River. The results of the VER pilot testing, along with the results of chemical oxidation pilot testing conducted at the site, have been summarized in a Remedial Action Selection report, which recommended implementation of chemical oxidation in this portion of the site. A conceptual plan for implementation of chemical oxidation was submitted with the selection document. The work also included maintaining contact with regulatory agencies regarding the status of activities at the Terminal; preparing compliance monitoring reports for submittal to

the regulatory agencies; overall project coordination; and budget management and tracking.

- Principal Engineer for the investigation, design, and implementation of a soil remediation project at a 4-acre former oil terminal in Cold Spring Harbor, New York under the NYSDEC spills program. The remedy completed included excavation and offsite disposal of approximately 20,000 tons of petroleum contaminated and/or hazardous lead contaminated soil in accordance with the future use of the site under an Environmental Easement. Additional activities completed by Roux at the site included asbestos remediation followed by building demolition, UST removal, and cesspool remediation. Roux prepared a Final Engineering Report, which was accepted by NYSDEC and resulted in the closure of the spill number for the Site.
- Principal Engineer for the investigation, design, and implementation of a soil remediation project at a portion of a former oil terminal in Sag Harbor, New York. The remedy completed included excavation and offsite disposal of approximately 2,000 tons of petroleum contaminated soil from beneath an active public roadway under the NYSDEC spills program. The remedy included extensive traffic control and coordination with Village of Sag Harbor officials, dewatering, water treatment, temporary water discharge of treated water to Sag Harbor and restoration of the public roadway in accordance with the Village of Sag Harbor Department of Public Works requirements. Roux prepared a Final Engineering Report, which was accepted by NYSDEC and resulted in the closure of the spill number for the Site. Project Manager for preparation of a work plan, direction the field activities and preparation of a summary report for investigation of the storm-water collection system at a petroleum terminal in Buffalo, New York. The objectives of the storm sewer investigation were to: prepare a detailed map of the Site's sewer system; re-establish connections that may have become blocked by debris; investigate the structural integrity of the storm sewers; locate areas of groundwater infiltration and assess infiltration rate and quality; assess wet and dry-weather flow and quality; and identify areas contributing surface water to the collection system, including hydrologic modeling using TR-55. Based on the results of the investigation, several improvements to the sewer system were recommended, including eliminating inlets to the system in areas of the site where no active operations currently take place and rehabilitation and/or installation of new sewers to restore flow by gravity to the treatment system.
- Principal Engineer for the investigation, remedial design, construction oversight and operation and maintenance of a bioventing and soil vapor extraction system at the Site of a diesel UST failure in Brooklyn. A free product recovery system was also designed, installed, and operated by Roux. Investigation activities included the use of the sonic drilling technique to advance twelve wells to 85 feet below grade through cobbles and boulders for delineation of separate phase product, soil and groundwater impacts. Eight wells were converted to combination biovent/SVE wells. Design included specification of SVE and biovent blowers, piping, valves, and an automatic control system. Product only pumps were also designed and installed in three wells. Approximately 2,000 gallons of product were recovered to by the two systems and the spill was closed by NYSDEC in 2011.
- Principal Engineer for a Brownfield redevelopment in Staten Island, New York of a former retail service station site under the NYSDEC BCP. There is soil, groundwater and vapor contamination from petroleum-related constituents in the vicinity of the former gasoline piping and pump island (the petroleum source area), as well as historic fill across the entire site. The remedy, described in the Remedial Action Work Plan prepared by Roux, will consist of a sheet pile containment wall around the petroleum source area, a Site Cover System across the entire site, comprised of concrete building slab/walkways, asphalt parking areas and limited landscaped areas and site-wide a sub-slab depressurization system to prevent vapor intrusion into the proposed retail building and offsite migration of impacted soil vapor. A certificate of completion from NYSDEC was obtained in 2020.
- Project Manager for the remedial design at a Superfund Site in Nanuet, New York for the New York State Department of Environmental Conservation. The work included preparation of a preliminary design report, which evaluated two alternatives for handling hazardous soils and sediments at the site contaminated with volatile organic compounds. Each alternative was evaluated on the basis of technical feasibility, cost and schedule for implementation. Based upon this evaluation, off-site disposal was recommended over on-site treatment. The report presented a site-wide conceptual plan for remediation, including soil/sediment excavation, staging and sampling; stream diversion; excavation dewatering; temporary on-site groundwater treatment; and long term monitoring. Duties also included managing and tracking all project budgets and serving as the main client contact.
- Principal Engineer for the design and specification of a large-scale (750 scfm) soil vapor extraction (SVE) pilot system with thermal oxidation off-gas treatment for a client in Brazil. Responsibilities included equipment sizing and specification, selection of materials of construction, SVE well and equipment layout, description of general startup procedures and preparation of a pilot test work plan. The pilot test work plan included a description of the pilot test operating procedures to be followed, operating parameters to be monitored and data to be collected and analyzed. The work also included

conducting the pilot test activities and generating a report that included plans for expanding the SVE system across the Site. The work currently also included technical support for evaluating and optimizing system performance.

- Project Manager for a storm sewer study at the former metals manufacturing facility in Staten Island, New York as part of the Voluntary Cleanup Program for the Site to identify contaminated infiltration sources, provide an accurate site drainage map, and verify contributing areas to each outfall. The investigation included field inspections, surveying, dye testing, and sampling during varying tidal conditions. The storm sewer map prepared was used for future sewer closure and site redevelopment planning.
- Principal engineer for the design of a new storm water collection system for a metals manufacturing site in Staten Island, New York under the NYSDEC VCP. The design included evaluation and hydrologic modeling of the system using the U.S.g Soil Conservation Service TR-55 hydrologic analysis model, inlet structure and pipe sizing and layout, outfall design and specification of materials and methods of construction for all system components.
- Principal-in-Charge of the operation, maintenance, monitoring and reporting activities at multiple active and former petroleum storage and distribution terminals located in New York for a large petroleum company. The work includes operation, maintenance, and performance/ compliance monitoring services at the sites that currently have active remediation system installed and monitoring, sampling, and reporting services at sites without systems. The remediation systems include groundwater extraction and treatment, free product recovery, bio-sparging, and soil vapor extraction/air sparging. At these sites, Roux Associates is responsible for: maintaining and troubleshooting the various system components to reduce downtime to the extent possible; repairing and/or replacing equipment as needed; coordinating the upgrading of the electrical systems, as needed, to meet current building code requirements; expanding systems to meet regulatory requirements, as needed; optimizing system performance; collecting performance monitoring samples and data to track the efficiency of the treatment systems; and collecting compliance monitoring data.
- Principal Engineer for at multiple petroleum terminals in New York State for groundwater quality and surface water quality sampling and monitoring well gauging as required by the New York State Department of Environmental Conservation, as well as quarterly reporting for all sites. The work has also included collection of soil quality data at several sites and performance of an electromagnetic survey to support the divestiture and redevelopment of one of these sites. Based on these results, soil removal activities were performed at one of the former terminals in order to obtain regulatory closure of the site. Roux Associates successfully completed the remedial activities to the satisfaction of the regulator and received closure for the client of the open spill number. Regulatory closure of another of these former terminals was obtained based upon the results of ongoing groundwater monitoring and reporting.
- Project Engineer for design of a 2.6-mgd groundwater treatment system at the Fireman's Training Center for Nassau County Department of Public Works on Long Island. The work included design of air strippers, exhaust stacks, liquid-phase GAC treatment units, and all chemical feed and storage facilities, including unit sizing, selection of materials of construction, equipment layout, and coordination with other disciplines. The work also included development of the "mass balance" for the facility.
- Task leader in charge of overseeing a bioventing pilot study conducted by a subconsultant, to treat contaminated vadose zone soils at the Fireman's Training Center site in Nassau County, New York. The work included development of a preliminary design report for the full-scale implementation of bioventing at the site based upon the results of the pilot study.
- Project Engineer for the design, specification, construction and operation of an air sparging and soil vapor extraction pilot at the Long Island terminal of a large petrochemical distributor. The pilot was designed to treat contaminated ground water and vadose zone soils resulting from a one-million-gallon gasoline spill at the site. The work included development of the field sampling program and sampling and evaluation of various parameters to determine the pilot's radius of influence and effectiveness. The work also included performing data analysis and preparation of the pilot study report, which recommended full scale implementation of air sparging at the site. The site-wide implementation of air sparging and expansion of the site's existing vapor extraction system at the same Long Island petrochemical terminal was also part of the work. Responsibilities included design, specification, and layout of all mechanical equipment, vapor extraction, and air sparging wells and new vapor extraction/air sparging piping.
- Task leader responsible for investigating alternatives for the treatment of gasoline contaminated off-gas from air stripping operations a Long Island petrochemical terminal. Based on this evaluation, biofiltration was selected for piloting. Responsibilities included design of a pilot unit; development of sampling and data collection procedures; construction oversight and "troubleshooting" for the unit; coordination of data collection activities; and compilation and analysis of the pilot data.

- Project Engineer for the design of a 0.50-mgd groundwater treatment facility a Long Island petrochemical terminal. Responsibilities included the design, specification, and layout of mechanical equipment, including the air stripping tower, vapor phase granular activated carbon off-gas treatment, centrifugal blowers, ductwork, influent pump, and concrete wet well. Responsible for shop drawing review during the construction phase.
- Project Manager for an investigation at a gasoline service station with soil and groundwater contamination. Responsible for reviewing and evaluating the work of another consultant that performed the soil and groundwater sampling and conducted remedial activities at the site including: investigation summary reports; remedial designs; remediation progress reports; correspondence with regulators; and plans for future work at the Site. The work also included mapping the groundwater flow patterns in the area of the service station and mapping the areal and vertical extent of the groundwater contamination. Responsible for project coordination and budget management and tracking.
- Project Manager for the field investigation, feasibility evaluation, and remedial design at Superfund Site in Spring Valley, New York for the New York State Department of Environmental Conservation. The work included development of a work plan and site operations plan. The field investigations included Geoprobe soil borings; groundwater monitoring well installation; groundwater sampling; aquifer pump testing; and vapor extraction pilot testing. Work also included conducting the field operations for the vapor extraction pilot and producing a summary report of the field investigation results. The report presented an evaluation of the cost and feasibility of several alternatives for remediation of the site. It recommended reducing the level of effort of the remediation presented in the Record of Decision, based on lower levels of contamination encountered during the investigation. Duties also included project coordination; budget management and tracking; and development of subcontract agreements.
- Project Engineer for upgrades to the Spring Creek Auxiliary Water Pollution Control Plant for the City of New York. The work included the evaluation, design, and specification of a two-stage odor control system, chemical storage and feed facilities and new effluent disinfection system.
- Project Engineer responsible for preparation of design documents for the replacement of the sodium hypochlorite pumps and piping at the Mamaroneck Wastewater Treatment Plant for Westchester County Department of Environmental Facilities in New York.
- Project Engineer for design of upgrades to the New Rochelle Wastewater Treatment Facility for Westchester Count Department of Environmental Facilities in New York. Designed upgrades to the main influent pump station, including rehabilitation of the existing influent pumps and replacement of the magnetic drives with new variable frequency drives. Responsibilities also included design of a submersible automatic duplex sump pump system, new primary sludge pumps and piping and new primary and secondary settling tank equipment. The work also included assisting the County during the bidding and contractor selection phase and preparing addenda to the contract documents.
- Project Manager for the construction of upgrades to the New Rochelle Wastewater Treatment Facility. Responsibilities included overseeing the shop drawing logging and distribution process; reviewing mechanical equipment shop drawings; addressing contractor questions regarding the contract documents; and coordinating with the resident engineer in the field and the electrical and general contractors.
- Project Engineer for the performance evaluation of the Harriman Wastewater Treatment Plant for the Orange County Department of Environmental Facilities and Services. Responsibilities included documentation of the existing conditions at the plant and evaluation of the historical and current performance of the plant with respect to its potential for expansion. A summary report was prepared, which included evaluations of the existing plant processes with respect to standard design criteria, typical design practices and receiving water considerations. This summary report served as the basis for the facilities plan prepared as the next phase of the project.
- Project Engineer for the facilities plan for the upgrade of the Harriman Wastewater Treatment Plant. Responsibilities included evaluation of alternatives for expanding the plant's treatment capacity. A report was prepared, which recommended the conversion of the existing oxidation ditches to sequencing batch reactors (SBR) in order to increase the plant's treatment capacity to 6.0 mgd within the limited space available on the site.
- Project Engineer for the Gates-Chili-Ogden Pump Station and Force main design for Monroe County, New York. The design consisted of a new 36 mgd wet pit/dry pit pump station, influent sewer and force main. Responsibilities included evaluating influent pumping conditions, and design of the influent sewer, manual influent bar racks and a duplex automatic submersible sump pump system for the station.

Jessica L. Taylor, P.G.
Principal Hydrogeologist

TECHNICAL SPECIALTIES

Project Management and Field Management for large-scale soil excavation and remediation projects, including site assessment, remediation implementation, and construction activities. Negotiation with NYSDEC Brownfield Cleanup Program (BCP) and NYCOER E-Designation/Voluntary Cleanup Program. Coordination and management of large-scale demolition and renovation support. Performance of sampling and direction of field sampling teams for the following media: soil, groundwater, surface water, soil vapor, sludge, and sediment. Excavation sampling and oversight and waste tracking.

EXPERIENCE SUMMARY

Fifteen years of experience: Principal, Senior, Project, and Staff Hydrogeologist, Roux Environmental Engineering and Geology, D.P.C., Islandia, New York; Staff Hydrogeologist and Intern at GSC|Kleinfelder.

CREDENTIALS

B.S. Geology, Binghamton University, 2005
Professional Geologist, New York, 2017
OSHA 40-Hour HAZWOPER Training, 2005
OSHA 10-Hour Construction Safety Training, 2008

KEY PROJECTS

- Project Principal for a large on-going redevelopment project in Brooklyn, New York, including four buildings with E-Designations. The project encompasses 22 acres including the Barclays Center. Project includes coordination and oversight of *in situ* waste characterization sampling, excavation, and proper disposal of soil. Coordination of pre-demolition asbestos and hazardous materials surveys. Construction management and support for excavation of 500,000 CY of soil; environmental support for demolition and relocating of an active nine-acre 100-year old rail yard. Responsible for implementing and managing remediation work at several NYSDEC spill sites within the project footprint, including *in situ* chemical oxidation, UST removal, and soil excavation. Agency support for NYSDEC, NYCDEP, NYCOER, MTA (LIRR/NYCT), and ESDC.

- Project Principal for remediation of two parcels in Queens, New York as part of NYSDEC Brownfield Cleanup Program. This project included due-diligence environmental assessment and investigation, development of NYSDEC-approved Remedial Investigation Work Plan and Remedial Action Work Plan, and remediation during construction of two mixed-use, affordable housing developments. Also required coordination with NYCHPD and NYCDEP to meet regulatory requirements for funding.

- Project Principal for remediation of a 0.66-acre parcel in Brooklyn, New York as part of NYSDEC Brownfield Cleanup Program. This project included due-diligence environmental assessment and investigation, development of NYSDEC-approved RIWP and RAWP including an active sub-slab depressurization system, and remediation during construction of a mixed-use affordable housing developments including full cellar. Also required coordination with NYCHPD and NYCDEP to meet regulatory requirements for funding.

- Project Principal for management of E-Designation during excavation and construction of a hotel/residential building in Manhattanville, including management of waste characterization and disposal of 16,000 CY of soil.

- Project Principal for redevelopment of four properties in Brooklyn, with NYCOER to address NYCDEP E-Designations. Coordination with NYCOER to implement remedial investigation and develop RAP as part of the NYC VCP.

- Senior Project Manager for the environmental management of asbestos remediation during the renovation of Nassau Coliseum, Uniondale, New York. Responsible for coordinating inspections and delineation of ACM, preparing budgetary estimates, and bid support for full abatement. Also includes management of decommissioning and replacement of existing emergency generator UST.

- Project Manager for commercial redevelopment site in the Bronx, including *in situ* waste characterization, management and coordination of excavation, community air monitoring, and development of NYCDEP-approved RAP.

- Client liaison and full-time onsite construction manager at redevelopment site in Rego Park, New York. Collection of 500 *in situ* waste characterization soil samples, oversight of 250,000 cubic yards of soil excavation and remediation, development of post-remediation sampling plan, organization of waste manifests and hazardous waste documents to ensure proper disposal. Coordination of daily site activities with multiple construction contractors and other involved parties on behalf of client. Oversight and confirmatory soil sampling for on-site treatment of 75,000 cubic yards of hazardous lead contaminated soil.

- Project and Field Manager for multiple Phase I and Phase II ESAs of retail gasoline stations in New York and New Jersey. This includes drilling and sampling oversight and health and safety management, as well as writing Phase II ESA reports for over 40 sites.

Valerie Sabatasso

Project Scientist

TECHNICAL SPECIALTIES

Design, implementation, and management of Remedial Investigations and Remedial Actions for sites in regulatory programs including United States Environmental Protection Agency Superfund program, New York State Brownfields Cleanup Program, and New York City Office of Environmental Remediation Voluntary Cleanup Program; Management of due diligence Phase I & II Environmental Site Assessments; Preparation and management of Remedial Investigation Work Plans, Remedial Investigation Reports, Remedial Action Work Plans, and Remedial Action Reports; Investigation and evaluation of petroleum-related contamination and per- and poly fluoroalkyl substances (PFAS)-related contamination; Management of Environmental Site Assessments focusing on soil, groundwater, and soil vapor investigations. Performance of sampling for the following media: soil, groundwater, surface water, soil vapor, and sediment.; and Excavation sampling and oversight and waste tracking.

EXPERIENCE SUMMARY

Six years of experience: Project and Staff Scientist at Roux Environmental Engineering and Geology, D.P.C.

CREDENTIALS

B.S. Physics, Stony Brook University, 2014

OSHA 40-hour HAZWOPER Training, 2015

OSHA 30-hour Construction Safety Training, 2019
OSHA 8-hour Refresher Training, 2016 - 2019

OSHA 10-hour Construction Safety Training, 2015

First Aid and CPR Certified
Transportation Worker Identification Credential (TWIC)
Loss Prevention System (LPS) Awareness, 8-Hour Certified
MTA LIRR Roadway Worker Protection Training

KEY PROJECTS

- Project Manager for the ongoing large scale excavation of a former airport long-term parking lot in Queens, New York. Redevelopment includes a unique, large-scale warehouse meant to ease transportation of goods for the airport. The project is enrolled in the NYC OER VCP, which has transferred over 70,000 CY, most of which has been through the Clean Soil Bank, and will obtain a Track 1 Cleanup. Management of excavation oversight has included remediation for the closure of 28 drywells, nonfibrous asbestos abatement, and the removal of three unregistered USTs discovered during excavation.
- Project Manager for a series of clusters of sites across East New York and the Bronx, New York. Currently, seven Phase I ESAs and eight Phase II ESAs have been completed have been completed. A RAWP is being completed for one of the properties, which has an E designation and is under guidance of the NYC OER.
- Project Manager for an affordable housing redevelopment site under NYCDEP guidance in Bronx, New York. This project included a due diligence environmental investigation; remedial investigations (soil, groundwater, and soil vapor); site-wide *in situ* waste characterization sampling program; a Remedial Action Work Plan, the management of soil and bedrock excavation, and a Remedial Closure Report.
- Project Manager for the ongoing remediation of over 20 drywell structures at a strip mall facility in Setauket, New York. The drywell remediation project was conducted in accordance with the Suffolk County Article XII requirements and entailed coordination with Suffolk County Department of Health Services (SCDHS).
- Project Manager for remedial investigation at a former gas station located in Brooklyn, New York. Historical site operations adversely affected the subsurface through petroleum hydrocarbon impacts. Responsibilities included creating and managing an initial sample plan for soil and groundwater, designing a remediation plan that included a small scale excavation and the use of RegenOx™ oxygen-releasing pellets, and maintaining communication between subcontractors.
- Field Manager for the installation of over 400 points for a Vapor Mitigation System in an active warehouse in New Jersey. Responsible for semi-annual indoor air sampling consisting of 130 air samples collected following each tenant's specific schedule as well as consistent SSDS monitoring to ensure the system is running correctly and efficiently.
- Project Manager for underground storage tank (UST) discovery, inventory, and removal. Field responsibilities involved subcontractor oversight for excavation and removal of UST, tank cleaning, and waste management.
- Field Manager responsible for implementation of a remedial investigation at a former Manufactured Gas Plant (MGP) site in Brooklyn, New York. Tasks included management of remedial

investigation, collection of forensic samples, and management of on-site Health and Safety.

- Staff Scientist as a former alumina manufacturing facility in Corpus Christi, Texas. Tasks included intrusive site investigation, health and safety management, collection of samples for laboratory analysis from various media including soil, sediment, surface water, and groundwater, and completion of pH tests of surface water above 13 pH. Areas of concern being addressed by the investigation included the manufacturing area, wastewater percolation ponds, on-site landfills, and various surface water features.
- Performed numerous Phase I Environmental Site Assessments for due diligence in connection with property transfers for the Metro New York Area. Most properties included commercial properties, former automobile service stations, and residential/office buildings.
- Field manager responsible for soil excavation and waste removal oversight for development of residential buildings in Brooklyn, New York. Responsibilities included overseeing excavation, organization and proper handling of waste manifests and ensuring compliance with the Site Environmental Management Plan.
- Field Manager responsible for implementation of Remedial Investigation Work Plan (RIWP) at an industrial warehouse in Brooklyn, New York that is currently being developed for residential apartments. Responsible for groundwater level monitoring which included recording, entering, and reviewing data with in Situ electronic transducers.
- Field manager responsible for implementation of Community Air Monitoring Plan (CAMP) during excavation at a hospital in Greenwich Village, New York. Monitored airborne dust and VOCs that are potentially generated by remedial action work activities, reviewing the collected data for exceedances of the New York State Department of Health (NYSDOH) guidelines. Intrusive activities included removing concrete and rebar and backfilling with clean soil. In addition to CAMP activities, assisted project engineer and construction manager with contractor oversight, material review, health and safety oversight, and daily reporting.
- Staff Scientist responsible for Phase II Site Assessment and preparation of investigation reports for soil boring installation, monitoring well installation and corresponding soil, soil vapor, and groundwater sampling.
- Project execution manager for various projects at multiple locations in Manhattan, the Bronx, Staten Island, Queens, and Brooklyn, New York. Activities including: subcontractor coordination, scheduling, bottleware and sample management, subcontractor contract preparation, scope of work project design, subcontractor oversight, system operations and maintenance, tenant relations, and health and safety management.
- Site Safety Officer for various remedial investigation sites. Responsibilities include preparation of health and safety plans (HASPs), job safety analysis (JSA) documents development and review, onsite safety meeting management, safety document preparation (Lessons Learned, Near Loss, Field Audits, etc.), and planning/execution of corrective actions.

ATTACHMENT 2

NYSDEC January 2021 PFAS Sampling Guidance

NEW YORK STATE OF OPPORTUNITY.
Department of Environmental Conservation

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

Under NYSDEC's Part 375 Remedial Programs

January 2021

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January 2021

ERRATA SHEET for

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

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC’s Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	“However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101.”	“However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533.”	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	“In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.”	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020

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

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

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021

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

Objective

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

Applicability

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

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

Field Sampling Procedures

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

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

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

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

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

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

Routine Analysis

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

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

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

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

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

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

Data Assessment and Application to Site Cleanup

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

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below. In addition, further assessment of water may be warranted if either of the following screening levels are met:

a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or
b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L

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

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

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

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

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

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

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

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

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

General Guidelines in Accordance with DER-10

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

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

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

General

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

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

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

Equipment

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

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

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

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

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

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

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

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

Equipment

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

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

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

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

Equipment Decontamination

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

Sampling Techniques

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

Appendix D - Sampling Protocols for PFAS in Surface Water

General

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

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

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

Equipment

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

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

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

- stainless steel cup

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

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

General

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

Laboratory Analysis and Container

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

Equipment

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

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

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

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

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

Version: 8

Previous Version Date: 21 March 2018

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

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

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

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

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

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

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

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

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

1. Project and Site Name.

2. DEC Region.

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

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

5. Preservation Method.

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

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

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

3. Date collected.

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

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

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

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

D. General data collection recommendations:

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

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

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

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

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

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

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

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

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

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

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

    No materials containing Teflon.
    No Post-it notes.
    No ice packs; only water ice or dry ice.
    Any gloves worn must be powder free nitrile.
    No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
    No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
    Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
    Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
    Wear clothing washed at least six times since purchase.
    Wear clothing washed without fabric softener.
    Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

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

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

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

page ______ of ______

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

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

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

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

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

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

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

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

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

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

Town of ____, in __________________________________ County.

Item(s) ____

____

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

____ ____________________________
Signature Date

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

____ ___________________
Signature Date

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

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

NOTICE OF WARRANTY

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

HANDLING INSTRUCTIONS

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

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

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

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

EQUIPMENT LIST

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

Fish measuring board.

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

Individually numbered metal tags for fish.

Manila tags to label bags.

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

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic 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

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

General

New York State Department of Environmental Conservation’s Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER’s Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

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

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

ATTACHMENT 3

Laboratory's Standard Operating Procedures and Detection/Reporting Limits for Emerging Contaminants

Title: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometery (GC/MS), SW846 Methods 8270D and 8270E

Once printed, this is considered an uncontrolled document

Approvals (Signature/Date):

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1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

USEPA Methods 8270D and 8270E are analytical methods which employ the use of GC/MS to determine the concentration of semivolatile organic compounds in extracts prepared from many types of solid waste matrices, soils, and water samples

TestAmerica Edison has the capability to analyze and report the compounds listed in Table 1 via Methods 8270D and 8270E.

Table 1

Compound	CAS No.	Compound	CAS No.
1,1'-Biphenyl	92-52-4	Anthracene **(1)**	120-12-7
1,2,4,5-Tetrachlorobenzene	95-94-3	Atrazine	1912-24-9
1,2,4-Trichlorobenzene	120-82-1	Benzaldehyde	100-52-7
1,2-Dichlorobenzene	95-50-1	Benzidine	92-87-5
1,2-Diphenylhydrazine	122-66-7	Benzo[a]anthracene **(1)**	56-55-3
1,3-Dichlorobenzene	541-73-1	Benzo[a]pyrene **(1)**	50-32-8
1,3-Dimethylnaphthalene	575-41-7	Benzo[b]fluoranthene **(1)**	205-99-2
1,4-Dichlorobenzene	106-46-7	Benzo[g,h,i]perylene **(1)**	191-24-2
1,4-Dichlorobenzene-d4 **(ISTD)**	3855-82-1	Benzo[k]fluoranthene **(1)**	207-08-9
1,4-Dioxane **(1) (2)**	123-91-1	Benzoic acid	65-85-0
1-Methylnaphthalene	90-12-0	Benzyl alcohol	100-51-6
1-Naphthylamine	134-32-7	Bis(2-chloroethoxy)methane	111-91-1
2,2'-oxybis[1-chloropropane]	108-60-1	Bis(2-chloroethyl)ether **(1)**	111-44-4
2,3,4,6-Tetrachlorophenol	58-90-2	Bis(2-ethylhexyl) phthalate	117-81-7
2,3,7,8-TCDD	1746-01-6	Bisphenol-A	80-05-7
2,3-Dihydroindene	496-11-7	Butyl benzyl phthalate	85-68-7
2,3-Dimethylaniline	87-59-2	Caprolactam	105-60-2
2,4,5-Trichlorophenol	95-95-4	Carbamazepine	298-46-4
2,4,5-Trimethylaniline	137-17-7	Carbazole	86-74-8
2,4,6-Tribromophenol **(Surrogate)**	118-79-6	Chrysene **(1)**	218-01-9
2,4,6-Trichlorophenol	88-06-2	Chrysene-d12 **(ISTD)**	1719-03-5
2,4-Dichlorophenol	120-83-2	Coumarin	91-64-5
2,4-Dimethylphenol	105-67-9	Dibenz(a,h)anthracene **(1)**	53-70-3
2,4-Dinitrophenol	51-28-5	Dibenzofuran	132-64-9
2,4-Dinitrotoluene	121-14-2	Diethyl phthalate	84-66-2
2,4-Xylidine	95-68-1	Dimethyl phthalate	131-11-3
2,6-Dinitrotoluene	606-20-2	Di-n-butyl phthalate	84-74-2
2-Chloronaphthalene	91-58-7	Di-n-octyl phthalate	117-84-0
2-Chlorophenol	95-57-8	Fluoranthene **(1)**	206-44-0
2-Ethylaniline	578-54-1	Fluorene **(1)**	86-73-7
2-Fluorobiphenyl **(Surrogate)**	321-60-8	Hexachlorobenzene **(1)**	118-74-1
2-Fluorophenol **(Surrogate)**	367-12-4	Hexachlorobutadiene	87-68-3
2-Methylnaphthalene	91-57-6	Hexachlorocyclopentadiene	77-47-4
2-Methylphenol	95-48-7	Hexachloroethane	67-72-1
2-Naphthylamine	91-59-8	Indeno[1,2,3-cd]pyrene **(1)**	193-39-5
2-Nitroaniline	88-74-4	Isophorone	78-59-1
2-Nitrophenol	88-75-5	n,n'-Dimethylaniline	121-69-7
2-tertbutyl-4-methylphenol	2409-55-4	Naphthalene **(1)**	91-20-3
2-Toluidine	95-53-4	Naphthalene-d8 **(ISTD)**	1146-65-2

Table 1

Compound	**CAS No.**	**Compound**	**CAS No.**
3 & 4 Methylphenol	15831-10-4	n-Decane	124-18-5
3,3'-Dichlorobenzidine	91-94-1	Nitrobenzene	98-95-3
3,4-Dimethylaniline	95-64-7	Nitrobenzene-d5 **(Surrogate)**	4165-60-0
3,5-di-tert-butyl-4-hydroxytol	128-37-0	N-Nitrosodimethylamine **(1)**	62-75-9
3-Nitroaniline	99-09-2	N-Nitrosodi-n-propylamine	621-64-7
4,6-Dinitro-2-methylphenol **(1)**	534-52-1	N-Nitrosodiphenylamine	86-30-6
4-Bromophenyl phenyl ether	101-55-3	n-Octadecane	593-45-3
4-chloro-2-methylaniline	95-69-2	o-Toluidine-d9 **(Surrogate)**	194423-47-7
4-Chloro-3-methylphenol	59-50-7	Pentachloronitrobenzene	82-68-8
4-Chloroaniline	106-47-8	Pentachlorophenol **(1)**	87-86-5
4-Chloroaniline–d4 **(Surrogate)**	191656-33-4	Perylene-d12 **(ISTD)**	1520-96-3
4-Chlorophenyl phenyl ether	7005-72-3	Phenanthrene **(1)**	85-01-8
4-Methylphenol	106-44-5	Phenanthrene-d10 (**ISTD**)	1517-22-2
4-Nitroaniline	100-01-6	Phenol	108-95-2
4-Nitrophenol	100-02-7	Phenol-d5 **(Surrogate)**	4165-62-2
Acenaphthene **(1)**	83-32-9	Phenyl ether	101-84-8
Acenaphthene-d10 **(ISTD)**	15067-26-2	Pyrene **(1)**	129-00-0
Acenaphthylene **(1)**	208-96-8	Pyridine	110-86-1
Acetophenone	98-86-2	Terphenyl-d14 **(Surrogate)**	1718-51-0
Aniline	62-53-3	Total Cresols	STL00160
Aniline-d5 **(Surrogate)**	4165-61-1		

(1) Compound can be analyzed by full scan or Selected Ion Monitoring (SIM).
(2) Compound can also be analyzed by Isotope Dilution/SIM.

1.2 For a listing of method detection limits (MDLs) and Reporting Limits (RLs) please refer to the currently active Method 8270 Method Limit Groups in TALS (TestAmerica LIMS).

1.3 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 7 (*Review of Work)*, and Section 19 (*Test Methods and Method Validation)* in TestAmerica Edison's Quality Assurance Manual (TestAmerica Edison Document No. ED-QA-LQM).

1.4 Any variation in procedure shall be completely documented using an NCM. The NCM is approved by the supervisor and then automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA department also receives NCMs by e-mail for tracking and trending purposes. The NCM process is described in more detail in SOP ED-GEN-003. The NCM shall be filed in the project file and addressed in the case narrative. Any unauthorized deviations from this procedure must also be documented as a nonconformance, with a cause and corrective action described.

2.0 Summary of Method

2.1 This method is used for the analysis of aqueous and solid matrices for semi-volatile base, neutral and acid organic compounds that are extracted from the sample matrix with an organic solvent.

2.2 An aliquot of sample containing surrogate spiking compounds is extracted with an organic solvent. The extract is concentrated on a steam bath to a suitable volume. Internal standards are added to the extract.

2.3 Sample extraction techniques are specified for each matrix in the following TestAmerica Edison SOPs:

- ED-ORP-002 (*Extraction of Semivolatile Organic Compounds in Water by Separatory Funnel, SW846 Method 3510C*);
- ED-ORP-043 (*SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270);*
- ED-ORP-0044 (*Microwave Extraction for Solids, SW846 Method 3546*);

2.4 A small aliquot of the extract is injected into a gas chromatograph (GC) equipped with a capillary column. The GC is temperature programmed to separate the compounds which were recovered during the extraction step by boiling point. The effluent of the gas chromatograph is interfaced to a mass spectrometer (MS) which is used to detect the compounds eluting from the GC. The detected compounds are fragmented with an electron beam to produce a mass spectrum which is characteristic of the compound introduced into the MS. Identification of target analytes is accomplished by comparing their mass spectra with the electron ionization spectra of authentic standards. Quantitation is accomplished by comparing the response of a major ion (quantitation ion) relative to an internal standard established through a five-point calibration (six points for second order regression). Specific calibration and quality control steps are included in the method that must be performed and must meet the specifications of SW846 Methods 8270D or 8270E as applicable.

2.5 The standard preparation procedure for aqueous samples involves use of a Reduced Volume Extraction (250 ml) (RVE) followed by analysis using a Large Volume Injection (LVI). Optionally, a full volume (1000 ml nominal) may be employed. The details of the extractions are outlined in the applicable prep SOPs while the analytical details for 8270D and 8270E are presented in this SOP.

2.6 These methods are also applicable to the analysis of samples by Selected Ion Monitoring (SIM) for the purpose of obtaining lower reporting limits for the following compounds:

**Table 2 –
SIM Analytes**

SIM Analytes	CAS #
1,4-Dioxane	123-91-1
4,6-Dinitro-2-methylphenol	534-52-1
Acenaphthene	83-32-9

Table 2 –
SIM Analytes

SIM Analytes	CAS #
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo[a]anthracene	56-55-3
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[g,h,i]perylene	191-24-2
Benzo[k]fluoranthene	207-08-9
Bis(2-chloroethyl)ether	111-44-4
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Indeno[1,2,3-cd]pyrene	193-39-5
Naphthalene	91-20-3
N-Nitrosodimethylamine	62-75-9
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Pyrene	129-00-0

2.7 An isotope dilution selected ion monitoring (SIM) technique for the analysis of 1,4-dioxane in water at a reporting level of 0.2 ug/l is also described in this SOP. Using this technique 1,4-dioxane-d8 is added prior to sample extraction and is used as an internal standard to calculate the concentration of 1,4-dioxane present. Additionally, 1,4-dichorobenzene-d4 is added to the extract prior to analysis to monitor the recovery of 1,4-dioxane-d8.

3.0 Definitions

For a complete list of definitions refer to Appendix 2 in the most current revision of the Quality Assurance Manual (ED-QA-LQM).

4.0 Interferences

4.1 GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Analysts must take steps to determine the source of the interference and take corrective action to eliminate the problem.

4.1.1 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe is automatically rinsed with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross-contamination. Alternately, verify that the sample analyzed after the high concentration sample does not show any carryover through inspection of chromatogram and target results.

4.1.2 Contaminants from the extraction process detected in the method blank should be evaluated to determine the impact on the analysis. Interferences from any target analyte must not be present in the method blank above the reporting limit for that compound. If these types of interferences occur, corrective action is required. The source should be identified and corrective action initiated to eliminate the interference from the extraction process. Affected samples must be re-extracted and re-analyzed.

4.1.3 The analyst must take precautions to make sure that contaminants do not enter the analytical system. These precautions include systematic procedures designed to eliminate interferences.

4.2 Some compounds analyzed by this method are unstable or sensitive to extraction and/or instrument conditions:

- Benzidine is easily oxidized during extraction. Neutral extraction may enhance the recovery of this compound.
- Hexachlorocyclopentadiene breaks down photochemically and can decompose from high temperatures, particularly in the injection port of the GC. This compound can also react with acetone in solution.
- 1,2-Diphenylhydrazine is unstable even at room temperature and readily converts to azobenzene.
- Phenols are sensitive to active sites and can give a low response or exhibit poor chromatography by tailing. Therefore, it is important the GC is maintained in the best possible condition. See Section 10.1 for proper daily maintenance.
- N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be distinguished from diphenylamine.
- 3-Methylphenol cannot be separated from 4-methylphenol by the conditions specified in this method. They are reported as 3 and 4-methylphenol.
- Pyridine may perform poorly at the GC injection port temperatures listed in this SOP. Lowering the injection port temperature may reduce the amount of degradation.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1. Specific Safety Concerns or Requirements

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Toluene	Flammable Poison Irritant	200 ppm-TWA 300 ppm-Ceiling	Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Causes severe eye and skin irritation with redness and pain. May be absorbed through the skin.
Dimethyl-dichloro-silane	Flammable	none	Can be corrosive to the respiratory tract causing severe irritation and tissue damage. Harmful if absorbed through the skin. May cause severe irritation and systemic damage. Severely irritating to the skin and eyes. Harmful if swallowed. Can cause abdominal discomfort, nausea, vomiting, diarrhea, and irritation to the mouth, throat and stomach.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Gas chromatograph/mass spectrometer system

6.1.1 Gas chromatograph: An Agilent/HP 6890/7890/900 Intuvo (or equivalent) houses the capillary column. The GC provides a splitless injection port and allows the column to be directly coupled to the mass spectrometer. The oven is temperature programmable to meet the requirements of the method. An HP/Agilent 7673/7683/7963 autosampler (or equivalent) with a 10 ul syringe provides automatic injection of sample extracts while the instrument is unattended.

6.1.2 Analytical Column: 30m x 0.25mm ID, 0.25 um film thickness, Restek Rxi-5Sil MS, Catalog #13623

6.1.3 Mass spectrometer: Agilent (HP) 5972, 5973, 5975 or 5977A Mass Selective Detector (MSD) Capable of scanning from 35 to 500 amu every 1 sec or less, using 70 volts electron energy in the electron ionization mode. The mass spectrometer must be capable of producing a mass spectrum for 50 ng of decafluorotriphenylphosphine (DFTPP) which meets the criteria in Section 9.2.1 when 2 ul of the 25 ug/ml GC/MS tuning standard is injected through the GC.

6.1.4 GC/MS interface: Any GC-to-MS interface may be used that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria.

6.1.5 Data system: The data system is interfaced to the mass spectrometer and accommodates continuous acquisition and storage of GC/MS data throughout the duration of the chromatographic program. The data system consists of a Hewlett-Packard Chemstation equipped with Mustang software used for instrument control and data acquisition. This, in turn, is interfaced to TestAmerica's Chrom software for data processing. Data from sample extract analysis can be accessed in real-time, while sample data reports and library searches can be performed on data files from previously run samples. The software is also capable of searching any GC/MS data file for ions of a specific mass whose abundances can be plotted versus time or scan number which allows integration of abundances for any extracted ion between specified times or scan-number limits. Library searches utilize a NIST 02.1 Mass Spectral Library.

6.2 Bottles, glass with polytetrafluoroethylene (PTFE)-lined screw caps or crimp tops.

6.3 Injection port liners, splitless

6.4 Injection port septa

6.5 Injection port graphite seals

6.6 Pre-silanized glass wool (Supelco 2-0411 or equivalent)

6.7 Syringes, Assorted sizes 10ul - 1000ul; gas-tight

6.8 Bottles, 10 and 5ml amber screw cap with Teflon liner

6.9 Vials, 2ml amber screw cap with Teflon liner

6.10 Wheaton microvials 100ul (or equivalent)

6.11 Volumetric Flasks, Class A with ground glass stoppers (2ml - 100ml)

6.12 Analytical balance, ASP Model SP-180 (or equivalent), capable of accurately weighing to 0.0001 gr.

7.0 Reagents and Standards

The following items are recommended for performing this procedure. Equivalent items should only be used when they result in an improvement in quality, efficiency, productivity, or cost. An item can be considered equivalent if with its use, the analytical and QA/QC requirements in this SOP can be met. Please refer to the MSDS prior to the use of any reagent or standard.

The preparation of standards, surrogates and spiking solutions is documented in the TALS Reagent Module. Formulary reports can be generated upon request.

7.1. Reagents:

7.1.1. Methylene Chloride: J.T.Baker Resi-Analyzed, used for Organic Residue Analysis (P/N 9266-V8 or equivalent).

7.1.2. Methanol: J.T.Baker Purge and Trap Grade (P/N 9077-02 or equivalent).

7.1.3. Sylon-CT: Supelco (P/N 33065-U or equivalent). Sylon-CT is a highly reactive silanizing reagent consisting of 95% Toluene and 5% Dimethyldichlorosilane (DMDCS).

7.1.4. Each lot of solvent is screened for contaminants before being used for analysis as detailed in TestAmerica Corporate Quality SOP No. CA-Q-S-001 (*Solvent & Acid Lot Testing & Approval*) and TestAmerica Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*).

7.2. Standards:

7.2.1. **Calibration Standards (Full Scan Analysis)**: Stock analytical standard solutions are purchased mainly from Restek Corporation. Other standards are prepared in the laboratory as needed using neat compounds or prepared solutions purchased from Agilent, SPEX CertiPrep, Chem Service, Accustandard, Supelco or other suppliers. Standards prep instructions are detailed for the following full scan analyte list options:

- Full Volume Aqueous Prep; and,
- Reduced Volume Aqueous Prep and Soils

Secondary dilutions are either made from purchased stock solutions as listed below or from prepared solutions as listed in the following table:

NOTE: Second sources (from certified separate lots) are used for ICV standards.

Table 3 – Full Scan Stock Standards

Target Analyte Standard Name	Conc. (PPM)	Vendor	Catalog #
1,2,3,4-TCDD	50	SPEX	SVO-TANJ-12
Agilent Mix (contains compounds listed in Table 4 below)	2000 *	Agilent	Cus 0456
8270 List 1/ Std #1 Megamix	Varied	Restek	571995
8270 List 1/ Std#9	2000	Restek	569730
8270 List 1/ Std#11	2000	Restek	569732
8270 Surrogate Standard	5000*	Restek	567685
8270 Internal Standard	2000	Restek	567684
8270 List 1/ Std#10	2000	Restek	569731
Bisphenol-A	1000	Agilent	Cus-0457

*Agilent Mix, 8270 list1/std#9 and 8270 Surrogate standard are diluted to 100ppm prior to the preparation of the 1.0ppm and 0.5ppm standards.

Table 4
Agilent Mix
Catalog No. Cus-0456

Analyte	Concentration (PPM)
Pentachloronitrobenzene	2000
2 -tert-butyl-4-Methylphenol	2000
2,6-Di-tert-butyl-4-Methylphenol	2000
Coumarin	2000
Phenyl ether	2000
N,N’-Dimethylaniline	2000
N-Methylaniline	2000
Carbamazepine	2000
Benzonitrile	2000
1,3-Dimethylnaphthalene	2000

7.2.1.1. Individual calibration standards for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 5
Full Volume Aqueous Prep and Soils
Working Standards Preparation

Solution Name	120 PPM	80 PPM	50 PPM	20 PPM	10 PPM	5 PPM	2 PPM	1 PPM	0.5 PPM
8270 List 1/ Std #1 Megamix	3000 ul	2000 ul	2500 ul	500ul	250ul	250ul	100ul	50ul	25ul
8270 List 1/ Std #9	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	50ul	500ul*	250ul *
8270 List 1/ Std #10	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	-	-	-
Agilent custom Mix	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	50ul	500ul*	250ul *
1,2,3,4-TCDD	-	-	500ul	-	-	-	-	-	-
8270 Surrogate Standard	600ul	400ul	500ul	100ul	50ul	50ul	20ul	500ul*	250ul *
8270 Internal Standard	500ul	500ul	1000 ul	500ul	500ul	1000 ul	1000 ul	1000 ul	1000 ul
Bisphenol-A	3000 ul	2000 ul	2500 ul	500ul	250ul	250ul	100ul	-	-
8270 List 1/ Std #11	400ul	300ul	500ul	200ul	125ul	125ul	50ul	25ul	-
Final Volume (ml)	**25**	**25**	**50**	**25**	**25**	**50**	**50**	**50**	**50**

Note: The 1.0ppm and 0.5pmm standards (above) are prepared using the 100ug/ml standard for Agilent custom Mix, 8270 List1/std#9 and 8270 Surrogate Standard.

Table 6
Reduced Volume Extraction/LVI
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	1 PPM	0.4 PPM	0.2 PPM	0.1 PPM
120 ppm (see Table 5)	2.0mL								
80 ppm (see Table 5)		2.0 mL							
50 ppm (see Table 5)			2.0 mL						
20 ppm (see Table 5)				2.0 mL					

Table 6 Reduced Volume Extraction/LVI Working Standards Preparation									
Solution Name	**24 PPM**	**16 PPM**	**10 PPM**	**4 PPM**	**2 PPM**	**1 PPM**	**0.4 PPM**	**0.2 PPM**	**0.1 PPM**
10 ppm (see Table 5)					2.0 mL				
5.0 ppm (see Table 5)						2.0 mL			
2.0 ppm (see Table 5)							2.0mL		
1.0 ppm (see Table 5)								2.0 mL	
0.5 ppm (see Table 5)									2.0mL
Final Volume (ml)	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**

7.2.1.2. **Initial Calibration Verification (full scan)**: Second source ICVs for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of ICVs for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 7 8270/625 ICV Working Standards Preparation	
Solution Name	**25 PPM**
8270 List 1/ Std #1 Megamix (2nd Lot)	250ul
8270 List 1/ Std #9 (2nd Lot)	125ul
8270 List 1/ Std #10 (2nd Lot)	125ul
Agilent custom Mix (2nd Lot)	125ul
8270 Internal Standard	200ul
8270 List 1/ Std#11	125ul
Bisphenol-A (2nd Lot)	250ul
Final Volume (ml)	**10**

7.2.1.3. **Surrogate Standards (Full Scan Analysis):** A 5000ppm Surrogate Standard is purchased from Restek for use in spiking blanks, samples and associated QC prior to extraction (reference the applicable sample prep SOPs for spiking instructions).

Table 8
Full Scan Surrogate Standards Solution
Restek Catalog No. 567685

Surrogate Standard Compounds	Concentration (PPM)
Nitrobenzene-d5	5000
p-Terphenyl-d14	5000
2,4,6-Tribromophenol	5000
Phenol-d5	5000
2-Fluorobiphenyl	5000
2-Fluorophenol	5000

7.2.1.4. **Internal Standards** (**Full Scan Analysis**): The Internal Standards Solution at 2000ppm is purchased from Restek (Catalog # 567684). The Internal Standard solution is stored in 10ml amber screw cap bottles with Teflon liners in the dark at 4°C. The Internal standard solution is used in preparing all analytical standards. Inject 20ul of this solution (2000ppm) per ml of sample extract prior to analysis resulting in a concentration of 40ppm (ug/ml) in the extract.

Table 9
Full Scan Internal Standards Solution
Restek Catalog No. 567684

Internal Standard Compounds	Concentration (PPM)
1,4-Dichlorobenzene-d4	2000
Phenanthrene-d10	2000
Naphthalene-d8	2000
Chrysene-d12	2000
Acenaphthene-d10	2000
Perylene-d12	2000

7.2.2. **Calibration Standards (SIM analysis)**: The Edison lab currently analyzes only a select list of compounds by 8270D/8270E SIM (see Sections 1.0 and 2.0). Stock analytical SIM standard solutions are purchased mainly from Agilent. Working standards are prepared from these solutions as listed in the tables in Section 7.2.2.1:

Table 10 Stock SIM Standards

Standard Name	Concentration	Vendor	Catalog #
Pentachlorophenol	1000ppm	AGILENT	PH-180-1
n-Nitrosodimethylamine	100ppm	AGILENT	NS-100-1
Hexachlorobenzene	100ppm*	AGILENT	CH-151-1
PAH Mix	100ppm	AGILENT	PAH-605-1
Bis(2-chloroethyl)ether	100ppm*	AGILENT	BEC-110-1
4,6-Dinitro-2-methylphenol	1000ppm**	AGILENT	PH-150
1,4-Dioxane	1000ppm**	AGILENT	NV-152-1

*Hexachlorobenzene and Bis(2-chloroethyl)ether are diluted to 10ppm prior to SIM Standards prep

** 4,6-Dinitro-2-methylphenol and 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

NOTE: Second sources (from separate lots are used for ICV standards).

7.2.2.1 Individual calibration standards for SIM analysis are prepared in one of two ways depending upon the technique (full volume aqueous prep or reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 11
Full Volume Aqueous Prep – SIM
Working Standards Preparation

	0.025 PPM	**0.05 PPM**	**0.1 PPM**	**0.5 PPM**	**1.0 PPM**	**5.0 PPM**
Pentachlorophenol	2.5uL	2.5uL	12.5uL	10uL	20uL	50uL
n-Nitrosodimethylamine	25uL	25uL	125uL	100uL	200uL	500uL
PAH mix	6.25uL	5uL	25uL	50uL	100uL	200uL
Hexachlorobenzene	25uL	25uL	250uL	1000uL	2000uL	500uL*
Bis(2-chloroethyl)ether	25uL	25uL	250uL	1000uL	2000uL	500uL*
4,6-dinitro-2-methylphenol	50ul	50ul	250ul	200ul	400ul	1000ul
1,4-Dioxane	25ul	50ul	250ul	200ul	400ul	1000ul
ISTD	500uL	200uL	500uL	200uL	200uL	200uL
Final Volume (ml)	**25**	**10**	**25**	**10**	**10**	**10**

*For Hexachlorobenzene and Bis(2-chloroethyl)ether the 5.0 ppm level is prepared using the 100ppm standard.

Table 12
Reduced Volume Extraction/LVI – SIM
Working Standards Preparation

	0.005 PPM	**0.01 PPM**	**0.02 PPM**	**0.10 PPM**	**0.20 PPM**	**1.0 PPM**
0.025 PPM Std (see Table 11)	1.0 mL					
0.05 PPM Std (see Table 11)		1.0 mL				
0.1 PPM Std (see Table 11)			1.0 mL			
0.5 PPM Std (see Table 11)				1.0 mL		
1.0 PPM Std (see Table 11)					1.0 mL	
5.0 PPM Std (see Table 11)						1.0 mL
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**

7.2.2.2 Initial Calibration Verification (SIM): A 0.1 ppm separate lot SIM ICV is prepared as detailed in Table 13 using the stock standards detailed in Section 7.2.2 (above)

Table 13 0.1ppm SIM ICV preparation	
Pentachlorophenol	25uL
n-Nitrosodimethylamine	25uL
PAH mix	5uL
Hexachlorobenzene	5uL
1,4-Dioxane	5ul
4,6-Dinitro-2-methylphenol	100ul
ISTD	**100uL**
Final Volume	**5 ml**

7.2.2.3 Internal Standard solution (SIM): A 50 ppm Internal Standard solution for SIM analysis is prepared by adding 125ul of the 2000ppm stock ISTD (see Section 7.2.1.4) and bringing to volume with Methylene Chloride in a 5ml volumetric flask.

7.2.2.3.1 For SIM analysis inject 20ul of this solution (50ppm) per ml of sample extract prior to analysis resulting in a concentration of 1ppm (ug/ml) in the extract.

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7.2.3. Calibration Standards (Isotope Dilution SIM – 1,4-Dioxane): The Edison lab currently analyzes only for 1,4-dioxane by 8270D/8270E isotope dilution SIM (see Sections 1.0 and 2.0). Stock analytical isotope dilution SIM standard solutions are purchased mainly from Accustandard and Restek. Working standards are prepared from these solutions as listed in the tables below.

Table 14 - Stock 1,4-Dioxane Isotope Dilution SIM Standards			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane	1000ppm*	Accustandard	APP-9-096

* 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

Table 15 - Stock Labeled 1,4-Dioxane SIM Surrogate/Internal Standard (added at prep)			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane-d8	2000ppm	Restek	30614

Table 16 - Stock 1,4-Dioxane Isotope Dilution SIM Internal Standard (added to extract)			
Standard Name	**Concentration**	**Vendor**	**Catalog #**

1,4-Dichlorobenzene-d4	2000ppm	Accustandard	AZ-014J-3

7.2.3.1 Individual calibration standards for 1,4-dioxane isotope dilution SIM analysis are prepared at the concentrations detailed in the following tables. Prepare by combining the appropriate volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 17
Reduced Volume Extraction/LVI – 1,4-Dioxane Isotope Dilution SIM
ICAL Standard Concentrations (ug/ml)

	Lev 1	**Lev 2**	**Lev 3**	**Lev 4**	**Lev 5**	**Lev 6**	**Lev 7**	**Lev 8**	**ICV***
1,4-Dioxane	0.02	0.04	0.1	0.2	0.5	1	2	10	0.2
1,4-Dioxane-d8	4	4	4	4	4	4	4	4	4
1,4-Dichlorobenzene-d4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

***:** The ICV is prepared from the second source stock in Table 13.

7.2.4. **GC/MS Instrument Performance Check (DFTPP):** The DFTPP standard is prepared by is prepared at 25 ppm by adding 2.5ml of EPA 8270 GC/MS Tuning Solution II (Restek Catalog # 31615) to a 100ml volumetric flask and bringing to volume with Methylene Chloride.

7.2.5. Information on prepared standard solutions must be recorded in the TALS Reagent Module. Information such as standard supplier, lot number, original concentration, a description of how the standard was made, are required along with the laboratory lot number, analyst's initials, date prepared, expiration date and verification signature. Standards must be remade every 6 months, or sooner, if the standards expire or begin to show signs of unacceptable degradation. Class "A" volumetric must be used at all times and syringes, preferably gas-tight syringes when available, should be checked for accuracy using an analytical balance. Class "A" pipettes should also be used if volumes permit.

7.2.6. Please refer to TestAmerica Edison SOP No. ED-GEN-008, Standard Operating Procedure for Preparation, Purity and storage of Reagents and Standards.

- Shelf Life of Standard: 1 year after preparation or stock standard manufacture expiration, whichever comes first;
- Storage Requirements: Stock standards are stored at 4°C and Working Standards stored at -10°C to -20°C.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 All samples must be stored at 4°C (± 2°C) upon receipt.

8.2 Sample Extract Storage. Samples extracts must be protected from light and refrigerated at 4°C (± 2°C) from time of extraction until analysis.

8.3 Sample Extract Holding Time. All sample extracts must be analyzed within 40 days of extraction.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Waters	Amber glass, 1L	1000 ml or 250 ml (1)	Cool 4 ± 2°C	7 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270D/8270E
Solids	Wide mouth glass, 8 or 16 oz.	50g	Cool 4 ± 2°C	14 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270D/8270E

(1) : Reduced volume extraction (RVE) LVI option

9.0 Quality Control

9.1. **Sample QC** - The following quality control samples are prepared with each batch of samples.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Rpt. Limit
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	Statistical Limits [4]
Matrix Spike (MS)[2]	1 in 20 or fewer samples	Statistical Limits [4]
MS Duplicate (MSD)[2]	1 in 20 or fewer samples	Statistical Limits [4]
Surrogates	every sample[3]	Statistical Limits [4]
Internal Standards	Every sample	Response within -50% to +100% of CCV

[1] LCS Duplicate (LCD) is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract.
[2] The sample selection for MS/MSD are randomly selected, unless specifically requested by a client….predetermined by the extraction lab.
[3] Analytical and QC samples (MB, LCS, MS/MSD, Method Blank)
[4] Statistical control limits are determined annually and are updated into TALS limit group..

9.1.1. **Method blanks** are extracted with every sample batch on each day that samples are extracted. To be considered acceptable, the method blank must contain less than the reporting limit of all target compounds except for phthalates, which can be present at up to 5x the MDL. For method 8270E the method blank is generally acceptable if target analyte concentrations are less than the one half the reporting limit.

If method blanks are unacceptably contaminated with target compounds that are also present in field samples, all affected samples must be re-extracted and re-analyzed. Corrective action must be taken to identify and eliminate the contamination source. Demonstrate that acceptable blanks can be obtained before continuing with sample extraction and analysis. Method blanks must be analyzed on each instrument on which the associated samples are analyzed.

9.1.1.1. Surrogate recoveries for the method blank are compared to laboratory generated limits. If two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference.. If any surrogate is still outside limits, all samples and QC samples associated with that method blank must be re-extracted (volume permitting).

9.1.2. Matrix Spike (MS)/Matrix Spike Duplicate (MSD): A matrix spike/matrix spike duplicate (MS/MSD) pair is extracted and analyzed with every 20 environmental samples of a specific matrix (defined as a sample batch). Full compound list spiking is employed for MS/MSDs and LCSs. These spikes are prepared and extracted concurrent with sample preparation. MS and MSD recoveries are calculated and compared to lab generated acceptance criteria. See the current active TALS 8270 Method Limit Group for QC limits. The MS/MSD spiking solution should the same as used for the calibration standards.

9.1.2.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.2.2 An LCS/LCSD may be substituted for the MS/MSD if insufficient sample volume is available.

9.1.3. Laboratory Control Sample (LCS)/Laboratory Control Sample Duplicate (LCSD): A Laboratory Control Sample (LCS) (aka blank spike) must be extracted and analyzed with each batch of 20 environmental samples. The LCS data is used to assess method performance if the MS/MSD recoveries fall outside of the lab generated limits (See the current active TALS 8270 Method Limit Group for QC limits). If the LCS recovery is within the current lab generated limits, the MS/MSD recoveries are attributed to matrix interference.

9.1.3.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.3.2 Spike recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.4. **Surrogate Standards:** All full scan samples, blanks and QC samples are spiked with a six (6) component surrogate standard mix (see Section 7.2.1.3). The percent recovery of the surrogate standards is calculated and compared to lab generated limits (See the current active TALS 8270 Method Limit Group for QC limits*)*.

If any two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference. If a surrogate is diluted to a concentration below that of the lowest calibration standard, no corrective action is necessary.

9.1.4.1 Surrogate recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.5. **Internal Standards:** The response (area count) of each internal standard in the sample must be within -50 +100% of its corresponding internal standard in the CCV or, the ICAL midpoint for samples analyzed under the initial calibration range. Failure to meet these criteria is indicative of sample matrix effects. All samples failing these criteria must be reanalyzed to confirm matrix effects.

9.2. Instrument QC

9.2.1 **GC/MS Instrument Performance Check (DFTPP)**: (**Note**: the DFTPP performance check applies only to full scan analyses and is not evaluated for SIM analysis). The GC/MS system is tuned using Perfluortributylamine (PFTBA) such that an injection of 50ng of Decafluorotriphenylphosphine (DFTPP) meet the abundance criteria listed in the table below. Prior to the analysis of any calibration standards or samples, the GC/MS system must meet all DFTPP key ion abundance criteria. This analysis will verify proper tuning of the system for a period of 12 hours post-injection. After 12 hours, the instrument performance must again be verified prior to the analysis of standards, QC or samples. Daily tune verification is not required for 8270E CCV.

DFTPP Key Ions and Abundance Criteria	
Mass	**Ion Abundance Criteria**
51	30-60% of mass 198
68	<2% of mass 69
69	reference only
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base Peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

9.2.1.1. Evaluate DFTPP using three scan averaging and background subtraction techniques. Select the scan at the peak apex, add +1 scan from the apex and -1 scans from the apex.

9.2.1.2. The mass spectrum of DFTPP may be background subtracted to eliminate column bleed or instrument background ions. Background subtract DFTPP by selecting a scan for subtraction ≤20 scans <u>before</u> the apex scan of DFTPP.

9.2.1.3. Check column performance using pentachlorophenol and the benzidine peaks (these compounds are included in the DFTPP solution). Benzidine & Pentachlorophenol should respond normally without significant peak tailing (Tailing Factor should be <2 measured at 10% peak height). If responses are poor and excessive peak tailing is present, corrective action for the GC/MS instrument may be required. Corrective actions may include:

9.2.1.3.1 Retune the GC/MS;
9.2.1.3.2 Clip the injector end of the GC column;
9.2.1.3.3 Replace the septum and injection port liner;
9.2.1.3.4 Change the injection port seal;
9.2.1.3.5 Replace the GC column;
9.2.1.3.6 Clean the injection port with MeCl2
9.2.1.3.7 Clean the MS ion source;
9.2.1.3.8 Place a service call.

9.2.1.4. The breakdown of 4, 4-DDT into 4,4-DDD and 4,4’DDE may also be used to assess GC column performance and injection port inertness. If so evaluated the breakdown must be <20%.

9.2.1.5. DFTPP parameter settings are stored in a tune file, which will be used in all subsequent analysis of standards and sample extracts.

9.2.2 Initial Calibration Range and Initial Calibration Verification

9.2.2.1. **Initial Calibration:** The initial calibration range consists of a minimum of five concentration levels of analytical standards (six for second order regression) prepared as described in Section 7.2. and analyzed once the DFTPP instrument performance check has met the criteria in Section 9.2.1. .

9.2.2.2. **Initial Calibration Verification (ICV):** An Initial Calibration Verification (ICV) standard is analyzed immediately after the Initial Calibration Range and before any samples are analyzed. The ICV is prepared as detailed in Section 7.2. The ICV must be from a source (or lot) separate from the standards used in the Initial Calibration Range.

9.2.3 Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV): A mid-point Continuing Calibration Verification (CCV) must be analyzed every 12 hours after the DFTPP instrument performance check (when applicable).. The CCV is prepared as detailed in Section 7.2. (typically, 50 ug/ml for full volume aqueous and soils, 10 ug/ml for LV, 0.02 ug/ml for LVI SIM) and 0.2 for isotope dilution SIM). Additionally a Low Level Continuing Calibration Verification (LLCCV) is analyzed after the CCV for full scan analysis. The LLCCV is the same as the lowest calibration level analyzed with the initial calibration range (See Section 7.2).

9.2.4 Calibration Acceptance Summary

9.2.4.1. **Retention Time Windows:** Retention time windows must be established to compensate for minor shifts in absolute retention times as a result of sample loading and normal chromatographic variability. Obtain the retention time for all compounds from the analysis of the midpoint standard for the calibration curve. Establish the center of the retention time window by using the absolute retention time for each analyte, internal standard and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration. For qualitative identification to be acceptable the retention time of the relative retention time (automatically calculated in Chrom) must be within 0.8 - 1.2 RRT units of its assigned internal standard. The relative retention times of each compound in the five calibration standards must agree within .06 relative retention time units.

9.2.4.2. **Initial Calibration Range:** Internal standard calibration is employed for this method. After the initial calibration range has been analyzed the relative response factor (RRF) for each target/surrogate compound at each concentration level is determined using the following equation.

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where:
A_x = Area characteristic ion (see Table 21) for the compound
Ais = Area characteristic ion (see Table 21) of associated internal standard
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

9.2.4.2.1. Determine the mean RRF for each compound. Minimum response factors must be met for each of the compounds listed in Table 18 (below). Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity in the analytical batch to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met.

Table 18:
Minimum Response Factors

Compound	Minimum Response Factor
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl) ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
Bis(2-chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200

Table 18:
Minimum Response Factors

Compound	Minimum Response Factor
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
4-chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethyl phthalene	0.010
2,6-Dinitrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-chlorophenyl-phenyl ether	0.400
Fluorene	0.900
4-Nitroanailine	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butyl phthalene	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3'-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010

Table 18:
Minimum Response Factors

Compound	Minimum Response Factor
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010
Pentachloronitrobenzene	0.050

9.2.4.2.2. Calculate the Standard Deviation (SD) and Percent Relative Standard Deviation (% RSD) of the response factors for each compound:

$$\% \text{ RSD} = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

9.2.4.2.3. The % RSD of the RRF's must be ≤20% for each target analyte listed in Table 18. The % RSD of each target analytes must be ≤20% in order for the calibration range to be acceptable. Additionally for 8270E, the calculated concentration or amount of each analyte of interest in the CCV standard should fall within ±20%. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit or do not meet the minimum correlation coefficient (0.99) for alternate fits (see below) then appropriate corrective maintenance action must be performed. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit **AND** do not meet the minimum correlation coefficient (0.99) then recalibration is necessary.

9.2.4.2.4. If the above listed criteria is met, the system can be assumed to be linear and sample analysis may begin and the average RF from the initial calibration range is used to quantitate all samples.

9.2.4.2.4.1 Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.2.5. An alternative calibration technique may be employed for those any compounds exceeding the 20% RSD criteria:

9.2.4.2.5.1 Calculate the first order linear regression for any compound which did not meet the 20% criteria. First order linear regression calibration may be employed if alternative average response calibration procedures were not applicable. The r value (Correlation Coefficient) of the equation must be ≥0.99 for the calibration to be employed.

9.2.4.2.5.2 Second order regression calibration can be used for any compound that has an established history as a non-linear performer.

9.2.4.2.5.3 If second order regression calibration is used a minimum of six (6) calibration levels must be analyzed.

9.2.4.2.5.4 If second order regression calibration is used, the r^2 (Correlation Coefficient) value must be $\underline{>}$ 0.99

9.2.4.2.5.5 Any compound that fails to meet the 20% RSD or or 0.99 correlation coefficient criteria must be flagged as estimated for detects (or must be noted in the narrative). If there are non-detects the compounds may be reported if there is adequate sensitivity to detect at the quantitation limit. To demonstrate adequate sensitivity analyze the low level point of the initial calibration in each analytical batch (LLCCV) The criteria for demonstrating adequate sensitivity is detection in the LLCCV using the standard qualitative identification criteria.

9.2.4.2.5.6. When calculating the calibration curve using the linear calibration model a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration back into the curve. The recalculated concentration of the low calibration point should be within ±50% of the standard's concentration. This evaluation can be checked using the Initial Calibration %Drift Report in Chrom. Any detects for analytes calibrated using the linear model and failing this readback criterion must be flagged as estimated or detailed in the narrative.

9.2.4.3. **Calibration Point Read-back Criteria**: Whichever calibration model above is selected, it should be subjected to an additional check to establish the representativeness of the data that were used to produce it. This check is the refitting of each calibration point response back to the calibration model, or the comparison of the calculated amount of the standard against the expected amount.

- CHROM software provides an Initial Calibration %Drift report which shows the % Error for each calibration point. This report must be reviewed in addition to the %RSD / Linear Response Factor.

- The absolute value of the % Error for each calibration point should be < 30%. For the lowest calibration point, the % Error may be <50%.

- See Section 11.8 for the Calculation of Percent (%) Error.

9.2.4.4. **Initial Calibration Verification (ICV):**.Once the initial calibration has been analyzed and has met the above criteria, a second source Initial Calibration Verification (ICV) (as prepared in Section 7.2) must be analyzed and evaluated. The ICV must meet the criteria of 70-130% recovery for all compounds with the exception of the poor performing compounds listed in Attachment 1 which are allowed to be within 50-150% : An NCM must be initiated to denote any ICV non-conformances.

9.2.4.5. The ICV must meet the criteria of 70-130% recovery for all compounds however up to 10% of the compounds are allowed to exceed these criteria as long as their recoveries are within 65-135%. For the poor performers (see Attachment 1) the range is 50-150%. If the criterion is not met, a second ICV may be analyzed after corrective measures are taken. If a second ICV analysis fails to meet criteria proceed with corrective action and the analysis of a new initial calibration range. Flagging: If the ICV limits are outside of criteria (high) for an analyte and that analyte is undetected in the sample, no flagging or narration is required. If the ICV limits are outside of criteria (low) for an analyte and that analyte is undetected in a sample, narrate the non-conformance in an NCM. When that out of spec analyte is detected in a sample, describe the issue in the narrative, or flag as estimated.

9.2.4.6. **Continuing Calibration Verification (CCV):** A CCV consisting of a standard at or near the midpoint of the Initial Calibration Range is analyzed every 12 hours of instrument operation or at the beginning of an analytical sequence to verify the initial calibration. The calibration verification consists of a DFTPP instrument performance check (not required for 8270E), and analysis of a calibration verification standard. **Note:** Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.5.1 Tune Verification: Follow the procedure for verifying the instrument tune described in section 9.2.1 using a 50 ng injection of DFTPP. If the tune cannot be verified, analysis must be stopped, corrective action taken and a return to “control” demonstrated before continuing with the calibration verification process. For 8270E analysis only, tune verification is required just prior to ICAL.

9.2.4.5.2 Calibration Verification: Analyze the calibration verification standard immediately after a DFTPP that meets criteria. Daily analysis of the DFTPP is not required as part of the CCV for 8270E analysis. .When samples are analyzed after an ICAL the last ICAL standard may be used as the starting time reference for evaluation. Use the mid point calibration standard (approximately 50ug/l). NOTE: The calibration standard contains internal standards; Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12}, and Perylene d_{12} at 40ug/l (0.1ug/L for SIM). The calibration check standard must also include all the target analytes from the original calibration.

9.2.4.5.3 The RFs must meet the criteria for the compounds in Table 18. Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met

9.2.4.5.4 The percent difference (when using average response factor) or percent drift (when using linear regression) of the compounds in Table 18 must be ≤20% for at least 80% of the total analyte list. If more than 20% of the compound list fail to 20% difference or drift criterion then appropriate corrective action must be taken prior to the analysis of the samples. Any individual compound that fails must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only (%D criteria are not applied) but the standard qualitative identification criteria in the method must be met.

9.2.4.5.5 **CCV Poor Performers**: Refer to Attachment 1 for the identification of poor and/or erratic performing analytes. These analytes are allowed a %D >20% but must be <50 %D to be acceptable. If there are poor performers that exceed 50%D, the data may be reported provided results are noted as estimated. An NCM must be initiated to denote this situation.

9.2.4.5.6 The retention times of the internal standards from the calibration check must be within ±30 seconds of the internal standards from the mid point standard of the original calibration. If the retention time for any internal standard changes by more than 30 seconds from the latest daily (12 hour) calibration standard, the chromatographic system is inspected for malfunctions, and corrections made as required. If corrective action does not result in the retention time criteria being achieved, the system must be re-calibrated using four additional standards.

9.2.4.5.7 The response (area count) of each internal standard in the calibration verification standard must be within 50 - 100% of its corresponding internal standard in the mid-level calibration standard of the active calibration curve. If the EICP area for any internal standard changes by more than a factor of two (-50% +100%), the mass spectrometer system must be inspected for malfunction and corrections made as appropriate. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning is required.

9.2.4.5.8 The relative retention times of each compound in the calibration verification standard must agree within .06 relative retention time units of its value in the initial calibration.

9.2.4.5.9 Use the average response factors from the original five-point calibration for quantitative analysis of target analytes identified in field samples.

9.2.4.5.10 Prepare a calibration summary or list indicating which compounds did not meet the 20% average percent difference criteria. Record this information in that run log.

9.2.4.7. **Low Level Continuing Calibration Verification (LLCCV):** An LLCCV consisting of the low level standard from the initial calibration range is analyzed every 12 hours of instrument operation after the CCV. The purpose and evaluation of the LLCCV is described in Section 9.2.4.4.4.

10.0 Procedure

10.1. Gas Chromatograph/Mass Spectrometer Operation

10.1.1. The sequence of events for GC/MS analysis involves many steps. First the injection system and column performance and calibration must be verified. Maintenance operations are performed as needed.

10.1.2. Preparation of the Injection Port Liner and Installation Procedure: Prior to the start of initial calibration and each daily analysis of sample extracts, a new liner for the injection port must be prepared. Once a liner has been used it is no longer inert and will cause serious chromatography problems with phenols and other compounds. When preparing the liner, proper laboratory protection must be worn and the liner must be prepared in a well-ventilated hood. When the procedure is completed all traces of toluene, Sylon-Ct and methanol will be removed immediately so that extraction solvents and preparation of sample extracts will not come into contact with these solvents and become contaminated.

10.1.2.1 Remove one liner from a 40ml VOA bottle containing other liners immersed in Sylon-Ct solution. Rinse off the liner with Toluene and wipe dry. Insert 1cm of pre-silanized glass wool partially into one end of the liner and trim neatly. Push the glass wool into the center of the liner so that it is 1 1/4" from the bottom. Do not use glass wool or solvents that are dirty (i.e. suspended particles) or use liners which are chipped on the ends, deformed or fractured. Inspect the glass wool for cleanliness after it has been inserted.

10.1.2.2 Using a Pasteur pipette flush out the interior of the liner containing the glass wool with Sylon-Ct. Rest the liner horizontally on a small beaker and allow the Sylon-Ct to re-deactivate the interior surfaces and the glass wool. There should be no air bubbles caught in the glass wool. After several minutes flush out the Sylon-Ct with toluene and finally with methanol. Dry the outer surface of the liner and rest it on the injection port housing until the remaining methanol is boiled off

10.1.2.3 Insert the liner with the newly silanized glass wool plug into the injection port. Verify that the column extends up into the injection port and is perpendicular. Inspect the graphite seal and replace it if the edges are knife-shaped.

10.1.2.4 The septum is always replaced daily. Bake out the column at 300^{o}C for 15 minutes after the vacuum in the analyzer has returned to normal.

10.1.2.5 Performance may enhanced by clipping a small portion of the column at the injection port end. Document this activity in the maintenance record.

10.1.3. Prior to calibration or sample analysis always verify that the analyzer is under sufficient vacuum and that the column has proper carrier gas flow.

10.1.4. Establish the following GC/MS operating conditions:

10.1.4.1 Full Scan Operating Mode

Full Scan Mode – Standard Injection Volume
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

Full Scan Mode – Large Volume Injection (LVI)
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C

25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 5ul
Splitless Valve Time: 0.3 minutes

10.1.4.2 SIM Operating Mode

SIM Mode
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.5 minutes
Initial Column Temperature and Hold Time: 40°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 3 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

10.1.4.3 Isotope Dilution Selected Ion Monitoring Mode :

SIM Parameters

Group 1
Plot 1 Ion: 74.0

Ions/Dwell in Group	(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
	42.0	50	43. 0	50	68.0	50
	74.0	50	128.0	50	129.0	50
	136.0	50	150.0	50	152.0	50
	93.0	50	66.0	50		
	58.0	50				
	88.0	50				

Group 2
Group Start Time: 6.00
Plot 1 Ion: 152.0

Ions/Dwell in Group	(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
	151.0	50	152.0	50	153.0	50
	154.0	50	162.0	50	164.0	50
	165.0	50	166.0	50		

Group 3
Group Start Time: 7.80
Plot 1 Ion: 188.0

Ions/Dwell in Group	(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
	94.0	50	101.0	50	142.0	50
	178.0	50	179.0	50	188.0	50
	202.0	50	264.0	50	266.0	50
	284.0	50				

Group 4
Group Start Time: 10.50
Plot 1 Ion: 228

Ions/Dwell in Group	(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
	120.0	50	228.0	50	229.0	50
	240.0	50				

Group 5
Group Start Time: 12.00
Plot 1 Ion: 252.0

Ions/Dwell in Group	(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
	138.0	50	139.0	50	252.0	50
	253.0	50	260.0	50	264.0	50
	267.0	50	276.0	50	278.0	50

Table 19: Target Compound - Primary and Monitoring Ions

Compound	1	2	3
1,4-Dioxane-d8	96	64	62
1,4-Dioxane	88	58	57
1,4-Dichlorobenzene-d4	152	150	

10.1.5. The above listed instrument conditions are used for all analytical standards for calibration and for all sample extracts analyzed by this method.

10.1.5.1 The column conditions, scan start time, and splitless valve time for analysis of DFTPP only are as follows are as follows:

Initial Column Temperature and Hold Time: 140^{O}C for 0.5 minutes
Column Temperature Program: 140^{O} to 320^{O}C at 22^{O}C/minute
Final Column Temperature Hold: 320C for 0.5 minutes
Scan Start Time: approx. 5 minutes
Splitless Valve Time: 0.3 minutes
Injection Volume: 2 ul

10.2. Analytical Sequence

10.2.1. Dilutions are made based on initial GC/MS analysis. Dilutions are made in 1-ml vials using microsyringes. Calculate the dilution factor using the equation below:

DF= Ph / 5 x Is
Where:
DF = Dilution Factor
Ph = Sample Peak Height
Is = Internal Standard Peak Height

When DF >1 but <2, combine 500ul of sample extract with 500ul methylene chloride in a 1 ml amber vial, add20 ul internal standard and crimp seal

Use **Table 20** to determine dilution and internal standard amount.

Table 20
Dilution Factor Calculations

DF Value	Volume of Sample (ul)	Volume of Methylene Chloride (ul)	Volume of ISTD (ul)
<1	1,000	None	None
>1, <2	500	500	10
>4, <5	200	800	16
>10, <20	100	900	36
>20	500*	500	10

*Prepare this dilution by serially diluting the >10, <20 dilution

10.2.2. Instrument Performance and Calibration Sequence

10.2.2.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.2.2.2. Analyze the Instrument Performance Check Standard (DFTPP) as discussed in Section 9.2.1.

10.2.2.3. Initially and as required, analyze the Initial Calibration Range (minimum 5 points, six points for second order regression) as detailed in Sections 7.2.1 and 9.2.4.2. Evaluate the acceptability of the Initial Calibration Range as detailed in Section 9.2.4.2.

10.2.2.4. Immediately after the Initial Calibration Range only, analyze the Initial Calibration Verification (ICV) as detailed in Sections 7.2. and 9.2.4.3. Evaluate the acceptability of the ICV as detailed in Section 9.2.4.3.

10.2.2.5. Every 12 hours, reanalyze and evaluate the Instrument Performance Check Standard (DFTPP), not required for 8270E followed by the Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV) as detailed in Section 9.2.3, 9.2.4.4 and 9.2.4.5. Evaluate the acceptability of the CCV and LLCCV as detailed in Section 9.2.4.4

10.2.2.6. Client samples and QC samples are analyzed (as detailed in Section 10.2.3) after acceptable Instrument Performance and Calibration Checks and until the 12 hour clock expires. Repeat the sequence as required. The automation of GC/MS runs is accomplished via the “SEQUENCE” macro of the ChemStation.

10.2.3. Sample Analysis Sequence

10.2.3.1. Sample extracts are normally prepared on the same day as analysis. The GC/MS operator will prepare the extracts that will be run on his or her instrument. Volume adjustments to the extracts will be made at the discretion of the supervisor.

10.2.3.2. Prior to the start of sample analysis the GC/MS operator will generate a sequence program containing the list of the sample extracts to be analyzed, the position on the autosampler tray, and the proper acquisition and tune methods that are to be used. This sequence program contains all the necessary information on the samples to be analyzed and how the GC/MS system is to analyze them. The sample extracts are loaded onto the autosampler (ALS) tray. Their position is verified by checking them against the ALS number on the sequence. This batch analysis will be performed automatically over the 12-hour period.

10.2.3.3. The analytical run log is printed as a record of samples analyzed. The analyst will annotate the run log with any required information regarding anomalies or unusual events. The run log must be signed by the analyst and a reviewed and signed by a trained peer or manager

10.3. Data Processing

10.3.1. Prior to processing any standards or samples, target compound lists and sublists must be assembled. Chrom's auto-processing system queries TALS (LIMS) for each sample's processing parameters (including target compounds lists) and downloads the required processing methods from LIMS to analyze data. These lists are required for processing of all data files including calibration files. The data includes compound names, retention time data, quantitation ions, qualitative identification ions, and the assigned internal standard for qualitative and quantitative identification.

10.3.2. Key data is manually entered the first time a compound list is used for data processing. Processing data using a compound list automatically generates response factor data and updates retention information.

10.3.3. The characteristic ions for target compounds, surrogate compounds, and internal standards which can be determined using SW8270D and 8270E are listed in Table 21..

10.4. Interpretation and Qualitative Identification: Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1 Target Analytes: Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.4.1.2. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other.

10.4.1.3. The relative retention time (RRT) of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

10.4.1.4. The most abundant ion in the standard target spectrum that equals 100% MUST also be present in the sample target spectrum.

10.4.1.5. All other ions that are greater than 10% in the standard target spectra should also be present in the sample.

10.4.1.6. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

10.4.1.7. If the compound does not meet all of the criteria listed above, but is deemed a match in the technical judgment of the mass spectral interpretation specialist, the compound will be positively identified and reported with documentation of the identification noted in the raw data record.

10.4.2 **Non-Target Analytes:** Upon client request a library search to identify non-target Tentatively Identified Compounds (TIC) is performed. The NIST/EPA/NIH mass spectral library is used to identify non-target compounds (not including internal standard and surrogate compounds) of greatest apparent concentration by a forward search of the library. The following guidelines are used by the analyst when making TIC identifications:

10.4.2.1. Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.

10.4.2.2. The relative intensities of the major ions should agree within ±20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

10.4.2.3. Molecular ions present in the reference spectrum should be present in the sample spectrum.

10.4.2.4. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

10.4.2.5. Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

10.4.2.6. If, in the technical judgement of the mass spectral interpretation specialist, no tentative identification can be made, the compound will be reported as ‘Unknown’. If the compound can be further classified the analyst may do so (i.e, ‘Unknown hydrocarbon’, ‘Unknown acid’ , etc.).

10.5. Data Reporting

10.5.1. Final Report. The Chom data system automatically produces a data report consisting of hardcopy reports corresponding to specific data reporting requirements, which is uploaded to the TALS LIMS System for the report production group.

10.5.1.1. Total Ion Chromatogram. Full length chromatogram depicting the full length of the GC/MS acquisition.

10.5.1.2. Spectra of all detected target compounds. A page for each detected target compound spectra with a standard reference spectrum for comparison.

10.5.1.3. The calculations of the concentrations of each target compound in the sample, reported in units of ppb, ug/kg or ug/l.

10.5.1.4. Data summaries for each method blank indicating which samples were extracted with the indicated blank.

10.5.1.5. A copy of the initial calibration range together with the calibration verification report, and tune report.

10.5.1.6. Quality Control (QC) data report for each batch including surrogate recoveries, internal standard area summaries, LCS, MS/MSD and RPD summaries.

10.6. The low-level calibration standard establishes the reporting limit. All reported data must be at a concentration at or above the low concentration standard. Any quantitative values below the report limit must be qualified as estimated.

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11.0. Calculations/Data Reduction

11.1. **Target Compounds:** are quantitated using the internal standard method (see the formula in Section 11.3).

11.1.1. Identified target compounds are quantitated using the integrated abundance from the EICP of the primary characteristic ion. The internal standard used shall be the one nearest the retention time of the analyte).

11.1.2. The average response factor (RRF) from the initial calibration is used to calculate the target analyte concentration in client samples using the formula found in Section 11.3. See Section 9.2.4 for discussion of RRF.

11.1.3. Secondary ion quantitation is utilized only when there are sample interferences preventing use of the primary characteristic ion. If secondary ion quantitation is used an average relative response factor (RRF) must be calculated using that secondary ion.

11.2. Non-Target Compounds (Tentatively Identified Compounds): An estimated concentration for non-target (tentatively identified compounds) is calculated using the internal standard method (see formula in Section 11.3). For quantiation, the nearest eluting internal standard free of interferences is used. The procedure used for calculating the concentration of non-target compounds is the same as that used for target compounds (see Section 11.1) with the following revisions:

11.2.1. The total area count of the non-target compound is used for As (instead of the area of a characteristic ion).

11.2.2. The total area count of the chosen internal standard is used as Ais (instead of the area of a characteristic ion).

11.2.3. A RF on 1.0 is assumed.

11.2.4. The resulting concentration is qualified as estimated (‘J’) indicating the quantitative uncertainties of the reported concentration.

11.3. Internal Standard Calculation:

11.3.1. Aqueous Samples

$$\text{Concentration } (\mu g/L) = \frac{(As)(Cis)(D)}{(Ais)(RF)(Vs)\,(Vi)\,(1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vs = Volume of sample extracted (ml)

The 1000 in the denominator represents the number of ul in 1 ml.

11.3.2. Solid Samples

$$\text{Concentration } (\mu g/KG) = \frac{(As)(Cis)(D)(Vt)}{(Ais)(RF)(Ws)\ (Vi)\ (1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vt = Volume of concentrated extract (ul)
Ws = Weight of sample (g)

The 1000 in the denominator represents the number of ul in 1 ml.

11.4. Relative Response Factors

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where:

A_x = Area characteristic ion for the compound (see Table 21)
Ais = Area characteristic ion of associated internal std (See Table 21)
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

11.5. Percent Relative Standard Deviation (% RSD) : as discussed in Section 9.2.4.4 (Initial calibration):

$$\%\ RSD = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

11.6. Percent Difference (% D):as discussed in Section 9.2.4.4 (Continuing calibration):

$$\%\ D = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \text{ X } 100$$

Where: RRFc = RRF from continuing calibration

$\overline{RRF_i}$ = Mean RRF from current initial calibration

11.7. Percent Recovery (% R): Surrogates and Spikes

$$\text{Recovery (\%)} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) added}} \times 100$$

11.8. Calculation of Percent (%) Error

$$\%Error = \frac{x_i - x_i'}{x_i} x\,100$$

Where:

x_i^1 = Measured amount of analyte at calibration level *i*, in mass or concentration units

x_i = True amount

11.9. Dry Weight Correction: All solid samples must be corrected for dry weight using the following formula for dry weight determination.

$$DW = \frac{Gd}{Gw} \times 100$$

Where:

DW = Percent % Dry Weight

Gd = Dry weight of selected sample aliquot

Gw = Wet weight of selected sample aliquot

Multiply the DW value times the wet weight of the sample extracted. NOTE: This calculation can also be performed automatically by the target system provided the DW value is available and entered into the system.

12.0. Method Performance

12.1. Method Detection Limit Study (MDL)

A Method Detection Limit (MDL) study, as described in the TestAmerica corporate Detection and Quantitation Limits SOP, CA-Q-S-006, must be performed initially and whenever a significant change affecting sensitivity is made to the analytical system. The MDL must be re-evaluated from quarterly MDL points at least every 12 months.

12.2. Demonstration of Capabilities

For DOC procedure refer to Section 19 in the most current revision of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM).

12.3. Lower Limit of Quantitation Verification

The lowest calibration standard analyzed establishes the LLOQ or Reporting Limit. The capability to reliably detect this concentration through the preparation, clean-up and analytical procedure is verified through the annual analysis of a standard at the LLOQ/RL. The LLOQ verification shall also be performed whenever significant changes are made to the preparation and/or analytical procedure.

12.3.1 The LLOQ verification standard shall be prepared at a concentration 0.5-2 times the LLOQ/RL, and be taken through all of the same preparation and clean-up methods as client samples.

12.3.2 The LLOQ verification standard for aqueous matrix shall be prepared using laboratory deionized water and for the solid matrix using clean Ottawa sand. Other clean matrices may be used in addition, for project specific requirements.

12.3.3 The LLOQ shall be verified annually on each instrument used for client sample analysis.

12.3.4 Recovery of each analyte must meet the laboratory established LCS recovery limits + 20%. (For example, if the LCS recovery limits are 70-130%, the LLOQ verification must meet recovery limits of 50-150%.) Once sufficient points have been generated, LLOQ based statistical limits may be used in place of limits based on LCS recovery.

NOTE: The lower recovery limit for the LLOQ can be no lower than 10%.

12.4. Training Requirements

Refer to TestAmerica SOP No. ED-GEN-022, (*Training*), for the laboratory's training program.

13.0. Pollution Control

13.1 It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

14.0. Waste Management

14.1 Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to TestAmerica Edison SOPs Nos. ED-SPM-007 (*Disposal of Samples and*

Associated Laboratory Waste, current revision) and ED-SPM-008 (*Laboratory Waste Disposal Procedures, current revision).* The following waste streams are produced when this method is carried out:

- Auto sampler vials and expired standards: These vials are collected in satellite accumulation within the instrument laboratory. The vials are then placed into a 55 steel open top drum in the waste room. When the drums are full, the drum will be collected by the waste vendor for disposal. This waste is treated for incineration.

  Teris Profile Number: 50016652
  Onyx Profile WIP Number: 282493

- Mixed Solvent Waste: Mixed solvent waste is collected in a small beaker inside the bench top hood. This waste is then transferred into the satellite accumulation container in the Organic Prep. Lab. on a daily basis. This material is transferred into 5 gallon solvent cans as satellite accumulation. These cans are emptied every 24 hours into a steel drum in the waste room. This drum is kept in the walk in hood until it is full. The full drum is then removed from the hood and placed on secondary containment in the waste room.

  Teris Profile Number: 50016624
  Onyx Profile WIP Number: 545240

14.1. Pollution Prevention

14.2.1. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a prevention hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

14.2.2. The quantity of chemical purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

15.0. References / Cross-References

15.1. United States Environmental Protection Agency, “Method SW8270D, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry”, Test Methods for Evaluating Solid Wastes, SW846 Third Edition, Laboratory Manual, Physical/Chemical Methods, Revision 5, July 2014..

15.2. United States Environmental Protection Agency, “Method SW8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry”, Test Methods for Evaluating Solid Wastes, SW846 Update IV, Laboratory Manual, Physical/Chemical Methods, Revision 6, June 2018.

15.3. United States Environmental Protection Agency, “Method SW8000D: Determinative Chromatographic Separations”, Test Methods for Evaluating Solid Wastes, SW846, Laboratory Manual, Physical/Chemical Methods, Update V, Revision 4, October 2012..

15.4. TestAmerica Edison Document No. ED-QA-LQM, *Laboratory Quality Manual*, current revision.

15.5. TestAmerica Edison SOP No. ED-ORP-002, *SW846 Method 3510C-Extraction of Semi-Volatile Organic Compounds in Water by Separatory Funnel,* current revision.

15.6. TestAmerica Edison SOP No. ED-ORP-043, *SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270,* current revision.

15.7. TestAmerica Edison SOP No. ED-ORP-044, *Procedure for the Microwave Extraction of Solids, SW3546, current revision.*

15.8. TestAmerica Document No. CW-E-M-001, Corporate Environmental Health and *Safety Manual,* current revision.

15.9. TestAmerica Corporate Quality SOP No. CA-Q-S-001, *Solvent & Acid Lot Testing & Approval*, current revision.

15.10. TestAmerica Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*), current revision.

15.11. TestAmerica Edison SOP No. ED-GCS-001, *Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis*, current revision.

15.12. TestAmerica Edison Work Instruction Document No. EDS-WI-012, *Client Complaint/Corrective Action Form,* current revision.

15.13. TestAmerica Edison SOP No. ED-GEN-003, *Standard Operating Procedure for Control of Non-Conformances and Corrective Action,* current revision.

15.14. TestAmerica Edison SOP No. ED-ORP-001, *Extraction of Semivolatile Organic Compounds in Water, EPA Method 625.1,* current revision.

15.15. TestAmerica Edison SOP No. ED-GEN-022, *Training,* current revision.

15.16. TestAmerica Corporate Quality Memorandum, CA-Q-QM-002, *GC/MS Tuning Policy*, current revision.

15.17. TestAmerica Corporate Quality SOP No. CA-Q-S-006, *Detection and Quantitation Limits,* current revision.

16.0. Method Modifications:

Method 8270E requires the DFTPP tune standard to be analyzed once prior to an ICAL and not daily prior to sample analysis. Until such time as 8270D is removed from lab capabilities and in order to satisfy both 8270D and 8270E The laboratory will analyze the DFTPP tune daily, prior to QC and sample analysis. The laboratory will use the tighter criteria from Methods 8270C/8270D for tune evaluation, rather than the criteria suggested in Table 3 of Method 8270E.

17.0. Attachments

Attachment 1 Poor Performing Analytes

18.0. Revision History

- Revision 9, date 03/15/2021
    - Updated as needed to reflect 1,4-dioxane RL of 0.2 ug/l.
    - Updated Tables 11 and 12 to reflect new low ICAL standard concentration of 1,4-dioxane..
- Revision 8, date 06/29/2020
    - Updated to Eurofins branding.
    - Updated throughout to include 8270E requirements.
    - Removed references to SW846 3550B/C prep methods (no longer in use for this method at Edison lab).
    - Update equipment listed in Section 6.0.Updated analytical column in Section 6.1.2.
    - Updated, deleted and renumbered tables as required.
    - Made extensive updates to Standards (sources and preparation) in Section 7.2.
    - Removed all references to Aromatic Amines. Deleted all tables specific to Aromatic Amine analysis. Renumbered remaining tables in document and updated text references.
    - Throughout document clarified tune requirements for 8270E.
    - Following added to Section 9.1.1: For method 8270E the method blank is generally acceptable if target analyte concentrations are less than the one half the reporting limit.
    - Calibration Point Read-back Criteria was added to Section 9.2.4.3. The calculation for percent error was added to Section 11.8.
    - Section 9.2.4.2.3: added following for 8270E: the calculated concentration or amount of each analyte of interest in the CCV standard should fall within ±20%.
    - Section 9.2.4.2.5.6: added ‘The recalculated concentration of the low calibration point should be within ±50% of the standard’s concentration.”
    - Section 12.1 revised to reflect the updated MDL procedure.
    - Added Section 12.3: annual Lower Limit of Quantitation Verification
    - Added Corporate SOP CA-Q-S-006, Detection and Quantitation Limits to references.
    - Section 16.0: added a Method Modification regarding tuning check requirements.

- Revision 7, date 06/08/2018
    - Section 2.3: revised to clarify that RVE/LVI is lab standard procedure.
    - Section 9.1.3: removed statement regarding allowance for up to five analytes to recover outside of lab acceptance limits in LCS/LCSD.
    - Section 9.2.4.3: Replace table 'ICV Poor Performers (50-150% Recovery) with expanded list of 'Poor Performing Analytes' in Attachment 1.
    - Added Section 9.2.4.4.5: CCV Poor Performers
    - Corrected number in section 9.2.4.5
    - Added Attachment 1 – Poor Performing Analytes

- Revision 6, date 01/12/2018:
    - Section 7.2.5 included to specify reagent and standard storage conditions.
    - Revised Section 9.1.3 to clarify requirements for specific LCS/LCSD evaluation criteria regarding the # of out of criteria analytes.
    - Revised Section 9.2.4.3 to add 2,4-Dimethylphenol as a poor performing analyte, increased the range for the poor performers to 50-150 and also expanded the guidelines for flagging the ICV outliers.

- Revision 5, dated 09/29/2017:
    - Revised Section 9.1.1 to clarify requirements for surrogate recovery in method blanks.

- Revision 4, dated 08/21/2017:
    - Updated throughout to add a procedure for the analysis of 1,4-dioxane by isotope dilution selected ion monitoring (SIM)
    - Added tables for isotope dilution SIM standards. Renumbered all tables as necessary.
    - Section 7.2.1: added a list of full scan calibration list options.
    - Table 3: Renamed 'Full Scan Stock Standards'.
    - Section 9.2.1: noted that DFTTP applies only to full scan analysis.
    - Section 9.2.3: updated CCV concentrations
    - Added reference to GC/MS Tuning Policy in Section 15.16.

- Revision 3, dated 01/07/2016:
    - Tables 1 and 2: added SIM as option for 1,4-Dioxane.
    - Section 2.3: removed SW3541 (Soxtherm) as option for soils prep (lab has discontinued use of this method). Also removed SW3541 SOP reference from Section 15.0.
    - Tables 19 and 20: added source and prep instructions for 1,4-Dioxane SIM standard. Updated source and prep instructions for 4,6-Dinitro-2-methylphenol.
    - Table 22: added prep instructions for 1,4-Dioxane and 4,6-Dinitro-2-methylphenol SIM ICV standard.
    - Corrected the information in the 'DFTPP Key Ions and Abundance Criteria' table in Section 9.2.1 to match the info found in SW846 8270C.
    - Section 10.1.4.2: updated "SIM Parameters" to included ion masses/dwell times for 1,4-Dioxane.

- Revision 2, dated 01/28/2015:
    - Extensively reformatted the SOP. Placed tables that had been in rear of document into the body of the text. Renumbered tables as applicable and fixed text references to tables.
    - Section 1.1, Table 1: Revised table to include all current analytes. Also footnoted those compounds which are currently analyzed by SIM.
    - Section 2.3: added options for extraction of solids by SW846 3456 (Microwave Extraction) and by SW3580A (Waste Dilution) and added SOP references. Deleted reference to SOP ED-ORP-005 (SW3550B – Low Level); Updated Section 15 (References).
    - Section 2.5: added text detailing the RVE/LVI options.
    - Section 2.6: added table which includes all analytes routinely analyzed by SIM.
    - Section 6: updated to include newer GC, MS and autosampler models currently in use.
    - Section 6.1.3: added Zebron ZB column as an option.
    - Section 7.2: extensively revised standards information to reflect switch to Restek standards.
    - Table 3:Added Custom Aromatic Amine Surrogate Standard and revised Table 8 to include initial calibration prep instructions for the Aromatic Amine surrogates.
    - Throughout document: removed references to Target and replaced with Chrom.
    - Section 7.2.1: Added reference to section 10.2.1.2 for LVI.
    - Added Section 7.2.1.3.1 and Table 17A both of which discuss use of Aromatic Amine surrogates.
    - Section 7.2.1.2: Added reference to Tables 9,10 and 11 (ICV Preparation)
    - Section 8.0: Added Sample container and minimum sample size (250 ml) for Reduced volume extraction.
    - Sections 9.1.2, 9.1.3, 9.1.4 and 9.2.4: added statement that certain state regulatory programs have defined recovery limits which, where applicable, are used for spike and calibration evaluations.
    - Section 9.1.2: Deleted sentence "A minimum of 16 spiked analytes are reported to in client reports (the full list is reported at least once during each 2 year period because we employ full spiking list.
    - Section 9.1.4: Added note regarding use of Aromatic Amine Surrogates.
    - Section 9.2.2.2: Added reference to ICV Preparation tables in Section 7.2.
    - Section 9.2.3: added more specific info as to the concentration of the CCVs for all techniques.
    - Section 9.2.4.2.1: Changed to reflect that each analyte should meet minimum RF's, not the average across the calibration. Added LLCCV requirement.
    - Section 10.3.1: added explanation of Chrom's interaction with TALS. Removed references to Target.
    - Section 9.2.4.2.5.5: Added: (or can be noted in the narrative)
    - Section 9.2.4.2.5.6: Revised last sentence to read: "This evaluation can be checked using the Initial Calibration %Drift Report in Chrom."
    - Section 9.2.4.3: Removed 65-135% criteria and added "poor performing" analyte list and associated criteria of 60-140%.
    - Section 9.2.4.4.3: Added LLCCV criterion for RFs
    - Section 9.2.4.4.4: Added LLCCV criterion for %D
    - Section 10.1.4: Updated GC/MS operating conditions for full scan, SIM and DFTPP.
    - Section 10.1.4.1: added a table detailing operating conditions for LVI option.
    - Table 2: Added 2-ethylaniline, 2,4-dimethylaniline, 3,4-dimethylaniline, 2,3-

dimethylaniline, 2,4,5-trimethylaniline and 4-chloro-o-toluidine to Working Standards preparation information.
  - Table 25: updated to include all current analytis/surrogates/internal standards and associated ions.
  - Throughout document: updated LQM section references as appropriate as some have changed with the latest LQM revision.

- Revision 1, dated 11/07/2011
  - Section 1.1, Table 1: Added Pentachloronitrobenzene and associated CAS# to the analyte list.
  - Section 7.2.1: Added Pentachloronitrobenzene standard information.
  - Table 2: Added Pentachloronitrobenzene to Working Standards preparation information.
  - Table 4: Added Pentachloronitrobenzene and associated minimum RF.
  - Table 8: Added Pentachloronitrobenzene and associated ions.

- Revision 0, dated 02/22/2011: NEW

Table 21
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	**Primary Ion**	**Secondary Ion(s)**
1,1'-Biphenyl	154	153,76
1,2,4,5-Tetrachlorobenzene	216	214, 179
1,2,4-Trichlorobenzene	180	182, 145
1,2-Dichlorobenzene	146	148, 111
1,2-Diphenylhydrazine	77	105, 182
1,3-Dichlorobenzene	146	148, 111
1,3-Dimethylnaphthalene	156	141, 115
1,4-Dichlorobenzene	146	148, 111
1,4-Dichlorobenzene d4 **(ISTD)**	152	150, 115
1,4-Dioxane	88	58, 43
1-Methylnaphthalene	142	141, 115
1-Naphthylamine	143	115, 116
2,2'-oxybis[1-chloropropane]	45	77, 121
2,3,4,6-Tetrachlorophenol	232	131, 230
2,3,7,8-TCDD (screen)	320	322, 324
2,3-Dihydroindene		
2,3-Dimethylaniline	106	129
2,4,5-Trichlorophenol	196	198, 200
2,4,5-Trimethylaniline	102	55, 56
2,4,6-Tribromophenol **(Surrogate)**	330	132, 141
2,4,6-Trichlorophenol	196	198, 200
2,4-Dichlorophenol	162	164, 98
2,4-Xylidine	121	120, 106

Table 21
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	Primary Ion	Secondary Ion(s)
2,4-Dimethylphenol	122	107, 121
2,4-Dinitrophenol	184	63, 154
2,4-Dinitrotoluene	165	63, 89
2,6-Dinitrotoluene	165	63, 89
2-Chloronaphthalene	162	127, 164
2-Chlorophenol	128	64, 130
2-Ethylaniline	106	122,104
2-Fluorobiphenyl **(Surrogate)**	172	171
2-Fluorophenol **(Surrogate)**	112	64
2-Methylnaphthalene	142	141
2-Methylphenol	108	107
2-Naphthylamine	143	115, 116
2-Nitroaniline	65	108, 138
2-Nitrophenol	139	109, 65
2-tert-butyl-4-Methylphenol	149	121, 91
2-Toluidine	107	106, 77
3,3'-Dichlorobenzidine	252	254, 126
3,4-Dimethylaniline	106	129, 127
3,5-Di-tert-butyl-4-Hydroxytol	205	220, 145
3-Nitroaniline	138	108, 65
4,6-Dinitro-2-methylphenol	198	51, 105
4-Bromophenyl phenyl ether	248	250, 141
4-chloro-2-methylaniline	106	144, 142
4-Chloro-3-methylphenol	107	144, 142
4-Chloroaniline	127	129
4-Chloroaniline-d4 **(Surrogate)**	131	133
4-Chlorophenyl phenyl ether	204	206, 141
4-Methylphenol	108	107
4-Nitroaniline	138	108, 65
4-Nitrophenol	139	109, 65
Acenaphthene	154	153, 152
Acenaphthene d10 **(ISTD)**	164	162, 160
Acenaphthylene	152	151, 153
Acetophenone	105	77, 51
Aniline	93	66
Aniline-d5 **(Surrogate**)	98	71,42
Anthracene	178	176, 179
Atrazine	200	173,215
Benzaldehyde	77	105,106
Benzidine	184	92, 185
Benzo(a)anthracene	228	229, 226
Benzo(a)pyrene	252	253, 125
Benzo(b)fluoranthene	252	253, 125
Benzo(g,h,i)perylene	276	138, 277
Benzo(k)fluoranthene	252	253, 125
Benzoic Acid	122	105, 77

Table 21 Characteristic Ions Of Semi-Volatile Organic Compounds		
Compound	**Primary Ion**	**Secondary Ion(s)**
Benzyl Alcohol	108	79, 77
Bis(2-chloroethoxy)methane	93	95, 123
Bis(2-chloroethyl)ether	93	63, 95
Bis(2-ethylhexyl)phthalate	149	167, 279
Bisphenol-A	213	228, 119
Butyl benzyl phthalate	149	91, 206
Caprolactam	113	55,56
Carbamazepine	193	236, 135
Carbazole	167	166, 139
Chrysene	228	226, 229
Chrysene d12 **(ISTD)**	240	120, 136
Coumarin	146	118, 63
Dibenz(a,h)anthracene	278	139, 279
Dibenzofuran	168	139
Diethylphthalate	149	177, 150
Dimethylphthalate	163	194, 164
Di-n-butylphthalate	149	150, 104
Di-n-octylphthalate	149	167, 43
Fluoranthene	202	101, 203
Fluorene	166	165, 167
Hexachlorobenzene	284	142, 249
Hexachlorobutadiene	225	223, 227
Hexachlorocyclopentadiene	237	235, 272
Hexachloroethane	117	201, 199
Indeno(1,2,3-cd)pyrene	276	138, 227
Isophorone	82	95,138
Kepone	272	237, 355
N,N-Dimethylaniline	120	122, 104
Naphthalene	128	129, 127
Naphthalene d8 **(ISTD)**	136	68
n-decane	43	57
Nitrobenzene	77	123, 65
Nitrobenzene-d5 **(Surrogate)**	82	128, 54
N-Nitrosodimethylamine	42	74, 44
N-Nitroso-di-n-propylamine	170	42,101,130
N-Nitrosodiphenylamine	169	168, 167
n-Octadecane	57	43, 85
o-Toluidine-d9 **(Surrogate)**	114	112, 42
Pentachloronitrobenzene	237	214,295
Pentachlorophenol	266	264, 268
Perylene d12 **(ISTD)**	264	260, 265
Phenanthrene	178	179, 176
Phenanthrene d10 **(ISTD)**	188	94, 80
Phenol	94	65, 66
Phenol-d5 **(Surrogate)**	99	42, 71
Phenyl ether	170	77, 115

Table 21 Characteristic Ions Of Semi-Volatile Organic Compounds		
Compound	**Primary Ion**	**Secondary Ion(s)**
Pyrene	202	200, 203
Pyridine	79	52, 51
Terphenyl-d14 **(Surrogate)**	244	122, 212

Attachment 1
Poor Performing Compounds

1,2,4,5-Tetrachlorobenzene
1,4-Dioxane
1-Naphthylamine
2,3,4,6-Tetrachlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2-Chloroaniline
2-Naphthylamine
3&4-Methylphenol
3’3-Dichlorobenzidine
4,6-Dinitro-2-methyl- phenol
4-Chloroaniline
4-Nitrophenol
Aniline
Atrazine
Benzaldehyde
Benzidine
Benzoic Acid
Benzyl Alcohol
Biphenyl
Caprolactam
Diphenylamine
Hexachlorocyclopentadiene
Hexachloroethane
n-Decane
n-Nitrosodimethylamine
o,o,o-Triethylphosphorothioate
o-Toluidine
Pentachloronitrobenzene
Pentachlorophenol
Phenol
Pyridine

These analytes are exempt from the ICV and CCV criteria as detailed in this SOP

Title: Per- and Poly-fluorinated Substances (PFAS) in Water, Soils, Sediments and Tissue

[Method 537 (Modified), PFAS by LCMSMS]

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1.0 Scope and Application

This SOP describes the laboratory procedure for the preparation and analysis of per- and polyfluorinated substances using liquid chromatography/tandem mass spectrometry (LC/MS/MS).

Program specific requirements are not included in this SOP. The details of program specific requirements are specified in other laboratory work instructions relevant to the program.

1.1 Analytes, Matrices, and Reporting Limits

This procedure is amenable with water, soil, sediment and tissue sample matrices.
The list of target compounds that may be determined from this procedure is provided below. Table 1 presents the compounds along with their associated reporting limits (RL).

Compound Name	**Abbreviation**	**CAS #**
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-butanoic acid (Perfluoro-n-butyric acid)	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
Perfluoro-n-hexanoic acid	PFHxA	307-24-4
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluoro-n-decanoic acid	PFDA	335-76-2
Perfluoro-n-undecanoic acid	PFUdA (PFUnA)	2058-94-8
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8
Perfluoro-n-tetradecanoic acid	PFTeDA (PFTA)	376-06-7
Perfluoro-n-hexadecanoic acid	PFHxDA	67905-19-5
Perfluoro-n-octadecanoic acid	PFODA	16517-11-6
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
* Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1
* Perfluoro-1-nonanesulfonic acid	PFNS	68259-12-1
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluorinated sulfonamides (FOSA)		
Perfluoro-1-octanesulfonamide	FOSA	754-91-6
Perfluorinated sulfonamidoacetic acids (FOSAA)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9
Fluorotelomer sulfonates (FTS)		
* 1H,1H,2H,2H-perfluorohexanesulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctanesulfonic acid *(6:2)*	6:2 FTS	27619-97-2

1H,1H,2H,2H-perfluorodecanesulfonic acid *(8:2)*	8:2 FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonic acid (10:2)	10:2 FTS	120226-60-0
Fluorinated Replacement Chemicals		
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	DONA	919005-14-4
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	F53B Major (9Cl-PF3ONS)	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	F53B Minor (11Cl-PF3OUdS)	763051-58-1

Abbreviations in parenthesis are the abbreviations listed in Method 537, where they differ from the abbreviation used by the laboratory's LIMS.
***Indicates the analyte is not certified in any state or program.**
Note: Analytes with secondary certification in NJDEP can be found in Appendix D and samples collected in New Jersey are only approved for non-potable water.

The working range of the method is listed below. The linear range can be extended by diluting the extracts.

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	250 mL	2.0 ng/L - 5 ng/L	2.0 ng/L - 400 ng/L
Soil/Sediment	5 g	0.2 µg/Kg–0.5 µg/Kg	0.2 µg/Kg-40 µgKg
Tissue	1 g	1.0 µg/Kg–10 µg/Kg	1.0 µg/Kg–200 µg/Kg

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in the Quality Assurance Manual.

2.0 Summary of Method

Water Samples: Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an [redacted] solution.

Soil/sediment/tissue samples are extracted with a [redacted] solution using a TCLP tumbler operating at [redacted]. The mixture is centrifuged to reduce the amount of solid transferred when decanting the solvent. The solvent extract is exchanged to water using nitrogen blowdown, then the aqueous extract is extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide/methanol solution.

The final [redacted] extracts are analyzed by LC/MS/MS operated in electrospray (ESI) negative ion mode. PFAS are separated from other components on a C18 column with a solvent gradient program [redacted] and methanol.

An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDAs) consist of carbon-13 labeled analogs, oxygen-18 labeled analogs, or deuterated analogs of the compound of interest, and they are spiked into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantified by the IDA method using a closely related labeled analog.

Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak response is measured as the area of the peak.

This SOP is based on the following reference methods:

- US EPA, “Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)”, Version 1.1, September 2009.
- Method ISO 25101, “Water quality – Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry”, First Edition, 2009-03-01, International Organization for Standardization, Technical Committee ISO/TC 147, Water Quality, Subcommittee SC 2, Physical, chemical and biochemical methods.

If the laboratory’s SOP is modified from the reference method, a list of method modifications along with technical justification may be found in Section 16. Modifications to this SOP may be applied on a project specific basis to meet project data quality objectives. Project specific modifications are documented in the project record.

3.0 Definitions

Refer to the Laboratory’s Quality Assurance Manual (QAM) for the Glossary of Terms, Definitions and Acronyms except as follows.

Definitions of terms used in this SOP may be found in Appendix A.

4.0 Interferences

PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed below in Section 6.

To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use. Polypropylene (PP) or polyethylene (PE, HDPE) products may be used in place of PTFE products to minimize PFOA contamination.

Standards and samples are injected from polypropylene autosampler vials with polyethylene screw caps once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

Random evaporation losses have been observed with the polyethylene caps causing high IDA recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence.

Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same Teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is best to use polyethylene screw caps.

Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFAS. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

Both branched and linear isomers of PFOS, PFOA, PFHxS, PFBS, EtFOSAA and MeFOSAA can potentially be found in the environment, based upon scientific literature. If multiple isomers are present for one of these PFAS, these adjacent peaks are either completely resolved or not resolved but with a profound deflection that can be resolved during peak integration. The later of the peaks matches the retention time of the single labeled PFAS peak. In general, earlier peaks are branched isomers and are not a result of peak splitting, and all the chromatographic peaks observed in the standard and/or sample must be integrated and the areas included.

When reference standards of technical mixtures of specific PFAS area available, they should be used to ensure that all appropriate peaks are included during peak integration (at this time, only PFOS, PFOA, PFHxS, EtFOSAA and MeFOSAA are available as technical mixtures). Refer to Section 7, Reagents, for the available technical mixtures utilized by this SOP.

In an attempt to reduce PFOS bias, it is required that m/z 449>80 transition be used as the quantitation transition.

Per the Certificate of Analysis for labeled perfluorohexadecanoic acid (13C2-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. The laboratory utilizes a weighted linear regression that is not forced through the origin for the calibration of native perfluorohexadecanoic acid to account for this contribution from its labeled IDA.

5.0 Safety

Employees must abide by the policies and procedures in the NDSC Eurofins TestAmerica Laboratories Environmental Health and Safety Manual (CW-E-M-001), and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS must be handled in the laboratory as hazardous and toxic chemicals.

Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

Laboratory procedures such as the use of pipets and transferring of extracts represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

Eye protection that satisfies ANSI Z87.1 (as per the Eurofins TestAmerica Corporate Safety Manual), a laboratory coat and nitrile gloves must be worn while handling samples, standards, solvents and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

Perfluorocarboxylic acids are acids and are not compatible with strong bases.

The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

The HPLC and MS/MS have areas of high voltage. Depending on the type of work involved, the instrument should be turned off or disconnected from its source of power prior to extensive maintenance.

5.2 Primary Materials Used

Table 2 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the SDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- 15 mL polypropylene test tubes with screw caps, Fisherbrand 05-539-5 or equivalent.
- 250-mL HDPE wide-mouth bottles with screw caps (ESS 0250-1901-).
- Analytical balance capable of weighing to the nearest 0.01g, and checked for accuracy each day it is used in accordance with BR-GT-008.
- SPE Vacuum manifold, 24-port, [redacted] or equivalent.
- 1/8" OD Poly siphon lines, 30" long for sample loading.
- SPE Adaptor Caps for 1, 3, and 6 mL SPE Tubes, Polyethylene, [redacted] or equivalent.
- SPE Stopcocks, Polyethylene and Polypropylene, [redacted] or equivalent.
- Stainless steel solvent guide needles, [redacted], or equivalent.
- Heavy-Wall filter flask, Fisherbrand 4000mL, [redacted] or equivalent.
- TCLP tumbler, [redacted] for extraction of soil, sediment and tissue samples.
- Glass-Col ZipVap 24-port extract concentrator.

- Polypropylene Syringe, 10 mL with luer-lok or luer slip tips, [redacted] or equivalent.
- Volumetric Syringes, Class "A" (25µL, 50µL 100µL, and 500µL), Hamilton or equivalent.
- Automatic Pipettor, Finnpette, 1-5mL.
- Polypropylene autosampler vials, 300µL, 700µL and 2mL with polyethylene screw caps.
- Waters Oasis [redacted] or equivalent, for the extraction of PFAS from aqueous samples.
- Waters Oasis [redacted] or equivalent, for the cleanup of soils.
- 250mL Poly bottles containing 1.25g of Trizma Pre-Set Crystals, used for batch QC for samples received with Trizma preservation.
- 50mL graduated polypropylene centrifuge tubes. [redacted] or equivalent.
- 500ml Polyethylene wash bottle
- 4, 6, and 12ml Class A Volumetric Pipette
- Graphitized carbon (Envi-Carb^{TM} or equivalent)
- Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc). These should be disposable wherever possible, or marked and segregated for high-level versus low-level use.

6.2 Analytical System

Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS)-as described below. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.1 or equivalent.

- SCIEX LC/MS/MS

  This system consists of a [redacted] HPLC interfaced with a [redacted] The instrument control and data acquisition software is [redacted] equivalent.

  [redacted] HPLC equipped with [redacted] and one [redacted] or equivalent. [redacted] Column Oven.

  [redacted] or equivalent.

  PFAS Isolator column. [redacted]. These are plumbed between the pump's mixing valve and the autosampler to minimized the HPLC-based PFAS background from injection-based PFAS.

7.0 Reagents and Standards

7.1 Reagents

All reagents must follow traceability guidelines found in SOP BR-QA-002.

- Ammonium acetate Stock Solution, [redacted]
- [redacted] ammonium acetate eluent.. [redacted]

- Ammonium hydroxide, concentrated, JT Baker or equivalent.
- Ammonium hydroxide (NH_4OH) [redacted] of Methanol. Volume prepared may be adjusted based on usage/need.
- Potassium hydroxide pellets, 87% purity, JT Baker P250-1 or equivalent.
- Potassium hydroxide (KOH), [redacted]
- Reagent Water, house reverse-osmosis reagent water ("PFAS-Free" via in-house testing).
- Hexane, Ultra-Resi Analyzed, JT Baker or equivalent.
- Methanol, HPLC JT Baker or equivalent.
- Sodium hydroxide, pellets, JT Baker or equivalent.
- Sodium hydroxide (NaOH), [redacted]
- Acetonitrile, Optima Grade, Fisherbrand or equivalent.

7.2 Standards

Purchase high purity, technical grade solids (96% or greater) or certified solutions from commercial vendors. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at $4 \pm 2°C$. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

Per the Certificate of Analysis for labeled perfluorohexadecanoic acid (13C2-PFHxDA) produced by Wellington Laboratories, the stock standard contains ~0.3% of native PFHxDA. This equates to roughly 0.30 ng/L or 0.015 ug/Kg of PFHxDA expected in all samples and blanks.

As of this writing, only PFOS, PFOA, PFHxS, MeFOSAA and EtFOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

PFBS, PFHxS, PFHpS, PFOS, PFDS, and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$\text{Mass}_{\text{acid}} = \text{Measured Mass}_{\text{salt}} \times \text{MW}_{\text{acid}} / \text{MW}_{\text{salt}}$$

Where: MW_{acid} is the molecular weight of PFAA

MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be multiplied by a factor of 0.956 to account for the amount of PFOS in the final solution.

While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers.

Prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

A technical (qualitative) grade PFOA standard is analyzed initially, then after initial calibration when a new column is installed or when significant changes are made to the HPLC parameters. This solution is used as a reference for the PFOA isomers (branched and linear) retention times.

A second source solution for PFAS is purchased from the same vendor; the PFC-MXB contains most of the target analytes in this mixture and is used as an ICV. For those compounds not available in this mixture or are not available from another vendor, a second analyst may prepare a second source standard from the same source as the ICAL to produce an ICV. The recommended concentration of the ICV standard should be in the mid-range of the calibration curve. The concentration may be adjusted if the initial calibration levels are changed or altered. The IDA and ISTD are added at a fixed concentration (2.5 ng/mL in extract).

7.3 Extraction Spiking Solutions

PFAS LCS/Matrix Spike Solution, 400 ng/mL

The PFAS spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 400 ng/mL in methanol.

PFAS High Level LCS Solution, 1000 ng/mL

The PFAS spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 1000 ng/mL in methanol.

PFAS Isotope Dilution Analyte Solution, 500 ng/mL

The PFAS-IDA solution is prepared by diluting all labeled PFAS to produce a solution containing each IDA compound at a concentration of 1000 ng/mL in methanol.

Internal Standard Solution, $^{13}C_2$-PFOA, 1250 ng/mL

The internal standard solution is prepared by diluting the stock 50 µg/mL $^{13}C_2$-PFOA 20-fold in methanol.

See Appendix B for analyte lists and concentrations.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP, sampling requirements may be found in the published reference method.

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
Water	250 mL HDPE Bottle	250 mL	0-6°C, Trizma (5g/L) (if from a known	14 days from collection	Method 537

			chlorinated source)		
Soil/Sediment	4/8 oz HDPE wide-mouth container	100 g	0-6°C	14 days from collection	SW-846 Organic Methods
Extract	700 µL Polypropylene (PP) Vial with HDPE Screw cap	NA	0-6°C	40 days from extraction (28 days from extraction for samples collected in NJ)	NJDEP guidance

[1] *Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.*

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

Sample QC

When samples contain the preservative Trizma, all associated QC must be treated with the same preservative.

Initial Demonstration of Capability (IDOC) and Method Detection Limit (MDL) studies described in Section 12 must be acceptable before analysis of samples may begin.

Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence.

The laboratory prepares the following sample QC for each extraction batch (an extraction batch is limited to a maximum of 20 field samples of the same matrix processed using the same procedure and reagents within the same time period):

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 per extraction batch	See Table 3
Laboratory Control Sample (LCS)	1 per extraction batch (Spiking Level rotates between Low, Medium and High on a batch-by-batch basis)	See Table 3
LCS Duplicate (LCSD)	1 per extraction batch whenever insufficient sample is available for an MS/MSD/DU	See Table 3
*Matrix Spike (MS/MSD)	1 per extraction batch (if sufficient sample is available)	See Table 3
*Sample Duplicate (SD)	DW-1 per extraction batch (if sufficient sample is available); Non-DW matrices- client request	See Table 3

	if sufficient sample is available	
Field Reagent Blank, FRB	Per client set of samples	See Table 3

*An NCM must be applied if there is insufficient volume for a MS/MSD or duplicate.

Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially, when CCV fails and after major instrument maintenance	See Table 3
Initial Calibration Blank (ICB)	Immediately after ICAL	See Table 3
Second Source Verification (ICV)	Immediately after ICB	See Table 3
Continuing Calibration Verification (CCV)	Beginning, end and after every 10 field samples. Alternate between ICAL Levels 4 and 5 (in order) throughout sequence	See Table 3
Continuing Calibration Verification Low (CCVL)	Immediately prior to Level 4 CCV at beginning of every non-ICAL analytical sequence	See Table 3
Isotope Dilution Analytes (IDA)	Added to Every injection (Standards, QC and Field Samples) at the same concentration	See Table 3

10.0 Procedure

One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a Non-Conformance Memo (NCM). The NCM process is described in more detail in SOP BR-QA-016. The NCM shall be filed in the project file and addressed in the case narrative. ***Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.***

10.1 Water Sample Preparation

Visually inspect samples for the presence of settled and/or suspended sediment. If the amount of sediment is so great that the SPE cartridge will clog before the majority of the sample has eluted, filter the water sample through a glass fiber filter [redacted] or equivalent). Gravity or vacuum can be used to pass the sample through the filter. Prepare a filtration blank and LCS with any samples requiring filtration. File an NCM noting the need for filtration.

> Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

Due to the high surface activity of the analytes, filtration should be regarded as a last resort. All samples will be spiked with IDA prior to filtration (if enough sample is available, perform an MS on each sample); this will allow any losses caused by filtration to be monitored and corrected for.

NOTE: for samples which full volume extraction is not possible, care MUST be taken to ensure the actual sample volume that is both spiked and extracted are documented in the sample worksheet notes.

Prepare two 250 mL aliquots of HPLC-grade water for the method blank and LCS.

Rotate the LCS concentration with each batch.

-Low Level LCS (50-150 %R), spike with 0.50 mL of PFAS LOQV solution. This will result in sample concentrations at the method Reporting Limit.

-Medium Level LCS (70-130 %R), spike with 0.025 mL (25 µL) of the PFAS LCS/Matrix Spike solution (Section 7.2). This will result in a sample concentration of 40 ng/L.

-High level LCS (70-130 %R), spike at 0.05mL (50uL) of the PFAS High Level LCS Spike solution (Section 7.2). This will result in a sample concentration of 200 ng/L.

Spike the MS/MSD (if available volume) with 0.025 mL (25 µL) of the PFAS LCS/Matrix Spike solution (Section 7.2). This will result in a sample concentration of 40 ng/L. NCM if there is insufficient volume to perform the MS/MSD.

Add [redacted] of the PFAS-IDA solution (Section 7.2) into each sample and QC sample, for a fixed concentration of 1.25 ng/mL in extract.

Due to the surface active nature of the PFAS analytes, it is necessary to extract the entire sample as well as the container walls to maximize recovery. It is therefore ideal to receive full 250 mL HDPE bottles for each sample (and MS/MSD if sufficient volume is received) so the entire sample can be processed from that container.

Weigh each container to determine its pre-extraction mass (Gross Weight). Spike each container in the batch with PFAS-IDA solution. Spike the LCS and LCSD (or MS/MSD, if available volume) with PFAS LCS/Matrix solution. Shake to mix the contents. After the extraction has been completed, allow the container to completely dry (uncapped). Replace the cap and reweigh the container to determine the container mass (Tare Weight). The sample volume extracted can be determined by subtracting the Tare Weight from the Gross Weight. These calculations are captured in the PFAS water sample prep module (TALS Method 3535_IVWT and 25101_2009_SPE).

10.1.1 Solid Phase Extraction (SPE) of Aqueous Samples

Condition the SPE cartridges [redacted] by passing the following without drying the column.

> **WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.**

Wash with 5.0 mL of [redacted]

Wash with 5.0 mL of [redacted] Close valve when ~ 1 mL remains on top to keep column wet. After this step, the columns should not go dry until the completion of loading and rinsing samples.

Appropriately label the SPE cartridges.

Add a poly siphon line to an adapter which has been firmly inserted into the SPE cartridge and place the other end of the line into the corresponding sample container.

Turn on the vacuum and pull the entire sample volume (minimum of 250 mL) through the cartridge at rate of approximately [redacted]

Stop the sample elution when ~0.1 mL remains. Add ~5 mL of water to the SPE column and restart the elution to complete the loading process. The added water volume ensures there are no small sample droplets remaining that may be clinging to the wall of the SPE cartridge.

After the sample and water rinse has passed through the cartridge, allow the cartridge to completely dry with vacuum (this could take up to 90 minutes). The cartridge should return to a uniform color. NOTE: Remove and replace each cartridge during the drying process to ensure any water droplets that may be in the flow path are eliminated.

10.1.2 SPE Column Wash of Aqueous Samples with Hexane

Add [redacted] to each SPE column and let the column become fully saturated with solvent. Close the stopcock and allow the column to soak for five minutes, then elute to waste.

Load a second [redacted] and elute to waste (without a soaking period).

Allow the column to dry with vacuum for 5 to 10 minutes. Columns must be dried thoroughly before continuing. The cartridge should return to a uniform color. Wipe any remaining water droplets from the bottom of the stainless steel guide needles using a fresh Kimwipe for each needle prior to proceeding to the next step.

10.1.3 SPE Elution of Aqueous Samples

Note: The use of glass should be avoided where able. However, disposable glass pipettes have a much narrower opening, which is necessary to reduce spillage during the following transfer steps.

Place labeled 15 mL polypropylene test tubes containing [redacted] of Reagent Water as receiving tubes in the SPE manifold.

Rinse the dried sample bottles with [redacted] and transfer to the corresponding SPE cartridge using a disposable glass pipet (NOTE: the sample container has molded ridges in the neck that can trap up to 0.5mL of the solvent rinsate; make sure to tip the container slightly to draw the rinsate out of the ridges). Allow the solution to soak the cartridge for 5 minutes and then elute into the 15 mL collection tube.

Repeat the sample bottle rinse to cartridge elution process with a [redacted] (without the soaking period). The total collection should be approximately 10 mL. Adjust to 10 mL with methanol.

10.1.4 Sample Cleanup with Graphitized Carbon (Optional)

Note: If this step is to be performed, do not add the [redacted] to the receiving tubes prior to extract collection. Add [redacted] of graphitized carbon to each sample extract and QC extracts to aid in the removal of organic interferences. Shake vigorously and then let sit for 10 minutes. Centrifuge each sample for 2 minutes at 1000 rpm. Decant the solvent layer into a new 15mL centrifuge tube containing 2 mL of Reagent Water and swirl to mix. Adjust the volume to 10 mL with methanol.

10.1.5 Internal Standard Addition

Add [redacted] internal standard to each extract and vortex to mix well.

Transfer a portion of the extract to a labeled 300µL polypropylene autosampler vial (6 drops or approximately 60µL). Archive the rest of the extract in the event the sample needs re-injection and/or dilution.

Seal the vials with polyethylene screw caps. Note: Teflon lined caps may not be used due to detection of low level concentration of PFAS.

10.2 Soil Sample Preparation

Visually inspect soil samples for homogeneity. Weigh a representative 5 g aliquot of soil, sediment or 1 g of tissue sample into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested and enough sample mass is available. Weigh 5 g aliquots of Ottawa sand or 0.1 g of oil for the MB and LCS samples.

Spike the LCS and MS/MSD (if requested) with 25 µL LCS/Matrix Spike Solution. This will result in a sample concentration of 2.0 ng/g (1.0 ng/mL ext).

Add [redacted] of IDA PFC Spiking Solution into each sample and QC sample, for a fixed concentration of 1.25 ng/mL in the final sample vial.

Cap the sample tubes and allow the spikes to settle into the sample matrix. Gently shake the bottles to mix the spike into the matrix.

Add [redacted] to each sample. Cap each sample and shake lightly to confirm container is sealed.

Place all samples in the prep batch into the TCLP tumbler and tumble for 3 hours.

After removing the samples from the tumbler, gently shake each container to confirm the solid material has settled to the bottom of the centrifuge tube, then place in a sonic bath for 12 hours.

Centrifuge each sample at 3500 rpm for 15 minutes.

Transfer the supernate (solvent) to a second, labeled 50 mL centrifuge tube containing 2 mL of Reagent Water.

Slowly add [redacted] to original 50 mL extraction tube. Pour the 2 mL of solvent rinse into the second labeled tube to complete the quantitative transfer.

Place extracts in the ZipVap set to 60 C for ~3 hours with nitrogen flow just strong enough to gently ripple the surface of the extracts. The concentration step is complete when the final volume either gets below 2 mL or maintains at the same level after consecutive checks a 5 minute intervals (this may be due to sample-based moisture contributing to the amount of water in the extract). Remove the sample from the ZipVap when the concentration has completed and allow the extracts to cool.

Adjust the volume of each sample's extract to 15 mL with Reagent Water and add 75 uL of Glacial Acetic Acid to neutralize the solution to pH 6-8. If the extracts contain suspended solids, centrifuge them at 3500 rpm for 15 minutes.

10.2.1 Solid Extract Cleanup by SPE

Condition the SPE cartridges [redacted] by passing the following without drying the column.

Wash with [redacted] with [redacted] Wash with a second [redacted] followed by a second [redacted] Close valve when ~ 0.5 mL remains on top to keep column wet. After this step, the columns should not go dry until the completion of loading and rinsing samples.

Appropriately label the SPE cartridges.

Pour each aqueous sample extract into its corresponding SPE cartridge until it is filled. Turn on the vacuum and open the stopcock to load the sample onto the cartridge. Add the remaining extract to the cartridge before it goes dry and stop the flow just before all of the sample has been drawn into the media. [redacted] 50 mL centrifuge tube to rinse the tube and complete the quantitative transfer. Pour this rinse into the SPE cartridge and open the stopcock to load the rest of the rinsate onto the cartridge. The added water volume ensures there are no small sample droplets remaining that may be clinging to the wall of the SPE cartridge. Set the centrifuge tubes aside and allow them to completely dry.

After the sample and water rinse has passed through the cartridge, allow the cartridge to completely dry with vacuum (this could take up to 30 minutes). The cartridge should return to a uniform color. NOTE: Remove and replace each cartridge during the drying process to ensure any water droplets that may be in the flow path are eliminated.

10.2.2 SPE Column Wash of Solid Extracts with Hexane

Add [redacted] of hexane to each SPE column and let the column become fully saturated with solvent. Close the stopcock and allow the column to soak for five minutes, then elute to waste.

Load a second [redacted] of hexane and elute to waste (without a soaking period).

Allow the column to dry with vacuum for 5 to 10 minutes. Columns must be dried thoroughly before continuing. The cartridge should return to a uniform color. Wipe any remaining water droplets from the bottom of the stainless steel guide needles using a fresh Kimwipe for each needle prior to proceeding to the next step.

10.2.3 SPE Elution of Solid Extracts

Place labeled 15 mL polypropylene test tubes containing [redacted] as receiving tubes in the SPE manifold.

Rinse the dried sample tubes [redacted] and transfer to the corresponding SPE cartridge. Allow the solution to soak the cartridge for 5 minutes and then elute into the 15 mL collection tube.

Repeat sample bottle rinse to cartridge elution process with [redacted] (without the soaking period) The total collection should be approximately 10 mL. Adjust to 10 mL with methanol.

10.2.4 Sample Cleanup with Graphitized Carbon (Optional)

Note: If this step is to be performed, do not add the [redacted] to the receiving tubes prior to extract collection. Add [redacted] of graphitized carbon to each sample extract and QC extracts to aid in the removal of organic interferences. Shake vigorously and then let sit for 10 minutes. Centrifuge each sample for 2 minutes at 1000 rpm. Decant the solvent layer into a new 15mL centrifuge tube containing 2 mL of Reagent Water and swirl to mix. Adjust the volume to 10 mL with methanol.

10.2.5 Internal Standard Addition

Add [redacted] internal standard to each extract and vortex to mix well.

Transfer a portion of the extract to a labeled 300µL polypropylene autosampler vial (6 drops or approximately 60µL). Archive the rest of the extract in the event the sample needs re-injection and/or dilution.

Seal the vials with polyethylene screw caps. Note: Teflon lined caps may not be used due to detection of low level concentration of PFAS.

10.3 Instrument Operating Conditions

Suggested operating conditions are listed below for the [redacted] LCMS system:

Recommended Instrument Operating Conditions					
HPLC Conditions (Shimadzu HPLC)					
Column (Column temp = 45°C)	Phenomenex Gemini C18 3um, 3.0mm x 100mm				
Mobile Phase Composition	A=20mM Ammonium Acetate (90/10 water/methanol) B=Methanol				
Gradient Program	**Time**	**%A**	**%B**	**Curve**	**Flow Rate mL/min.**
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	Maximum pressure limit = 5,000 psi				
Injection Size	[redacted]				
Run Time	[redacted]				
Mass Spectrometer Interface Settings (Sciex 5500 QQQ)					
MS Interface Mode	[redacted]				
Ionspray (volts)	[redacted]				
Declustering Potential-DP (volts)	[redacted]				
Entrance Potential-EP (volts)	[redacted]				

Source Temp (TEM)	[redacted]
Curtain Gas (CUR)	[redacted]
Collision Gas (CAD)	[redacted]
Ion Source Gas 1 (GS1)	[redacted]
Ion Source Gas 2 (GS2)	[redacted]
Collision Energy-CE (volts)	[redacted]
Collision Cell Exit Potential-CXP (volts)	[redacted]

Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings [redacted]

Compound	Comments	Reaction (MRM)	Dwell (sec)	DP(v)	EP(v)	CE(v)	CXP(v)
PFBA	Native analyte	212.9 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFBA	IDA	217.0 > 172.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeA	Native analyte	262.9 > 219.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C5 PFPeA	IDA	267.9 > 223.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFBS	Native analyte	298.9 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFBS_2	Native analyte	298.9 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C3 PFBS	IDA	301.9 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxA	Native analyte	313.0 > 269.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxA_2	Native analyte	313.0 > 119.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFHxA	IDA	315.0 > 270.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
4:2FTS	Native analyte	327.0 > 307.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
M2-4:2FTS	IDA	329.0 > 81.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeS	Native analyte	349.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeS_2	Native analyte	349 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
HFPO-DA	Native analyte	329.1 > 285	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C3 HFPO-DA	IDA	332.1 > 287	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpA	Native analyte	363.0 > 319.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpA_2	Native analyte	363.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFHpA	IDA	367.0 > 322.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxS	Native analyte	399.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxS_2	Native analyte	399.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
18O2 PFHxS	IDA	403.0 > 84.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
DONA	Native analyte	377 > 251	0.011	[redacted]	[redacted]	[redacted]	[redacted]
DONA_2	Native analyte	377 > 85	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOA	Native analyte	413.0 > 369.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOA_2	Native analyte	413.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFOA	Internal Std	415.0 > 370.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFOA	IDA	417.0 > 372.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
6:2FTS	Native analyte	427.0 > 407.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
M2-6:2FTS	IDA	429.0 > 81.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpS	Native analyte	449.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpS_2	Native analyte	449.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNA	Native analyte	463.0 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNA_2	Native analyte	463.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]

13C5 PFNA	IDA	468.0 > 423.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOS	Native analyte	499.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOS_2	Native analyte	499.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
9Cl-PF3ONS	Native analyte	531 > 351	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFOS	IDA	503.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDA	Native analyte	513.0 > 469.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDA_2	Native analyte	513.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFDA	IDA	515.0 > 470.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
8:2FTS	Native analyte	527.0 > 507.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
M2-8:2FTS	IDA	529.0 > 81.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNS	Native analyte	549.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNS_2	Native analyte	549.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
MeFOSAA	Native analyte	570 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
d3-MeFOSAA	IDA	573.0 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
11Cl-PF3OUdS	Native analyte	631 > 451	0.011	[redacted]	[redacted]	[redacted]	[redacted]
FOSA	Native analyte	498.0 > 78.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C8 FOSA	IDA	506.0 > 78.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFUdA	Native analyte	563.0 > 519.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFUdA_2	Native analyte	563.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFUdA	IDA	565.0 > 520.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
EtFOSAA	Native analyte	584.0 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
d5-EtFOSAA	IDA	589.0 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDS	Native analyte	599.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDS_2	Native analyte	599.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDoA	Native analyte	613.0 > 569.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDoA_2	Native analyte	613.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFDoA	IDA	615.0 > 570.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
10:2FTS	Native analyte	627 > 607	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDoS	Native analyte	699 > 80	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFDoS_2	Native analyte	699 > 99	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFTrDA	Native analyte	663.0 > 619.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFTrDA_2	Native analyte	663.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFTeDA	Native analyte	713.0 > 669.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFTeDA_2	Native analyte	713.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFTeDA	IDA	715.0 > 670.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxDA	Native analyte	813 > 769	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxDA_2	Native analyte	813 > 169	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFHxDA	IDA	815 > 770	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFODA	Native analyte	913 > 869	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFODA_2	Native analyte	913 > 169	0.011	[redacted]	[redacted]	[redacted]	[redacted]

Recommended Instrument Operating Conditions

Retention Times & Quantitation [redacted]

Native Compounds	Typical Native RT (minutes)	IS analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	[redacted]	13C4 PFBA	[redacted]	Isotope Dilution
PFPeA	[redacted]	13C5 PFPeA	[redacted]	Isotope Dilution
PFBS	[redacted]	13C3 PFBS	[redacted]	Isotope Dilution
4:2FTS	[redacted]	M2-4:2FTS	[redacted]	Internal Standard
PFHxA	[redacted]	13C2 PFHxA	[redacted]	Isotope Dilution
PFPeS	[redacted]	13C3 PFBS	[redacted]	Internal Standard
HFPO-DA	[redacted]	13C3 HFPO-DA	[redacted]	Isotope Dilution
PFHpA	[redacted]	13C4 PFHpA	[redacted]	Isotope Dilution
PFHxS	[redacted]	18O2 PFHxS	[redacted]	Isotope Dilution
DONA	[redacted]	13C4 PFOS	[redacted]	Internal Standard
6:2FTS	[redacted]	M2-6:2FTS	[redacted]	Isotope Dilution
PFOA	[redacted]	13C4 PFOA	[redacted]	Isotope Dilution
PFHpS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFNA	[redacted]	13C5 PFNA	[redacted]	Isotope Dilution
PFOS	[redacted]	13C4 PFOS	[redacted]	Isotope Dilution
9Cl-PF3ONS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
8:2FTS	[redacted]	M2-8:2FTS	[redacted]	Isotope Dilution
PFDA	[redacted]	13C2 PFDA	[redacted]	Isotope Dilution
PFNS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
MeFOSAA	[redacted]	d3-MeFOSAA	[redacted]	Isotope Dilution
11Cl-PF3OUdS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
EtFOSAA	[redacted]	d5-EtFOSAA	[redacted]	Isotope Dilution
PFDS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFUdA	[redacted]	13C2 PFUdA	[redacted]	Isotope Dilution
FOSA	[redacted]	13C8 FOSA	[redacted]	Isotope Dilution
PFDoA	[redacted]	13C2 PFDoA	[redacted]	Isotope Dilution
10:2FTS	[redacted]	M2-8:2FTS	[redacted]	Internal Standard
PFDoS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFTrDA	[redacted]	13C2 PFTeDA	[redacted]	Internal Standard
PFTeDA	[redacted]	13C2 PFTeDA	[redacted]	Isotope Dilution
PFHxDA	[redacted]	13C2 PFHxDA	[redacted]	Isotope Dilution
PFODA	[redacted]	13C2 PFHxDA	[redacted]	Internal Standard

Note: clients must be notified when the quantitation of an analyte is performed using an Internal standard. Changes to these IDA/ISTD associations may be necessary when sources of IDAs are updated: this may include additions as new IDAs become available, or subtractions if IDAs are unavailable.

10.4 Instrument Tuning

Instrument tuning is done initially when the method is first developed and thereafter as needed to maintain the sensitivity and selectivity of the method. Tuning is done by infusing each individual compound (native and IDA) into the MS/MS electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and calibrated if necessary. The mass assignments must be within ± 0.5 amu of the values shown in the table above.

10.5 Instrument Calibration

Perform initial calibration with a minimum of five calibration standards before any sample analysis (initial method set-up), whenever a new column is installed, when significant instrument maintenance has been performed, and when the CCV does not meet acceptance criteria. Significant instrument maintenance includes installing a new column, changing the proportioning valve, or changing components of the MS/MS system. A new calibration is not required following minor maintenance.

With the exception of the circumstances delineated in policy CA-Q-P-003, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points. The same injection volume must be used for all injections (standards and extracts).

Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear; it's use requires a minimum of 6 calibration standards.

For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated by isotope dilution must be < 20% for the curve to be valid.

For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated by internal standard (i.e. those compounds that do not have corresponding isotopically labeled analogs) must be < 25% for the curve to be valid.

For linear fit, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r2) must be greater than or equal to 0.990 for the curve to be considered valid (or the correlation coefficient (r) > 0.995).

Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

-Response must increase with increasing concentration.

-The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.

-There should be no carryover at or above 1/2 MRL after a high CAL standard.

-The low cal. point must recover to within 50-150%, and all others must recover to within 70-130%.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.6 Initial Calibration

Prepare the working calibration standards using the recommended formulations given in Appendix B ensuring the lowest calibration standard for each analyte is equal to or below the established RL. Unless otherwise specified on a project basis, use calibration levels 1 to 6 to establish the calibration curve for each analyte.

Prime the instrument by analyzing a minimum of 4 “primer” solutions consisting of 80/20 methanol/water. In general, an HPLC contains components made from PTFE, which enable the pumps to work with many types of organic solvents. Despite efforts to remove as much PTFE as possible, certain components cannot be replaced and contribute PFAS. The longer the system remains idle, the more PFAS that is yielded. Therefore these primers serve to reduce and stabilize the amount of PFAS that are contributed. Immediately following the primers is a Blank, the ICAL sequence (run in ascending order of Level 1 to Level 6), the ICB, the ICV and the first analytical window of extracts (up to 10 field samples). The data is acquired using Sciex’s Analyst 1.6.

The Chrom Review data system generates calibration data by generating relative response factors (RRFs) based on the response of the target analyte and its corresponding Isotope Dilution Analyte (or Internal Standard) as well as their injection concentrations to ultimately generate Mean Response Factors. All analytes calibrated using IDA must have RSD values < 20%, all analytes calibrated using ISTD must have RSD values < 25%. The IDA compounds are also calibrated using an external RF model using response and concentration. The IDA RSD must be < 50%. Alternatively, a linear regression curve of concentration vs. peak area for each analyte relative to their corresponding IDA/ISTD and their concentrations calculates the correlation coefficient with 1/concentration weighting. The calibration must have a correlation coefficient (r) ≥ 0.995 ($r^2 \geq 0.990$). If criteria are not met, correct the problem and repeat calibration. Further analysis may not proceed without valid calibration.

10.7 Initial Calibration Blank (ICB)

Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of [redacted] fortified with IDA solution at 50 ng/mL

The result for the calibration blank must be less than the reporting limit.

If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.8 Second Source Calibration Verification (ICV)

Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

The recovery for the ICV must meet the appropriate following criteria:

The native analyte must be within or equal to 70-130% for all native analytes quantitated by isotope dilution.

The native analyte must be within or equal to 70-130% for all native analytes quantitated by internal standard (i.e. those compounds that do not have corresponding isotopically labeled analogs).

The IDA recovery must be within or equal to 50-150%.

See Table 3 for corrective actions in the event that the ICV does not meet the criteria above.

10.9 Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are usually at the mid-level range of the curve and should vary throughout the run. The curve and ICV do not need to be run every day. To start an analytical run a CCV can be analyzed and if it meets acceptance criteria a run can be started. In addition, the low standard in the curve must be analyzed and must be within ± 50% of the expected value.

The recovery for the CCV standards must be equal to or within 70-130% (50-150% for low level standards) for all natives quantitated by isotope dilution and for all natives quantitated by internal standard. The recovery for the IDA must be within or equal to 70-130% of the true value.

If this is not achieved, the instrument has drifted outside the calibration limits. If the CCV fails again following minor maintenance, the instrument must be recalibrated.

10.10 Isotope Dilution Analytes (IDA)

The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 10.1. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

IDA recoveries are flagged if they are outside of the acceptance limits. Quantitation by isotope dilution generally precludes any adverse effect on data quality due to IDA recoveries being outside of the acceptance limits as long as the signal-to-noise ratio is greater than 10:1.

> Evaluate data quality for usability, flag and submit a non-conformance memo for any analytes outside of the recovery criteria, and report if data is deemed not adversely effected.
>
> Re-extraction of samples should be performed if the signal-to-noise for any IDA is less than 10:1 or if the IDA recoveries fall below 10%.
>
> Re-extraction may be necessary under other circumstances when data quality has been determined to be adversely affected.

10.11 Troubleshooting:

Check the following items in case of calibration failures:

Evaluate the failure to determine whether it affects all of the compounds in the ICAL equally. If one ICAL point appears low or high, reprep the curve and rerun, as the error was most likely prep-based. If only a subset of the analytes are affected, check the integration and chromatography to see if there are anomalies; if justifiable, correct the integration so it is consistent with the other ICAL levels.

If there are no peaks for all compounds or no peaks after a specific retention time, ensure that the HPLC pump is pumping properly; it may have shut down due to overpressure or has a leak. If the pump has shut down, confirm it is primed and replace the in-line filter. If the pressure climbs above expected levels, changing the guard column and even analytical column may be necessary. It's best to chase high pressure sources from the pump forward (ie the post-pump in-line filter, isolator column, post-autosampler in-line filter, guard column, analytical column and MSMS inlet. If the pump is still pumping, check the system pressure. If it is lower than expected, check for leaks. Start with all connections, then move on to pump seals, especially if there are wide variations in pressure when pumping the same solvents at the same flow rates. If the pump is still pumping and the pressure is normal, check to make sure the MSMS is still functioning properly. Most issues with the MSMS system will be noted by the instrument software.

If there are peaks for all analytes, evaluate the peak shapes by comparing them to the ICAL chromatography. If the peaks have changed (shorter and wider), a new guard column may improve peak shape and bring the system back into compliance. If a new column is necessary, a new ICAL will be needed.

Preventive and routine maintenance is described in the table below

HPLC/MS/MS Preventative Maintenance
As Needed: Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes.
Daily (When in use) Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Verify that multiplier is functioning.

10.12 Sample Analysis

Place the field and QC samples in a sequence that begins with the calibration standards followed by the analysis of QC samples, field samples and continuing calibration verification standards (CCVs).

An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Primer 1
2	Primer 2
3	Primer 3

Injection Number	Lab Description
4	Primer 4
5	Blank
6	Calibration Level 1
7	Calibration Level 2
8	Calibration Level 3
9	Calibration Level 4 (ICIS)
10	Calibration Level 5
11	Calibration Level 6
12	ICB
13	ICV
14	T-PFOA
15	MB
16	LCS
17-26	(up to) 10 Field samples
27	CCV L4
28-37	(up to) 10 Field samples
38	MS
39	MSD
40	CCV L5
41	MB
42	LCS
43-52	(up to) 10 Field samples
53	CCV L4
54-63	(up to) 10 Field samples
65	MS
66	MSD
67	CCV L5

An example analytical sequence without ICAL:

Injection Number	Lab Description
1	Primer 1
2	Primer 2
3	Primer 3
4	Primer 4
5	CCB
6	CCVL (LOQV)
7	CCVIS (L4)
8	MB
9	LCS
10-19	(up to) 10 Field samples
20	CCV L5
21-30	(up to) 10 Field samples
31	MS
32	MSD
33	CCV L4
34	MB
35	LCS

36-45	(up to) 10 Field samples
46	CCV L5
47-56	(up to) 10 Field samples
57	MS
58	MSD
59	CCV L4

Enter the sample ID's into the data acquisition program in the order the samples were placed in the autosampler and initiate the analytical sequence.

11.0 Corrective Action

When an out-of-control situation occurs that is not delineated in this corrective action table or the corrective actions listed do not adequately address the circumstances, a Corrective Action Report (CAR) (NCM), etc., must be developed (see SOP BR-QA-016) and the analyst must use his/her best analytical judgment and available resources to determine the corrective action to be taken. The out-of-control situation may be caused by more than one variable. The analyst should seek the assistance of his/her immediate supervisor, QA manager or other experienced staff if they are uncertain of the cause of the out-of-control situation. The analysis must not be resumed until the source of the problem and an in-control status is re-established. All samples associated with the out-of-control situation must be reanalyzed after in-control status has been re-established or if authorization is received from the supervisor or QA Manager for release with data qualification.

12.0 Calculations / Data Reduction

12.1 Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the retention times of the initial calibration standards. The retention times of PFAS with labeled standards must be the same as that of the labeled IDA's to within 0.05 min. For PFAS with no labeled standards, the RT must be within ± 0.3 minutes of the CCVIS standards. *Note: The IS RT and native RT may be offset by 0.02 to 0.04 minutes.*

12.2 Quantitative Identification

The ICAL established in Section 10.10 is used to calculate concentrations for the extracts. The data processing system determines on-column concentration. Final results are calculated by the laboratory's LIMS information system (TALS).

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

Check the results of samples analyzed immediately after high concentration samples (those with results above calibration range) for signs of carry-over. Reanalyze all samples suspected of carry-over.

12.3 Calculations

See Appendix C.

12.4 Data Review

Refer to laboratory SOP BR-QA-019 for additional instruction on the requirements for data review. The following sections summarize the general procedure as described in the data review SOP.

12.5 Primary Review

Review the chromatography and quantitation in the data processing system to confirm quantitative and qualitative identification of each target analyte. Perform and document manual integrations only if needed per the instructions in corporate policy CA-Q-S-002, Acceptable Manual Integration Practices.

Upload the data files to TALS and process the batch. Enter job information into the batch editor and add the standards and reagent additions to the worksheet, if necessary. Review the results against acceptance criteria. If acceptance criteria are not met, perform corrective action or make arrangements for corrective action with another analyst.

Set results to primary, secondary, acceptable or rejected. Set results to be reported to a status of primary and secondary. Set results that meet criteria but will not be reported to acceptable. Set results that do not meet criteria to rejected, to prevent inadvertent reporting of data.

Verify that all appropriate QC were performed and acceptable. If insufficient volume is received (MS, MSD, FRB, etc…) document in an NCM. Record all instances where acceptance criteria are not met in a nonconformance memo (NCM).

Verify that all project requirements or program specific requirements were followed. If not, immediately notify the project manager to determine an appropriate course of action. Record decisions made in the data review checklist.

Set the batch to 1st level review. Complete the data review checklist and make arrangements for secondary review by a peer analyst.

12.6 Secondary Data Review (Performed by Peer Analyst)

Record review using the data review checklist.

Verify that all project requirements or program specific requirements were followed. If not, consult with the primary analyst to determine cause. Any decisions made should be recorded on the data review checklist and retained as part of the analytical record.

Review the TALS batch editor to verify ancillary information for the work performed is filled in.

Verify that that the procedures in this SOP were followed. If discrepancy between the SOP and the analytical record is found, consult with the primary analyst to determine the source of the discrepancy. Resolve the discrepancy and verify any modifications to the SOP are properly documented and were approved by laboratory management. Record all SOP deviations in an NCM.

Spot-check ~15% of samples in the batch to verify quantitative and qualitative identification.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in SOP CA-Q-S-002.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in SOP CA-Q-S-002.

- If an error is suspected, the reviewer must consult with the analyst that performed the integration to determine if a correction is necessary. Input from the Technical Manager (TM), Department Manager (DM), or QA Manager (QAM) may be sought as necessary. **The reviewer may not reintegrate except in those circumstances approved by laboratory management**, such as when the analyst that performed the integration is on vacation. If re-integration is performed by the reviewer, the reviewer is now considered the “primary analyst” and the re-integration is subject to the same review and documentation requirements as the original integration.

Verify acceptance criteria were met. If not, verify that corrective actions were performed and the nonconformance was documented with an NCM. Review the NCM to verify the form is filled out and the requisite information has been included in the internal comments tab. If corrective action was not performed and the failure not documented, consult with the primary analyst to determine cause. Consult with the primary analyst and department management to determine what actions should be taken, then follow-through with the decision made.

Run the QC checker and fix any problems found. Run and review the deliverable for gross error such as missing data. Fix any problems found.

When review is complete set the method chain to lab complete. Complete the data review checklist and forward associated paperwork to report/project management.

12.7 Data Reporting & Record Retention

The specifications for data reporting are set by the project manager and are performed by TALS using the formatter selected by the PM. The type of deliverable is also set by the PM based on various deliverable options in the TALS system. The formatters and deliverables are programmed into TALS by corporate IT staff and cannot be modified locally.

The following sections describe the default reporting scheme set for this method in TALS:

Data is retained, managed and archived as specified in laboratory SOP BR-QA-014 Laboratory Records.

13.0 Method Performance

13.1 Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. An initial method detection limit study is performed in accordance with SOP BR-QA-005. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency.

13.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows.

13.2.1 Four aliquots of the QC check sample are analyzed using the same procedures used to analyze samples, including sample preparation. The concentration of the QC check sample may be equivalent to a mid- level calibration.

13.2.2 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

13.2.3 If any analyte does not meet the acceptance criteria, the test must be repeated. Only those analytes that did not meet criteria in the first test need to be evaluated. TNI 2016 requires consecutive passing results. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

13.2.4 Until the IDOC is approved by the QA Manager (or designee); the trainer and trainee must be identified in the batch record.

13.3 Training Requirements

The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. A new analyst must be working under documented supervision prior to approval of the IDOC. Documentation that a new analyst is performing under supervision must be entered into the batch record (View Batch Information) until that analyst's IDOC has been approved by the QA Manager (or designee). See requirements for demonstration of analyst proficiency in SOP BR-QA-011.

14.0 Pollution Control

Employees must abide by the policies and procedures in the NDSC Eurofins TestAmerica Laboratories Environmental Health and Safety Manual (CW-E-M-001), Radiation Safety Manual and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

15.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite Container: 30 gallon poly barrel located under GC-Semi prep hood.
- Solvent Waste: Satellite Container: 5 gallon poly carboy located under LCMSMS.

16.0 References / Cross References

- Cheryl Moody, Wai Chi Kwan, Johnathan W. Martin, Derek C. G. Muir, Scott A. Mabury, "Determination of Perfluorinated Surfactants in Surface Water Samples by Two Independent Analytical Techniques: Liquid Chromatography/Tandem Mass Spectrometry and 19FNMR," Analytical Chemistry 2001, 73, 2200-2206.
- John Giesy et al., "Accumulation of Perfluorooctane Sulfonate in Marine Mammals", Environmental Science & Technology, 2001 Vol. 35, No. 8, pages 1593-1598.
- U.S. EPA, "Residue Chemistry Test Guidelines, OPPTS 860.1340, Residue Analytical Method", EPA 712-C-95-174, August 1995.
- STL Denver White Paper DEN-W-LC-002, "Method Validation Study for Analysis of Ammonium Perfluorooctanoate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, September 5, 2003.
- STL Denver White Paper DEN-W-LC-003, "Addendum A to Method Validation Study for Analysis of Ammonium Perfluorooctanoate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, August 6, 2003.
- STL Denver White Paper DEN-W-LC-004, "Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography/Tandem Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, January 26, 2005.
- Waters application note; "Acquity UPLC System for Quantifying Trace Levels of Perfluorinated Compounds with an Acquity PFC Analysis Kit", Peter J. Lee, Evan T. Bernier, Gordon T. Fujimoto, Jeremy Shia, Michael S. Young, and Alice J. Di Gloia, Waters Corporation, Milford, MA. USA.
- Method ISO 25101, "Water quality – Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry", First Edition, 2009-03-01, International Organization for Standardization, Technical Committee ISO/TC 147, Water Quality, Subcommittee SC 2, Physical, chemical and biochemical methods.
- US EPA, "Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)", Version 1.1, September 2009, J.A. Shoemaker, P.E. Grimmett, B.K. Boutin, EPA Document #: EPA/600/R-08/092.
- Laboratory SOP BR-QA-005 *Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).*
- Laboratory SOP BR-QA-011 *Employee Training*
- Laboratory SOP BR-EH-001 *Hazardous Waste*
- Laboratory SOP BR-QA-014 *Laboratory Records*

- Laboratory SOP BR-QA-006 *Procedures & Documentation Requirements for Manual Integration*
- Laboratory Quality Assurance Manual (QAM)
- Corporate TestAmerica SOP CA-Q-S-002 *Manual Integrations*.

17.0 Method Modifications

Modification Number	Method Reference	Modification & Technical Justification
1	Section 7.2	Method 25101 specifies that the values reported for PFOA and PFOS shall be the linear isomer only. In keeping with the dictates of USEPA 537 and other US conventions, the laboratory reports both the branched (when present) and linear isomers as a single value for these compounds.
2	Section 10.1	A different SPE cartridge, Waters OASIS WAX, is used for the extraction process. As a result, solvents and elution procedures are different.
3	Section 10.1	The samples are fortified with a greater number of labeled analytes (most analytes have labeled versions) prior to extraction.
4	Section 10.5	The HPLC Column, Eluents and gradient conditions have changed.
5	Section 10.5	For non-drinking water matrices, the analyte list has expanded. The number of labeled analytes has also expanded to improve quantitation.
6	Table 1	The reporting limits have changed to a consistent value.
7	Appendix B	Calibration levels have been changed so all levels have the same analyte concentration.

18.0 Attachments

- Table 1: Routine Compound List and LOQ
- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Table 4: Control Limits
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

19.0 Revision History (all revision history must be retained in this SOP)

Revision 6.1: Date effective 09/28/2020

- Updated cover page dates and signatories
- Section 1.1: Updated reporting limit ranges to reflect current practice. Added clarification for non-potable samples are only analyzed in NJ.

- Section 7.3: Updated standard preparation solutions for IDA solution from 1000 ng/mL to 500 ng/mL and Internal standard solution from 2500 ng/mL to 1250 ng/mL to reflect current practice.
- Section 8.0: Added 28 day holding time specific to samples collected in NJ.
- Section 10.1: Changed IDA solution to have a fixed concentration of 1.25 ng/mL
- Sections 10.1.5 and 10.2.5.: Updated Internal standard used from 2500 ng/mL to 1250 ng/mL to reflect current practice.
- Sections 5.0 and 11.0: Update to standard language as required by corporate NDSC.
- Section 19.0: Added effective dates.
- Table 1: Updated reporting limits to reflect current practice.
- Table 3: Added NJ specific requirement.
- Appendix B: Updated information to for IDA and Internal Standard formulations to reflect current practice.

Revision 6.0: Date effective 04/24/2020

- Updated cover page dates, copyright information, and signatories
- Throughout: Added support for soil, sediment and tissue matrices.
- Throughout: Removed reference to analysis using Waters instrumentation.
- Throughout: Removed reference to final extract concentration for aqueous samples.
- Section 1.1: Update Fluorotelomer sulfonates (FTS) to report acid forms
- Section 11.0: Added corrective action requirement as it is a corporate requirement to include.

Revision 5.0: Date effective 10/11/2019

- Updated cover page dates, copyright information, and signatories
- Throughout: removed references to drinking water. Will add back if adopted.
- Throughout: removed solid extraction/analysis verbiage missed in previous revision.
- Throughout: revised formatting to be consistent
- Throughout: added PFHxDA, PFODA, PFDoS, 10:2FTS, HFPO_DA, DONA, F53BMajor, and F53B Minor as additional analytes and IDAs
- Section 4.0: added interference information about $^{13}C_2$-PFHxDA
- Section 6.1: updated to include additional laboratory apparatus information
- Section 6.2: updated to include additional instrument and more detail for existing instrument
- Section 7.1: added more detail to reagent information and the addition of Ammonium acetate and Ammonium hydroxide
- Section 7.2: added PFHpS and PFDS as other PFAS not available in the acid form. Added the IDA and ISTD are added at a fixed concentration and removed the low level reference
- Section 9.1 added a NCM must be added for MS/MSD
- Section 10.1: removed the low level spike reference and added the PFAS-IDA solution is added to each sample and QC sample in concentrated extract and non-concentrated extracts
- Section 10.2: In the previous version of this SOP, the “Note” was removed and replaced with “Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect All glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.”
- Section 10.2: changed wording to clarify addition of poly siphon line into the SPE cartridge

- Section 10.3: removed to keep test tube as keep and added “Note: If the extracts will note be concentrated, [redacted] for the second bottle rinse so the final volume is approximately 8mL.”
- Section 10.5: added sample cleanup with graphitized carbon section
- Section 10.6: added wording to have [redacted] of reagent water to the 10mL extract at this time
- Section 10.7: updated wording
- Section 10.8: added operating system for new instrument and added more detail for existing instrument
- Section 10.17: updated sample analysis to include calibration currently in use
- Table 1 and Table 4: updated to include additional analytes and IDAs
- Appendix A: updated terms and definitions from body of SOP
- Appendix B: updated to include additional analytes and IDAs

Revision 4.0: Date effective 04/12/2019
- Updated cover page dates, copyright information, and signatories
- Headers: removed TestAmerica logo and added Eurofins logo
- Throughout: removed references to drinking water. Will add back if adopted.
- Throughout: revised formatting to be consistent
- Section 1.1: added note about addition of Appendix D, removed NJDEP as PAB
- Section 10.1.3: added note about the use of glass pipettes
- Section 10.3: In a previous version of this SOP, Table “Recommended Instrument Operating Conditions” incorrectly referenced PFTrDA as Isotope Dilution, so this was corrected to Internal Standard and added note to contact clients for ISTD quantitation.
- Removed verbiage regarding soil LOQ from Note on Table 1.
- Added Appendix D: NJDEP secondary certified analytes list

Revision 3.0: Date effect 12/12/2018
- Updated cover page dates and signatories
- Section 10.1: added note for handling incomplete volume extraction process
- Section 18: added previous revision history back into SOP
- Throughout: updated QC criteria from EPA 537 r1.1 that was missed in previous revision
- Throughout: removed solid extraction/analysis verbiage missed in previous revision.
- Throughout: updated calibration to include criteria from EPA 537 r1.1 and to include the 9 calibration points currently in use.
- Throughout: minor formatting updates

Rev 2.1: Date effective 10/11/2018
- Updated cover page dates and signatories
- Section 8: added preservation requirements for DW samples.
- Throughout: updated QC criteria to match EPA537 rev1.1
- Throughout: removed references to solid and tissue extraction/analysis.

Rev 2.0: Date effective 07/31/2018
- Updated cover page and signatories
- Section 8: added preservation requirements for DW samples.
- Throughout: included verbiage that Non-drinking water matrices are not certified under PAB.
- Throughout: separated DW and non-DW limits and QC requirements.

- Throughout: minor formatting and typographical corrections.
- Tables 3 & 4: updated limit to meet EPA 537 criteria.
- Appendix A: updated terms and definitions from body of SOP

Rev 1.0: Date effective 01/19/2018

- Extended analyte list to 21 native compounds and 18 IDAs.
- Altered concentration step in extract preparation by employing a reagent water keeper instead of concentrating to dryness.
- Incorporated use of internal standard for IDA recovery calculation.

Revision 0.0: Date effective 05/19/2017

- New SOP based on USEPA method 537

Previous revisions are retained by the QA department.

Table 1: Routine Compound List & Limit of Quantitation (LOQ)

Compound Name	Abbreviation	CAS #	Water (ng/L)	Soil/ Sediment (ug/Kg)	Tissue (ug/Kg)
Perfluoroalkylcarboxylic acids (PFCAs)					
Perfluoro-n-butanoic acid	PFBA	375-22-4	5.0	0.50	1.0
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3	2.0	0.20	1.0
Perfluoro-n-hexanoic acid	PFHxA	307-24-4	2.0	0.20	1.0
Perfluoro-n-heptanoic acid	PFHpA	375-85-9	2.0	0.20	1.0
Perfluoro-n-octanoic acid	PFOA	335-67-1	2.0	0.20	1.0
Perfluoro-n-nonanoic acid	PFNA	375-95-1	2.0	0.20	1.0
Perfluoro-n-decanoic acid	PFDA	335-76-2	2.0	0.20	1.0
Perfluoro-n-undecanoic acid	PFUdA	2058-94-8	2.0	0.20	1.0
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1	2.0	0.20	1.0
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8	2.0	0.20	1.0
Perfluoro-n-tetradecanoic acid	PFTeDA	376-06-7	2.0	0.20	1.0
Perfluoro-n-hexadecanoic acid	PFHxDA	67905-19-5	2.0	0.20	1.0
Perfluoro-n-octadecanoic acid	PFODA	16517-11-6	2.0	0.20	1.0
Perfluorinated sulfonic acids (PFSAs)					
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5	2.0	0.20	1.0
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4	2.0	0.20	1.0
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4	2.0	0.20	1.0
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8	2.0	0.20	1.0
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1	2.0	0.20	1.0
Perfluoro-1-nonanesulfonic acid	PFNS	68259-12-1	2.0	0.20	1.0
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3	2.0	0.20	1.0
Perfluoro-1-dodecanesulfonic acid	PFDoS	79780-39-5	2.0	0.20	1.0
Perfluorinated sulfonamides (FOSA)					
Perfluoro-1-octanesulfonamide	FOSA	754-91-6	2.0	0.20	1.0
Perfluorinated sulfonamidoacetic acids (FOSAA)					
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6	5.0	2.0	10.0
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9	5.0	2.0	10.0
Fluorotelomer sulfonates (FTS)					
1H,1H,2H,2H-perfluorohexane sulfonate *(4:2)*	4:2 FTS	757124-72-4	2.0	2.0	10.0
1H,1H,2H,2H-perfluorooctane sulfonate *(6:2)*	6:2 FTS	27619-97-2	5.0	2.0	10.0
1H,1H,2H,2H-perfluorodecane sulfonate *(8:2)*	8:2 FTS	39108-34-4	2.0	2.0	10.0
1H,1H,2H,2H-perfluorododecane sulfonate*(10:2)*	10:2 FTS	120226-60-0	2.0	2.0	10.0
Fluorinated Replacement Chemicals					
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	4.0	0.40	2.0
4,8-dioxa-3H-perfluorononanoic acid	DONA	919005-14-4	2.0	0.20	1.0
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	F53B Major (9Cl-PF3ONS)	756426-58-1	2.0	0.20	1.0
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	F53B Minor (11Cl-PF3OUdS)	763051-58-1	2.0	0.20	1.0

NOTE: The LOQ values may vary. The Water LOQ is based on a 250mL nominal sample volume.

Table 2: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Ammonium Hydroxide (3-0-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Hexane (2-3-0)	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Hydrochloric Acid (3-0-1)	Corrosive Poison	5 ppm (Ceiling)	Can cause pain and severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause deep ulcerations to skin, permanent eye damage, circulatory failure and swallowing may be fatal.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm (TWA)	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison		Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
Potassium Persulfate (2-0-1-OX)	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.

[1] Always add acid to water to prevent violent reactions.
[2] Exposure limit refers to the OSHA regulatory exposure limit.

Table 3: QC Summary, Acceptance Criteria and Recommended Corrective Action (EPA537)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
6-Point Calibration (5 point minimum for CF and Linear Regression) (ICAL)	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	CF = RSD $\leq$ 20% (compounds calibrated via IDA) CF = RSD $\leq$ 25% (compounds calibrated using "near-IDA" compounds) CF = RSD $\leq$ 50% (IDA standards using ISTD) Each cal pt. = +/-30%Rec. (+/-50%Rec for cal low pt.) Linear Regression: $r^2 \geq 0.990$	Correct problem and repeat initial calibration.
IDA Response	Every injection contains the IDA analytes	Non-DW matrices (for samples collected in NJ – see below): Standards: 50-150% recovery Field samples: 50-150% recovery (poor responding IDAs: 25-150%) (reportable if >10x S/N ratio and >10% ICAL RF)	Standard failures must be investigated to determine the cause of the failure. Recalibration may be required. Samples with recoveries outside acceptance limits must be evaluated for data usability. Re-extraction may be necessary if data quality has been adversely affected.
IDA Response	Every injection contains the IDA analytes	Non-Potable samples collected in NJ: Standards: 50-150% recovery Field samples: 50-150% recovery (reportable if >10x S/N ratio and >10% ICAL RF)	Standard failures must be investigated to determine the cause of the failure. Recalibration may be required. Samples with recoveries outside acceptance limits must be evaluated for data usability. Re-extraction may be necessary if data quality has been adversely affected.
IS Response	Every injection contains the IS analyte	ICAL Standards: Area of individual points must not deviate by more than 50% of ICAL mean area response Samples following ICAL: 50-150% of ICAL mean response Ongoing CCV: 50-150% of ICAL mean response Post-CCV Samples: Area must be within 50-150% of most recent CCVIS (daily opening CCV)	Standard failures must be investigated to determine the cause of the failure. Recalibration may be required. Sample failures may be matrix related and should be evaluated to determine if the data quality has been adversely affected.
Initial Calibration Blank (ICB)	Immediately following the ICAL	Non-DW: < RL for all target analytes	Determine source of interference/contamination, eliminate it and recalibrate.
Second Source Standard Verification (ICV)	Prior to the analysis of samples. Generally immediately after the ICB.	+/-30 for analytes, IS, and SUR.	Correct problem and verify second source standard. If that fails, repeat calibration.
Continuing Calibration Verification (CCV)	Beginning of each analytical sequence, every ten field samples and at the end of each analytical sequence. Alternate between levels 3, 4 and 5.	+/-30%	Rerun any samples analyzed before and after the failing CCV. Take corrective action; if subsequent CCV analyses fail, recalibrate instrument.
Continuing Calibration Verification-Low (CCVL)	Beginning of each analytical sequence that is not preceded by an ICAL to show LOQ is still valid.	CF = 50-150% (ISTD targets) IDA 50-150%	Stop sample acquisition. Take corrective action; if subsequent CCV analyses fail, recalibrate instrument.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Method Blank	One per extraction batch of 20 or fewer samples	Non-DW: < RL for all target analytes	Reprocess MB and associated samples if any target analyte in the MB is at or above the RL, greater than 1/10 the amount detected in any sample or 1/10 the regulatory limit, whichever is greater. If the target is not greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with appropriate qualifiers. If insufficient sample is available to reprocess, report data with appropriate qualifiers.
Laboratory Control Sample	One per extraction batch of 20 or fewer samples (rotate between Low, Med, High)	%R within control limits. See Table 4	Reprep and reanalyze samples for failed analytes. If reanalysis is not possible due to insufficient sample volume, report data with appropriate data qualifiers.
Matrix Spike / Matrix Spike Duplicate	One set per extraction batch when sufficient sample volume is provided	%R within control limits. See Table 4	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.
Sample Duplicate	One per extraction batch of 20 or fewer samples	RPD within control limits. See Table 4	Evaluate data to determine source for error. If analytical error is suspected, reanalyze or reprocess as appropriate.
Field Reagent Blank	Per client sample set	Non-DW: < RL for all target analytes	Analysis only required if samples contain target analytes at or above the RL. If analytes are present in the FRB at >1/3 RL, all samples must be recollected and re-analyzed.

Table 4: LCS and MS/MSD Control Limits*

Analyte	Water (Low Level) %R	Water (Med-High Level) %R	RPD
Perfluorobutanoic acid (PFBA)	50-150	70-130	20
Perfluoropentanoic acid (PFPeA)	50-150	70-130	20
Perfluorobutanesulfonic acid (PFBS)	50-150	70-130	20
Perfluorohexanoic acid (PFHxA)	50-150	70-130	20
Perfluoropentanesulfonic acid (PFPeS)	50-150	70-130	20
Perfluoroheptanoic acid (PFHpA)	50-150	70-130	20
Perfluorohexanesulfonic acid (PFHxS)	50-150	70-130	20
Perfluorooctanoic acid (PFOA)	50-150	70-130	20
Perfluoroheptanesulfonic acid (PFHpS)	50-150	70-130	20
Perfluorononanoic acid (PFNA)	50-150	70-130	20
Perfluorooctanesulfonic acid (PFOS)	50-150	70-130	20
Perfluorodecanoic acid (PFDA)	50-150	70-130	20
Perfluorononanesulfonic acid (PFNS)	50-150	70-130	20
Perfluoroundecanoic acid (PFUdA)	50-150	70-130	20
Perfluorodecanesulfonic acid (PFDS)	50-150	70-130	20
Perfluorooctanesulfonamide (FOSA)	50-150	70-130	20
Perfluorododecanoic acid (PFDoA)	50-150	70-130	20
Perfluorododecanesulfonic acid (PFDoS)	50-150	70-130	20
Perfluorotridecanoic acid (PFTrDA)	50-150	70-130	20
Perfluorotetradecanoic acid (PFTeDA)	50-150	70-130	20
Perfluorohexadecanoic acid (PFHxDA)	50-150	70-130	20
Perfluorooctadecanoic acid (PFODA)	50-150	70-130	20
1H,1H,2H,2H Perfluorohexanesulfonate (4:2FTS)	50-150	70-130	20

1H,1H,2H,2H Perfluorooctanesulfonate (6:2FTS)	50-150	70-130	20
1H,1H,2H,2H Perfluorodecanesulfonate (8:2FTS)	50-150	70-130	20
1H,1H,2H,2H Perfluorododecanesulfonate (10:2FTS)	50-150	70-130	20
N-Methyl Perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	50-150	70-130	20
N-Ethyl Perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	50-150	70-130	20
Hexafluoropropylene oxide dimer acid	50-150	70-130	20
4,8-dioxa-3H-perfluorononanoic acid	50-150	70-130	20
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	50-150	70-130	20
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	50-150	70-130	20

**The limits in this table are those in effect as of the published date of this SOP. The %R limits are specified by EPA 537r1.1 in sections 9.33, 9.36, and 9.37. The RPD the lab uses is more strict than those referenced in EPA 537 r1.1. If the lab makes changes to any of these limits, the updated limits will be no less strict than those specified in EPA537.*

Appendix A: Terms and Definitions

PFCAs: Perfluorocarboxylic acids
PFSAs: Perfluorinated sulfonic acids
FOSA: Perfluorinated sulfonamide
PFOA: Perfluorooctanoic acid
PFOS: Perfluorooctane sulfonate
PTFE: Polytetrafluoroethylene (e.g., Teflon®)
SPE: Solid phase extraction**.**
PP: Polypropylene
PE: Polyethylene
HDPE: High density polyethylene
AFFF: Aqueous Film Forming Foam
IDA: Isotope dilution analytes
Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.
Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.
Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).
Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.
Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.
Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.
Calibration Standard: A substance or reference used to calibrate an instrument.
Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.
Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.
Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)
Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.
Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.
Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.
Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.
Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.
Matrix Spike Duplicate (MSD): a second replicate matrix spike
Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).
Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a <u>range</u> where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.
Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.
Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.
Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.
Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.
Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.
Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.
Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in methanol using Class A volumetric glassware and Hamilton syringes and assign an expiration date of 1 year from date of preparation unless the parent standard expires sooner; then use the earlier date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance. For stock standards solutions made from neat material, assign an expiration date of 2 years from the date of formulation.

Stock Standard Solutions

PFAS LCS/Matrix Spike Stock Solution 1000 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
PFBA	Wellington Laboratories Code: PFBA	Perfluorobutanoic acid	50	200	10	1000
PFPeA	Wellington Laboratories Code: PFPeA	Perfluoropentanoic acid	50	200		1000
PFBS	Wellington Laboratories Code: L-PFBS	Perfluorobutanesulfonic acid	44.2	200		884
PFHxA	Wellington Laboratories Code: PFHxA	Perfluorohexanoic acid	50	200		1000
PFPeS	Wellington Laboratories Code: L-PFPeS	Perfluoropentanesulfonic acid	46.9	200		938
PFHpA	Wellington Laboratories Code: PFHpA	Perfluoroheptanoic acid	50	200		1000
PFHxSK	Wellington Laboratories Code: br-PFHxSK	Perfluorohexanesulfonic acid	45.5	200		910
PFOA	Wellington Laboratories Code: PFOA	Perfluorooctanoic acid	50	200		1000
PFHpS	Wellington Laboratories Code: L-PFHpS	Perfluoroheptanesulfonic acid	47.6	200		952
PFNA	Wellington Laboratories Code: PFNA	Perfluorononanoic acid	50	200		1000
PFOS	Wellington Laboratories Code: br-PFOSK	Perfluorooctanesulfonic acid	46.4	200		928
PFDA	Wellington Laboratories Code: PFDA	Perfluorodecanoic acid	50	200		1000
PFNS	Wellington Laboratories Code: L-PFNS	Perfluorononanesulfonic acid	48.0	200		960
PFUdA	Wellington Laboratories Code: PFUdA	Perfluoroundecanoic acid	50	200		1000
PFDS	Wellington Laboratories Code: L-PFDS	Perfluorodecanesulfonic acid	48.2	200		964
FOSA	Wellington Laboratories Code: FOSA-I	Perfluorooctane sulfonamide	50	200		1000
PFDoA	Wellington Laboratories Code: PFDoA	Perfluorododecanoic acid	50	200		1000
PFDoS	Wellington Laboratories Code: L-PFDoS	Perfluorododecanesulfonic acid	48.4	200		968
PFTrDA	Wellington Laboratories Code: PFTrDA	Perfluorotridecanoic acid	50	200		1000
PFTeDA	Wellington Laboratories Code: PFTeDA	Perfluorotetradecanoic acid	50	200		1000
PFHxDA	Wellington Laboratories Code: PFHxDA	Perfluorohexadecanoic acid	50	200		1000
PFODA	Wellington Laboratories Code: PFODA	Perfluorooctadecanoic acid	50	200		1000
4:2FTS	Wellington Laboratories Code: 4:2FTS	1H,1H,2H,2H-perfluorohexane sulfonate (4:2)	46.7	200		934
6:2FTS	Wellington Laboratories Code: 6:2FTS	1H,1H,2H,2H-perfluorooctane sulfonate (6:2)	47.4	200		948

8:2FTS	Wellington Laboratories Code: 8:2FTS	1H,1H,2H,2H-perfluorodecane sulfonate (8:2)	47.9	200		958
10:2FTS	Wellington Laboratories Code: 10:2FTS	1H,1H,2H,2H-perfluorododecane sulfonate (10:2)	48.2	200		964
NMeFOSAA	Wellington Laboratories Code: br-NMeFOSAA	N-methyl Perfluorooctane sulfonamidoacetic acid	50	200		1000
NEtFOSAA	Wellington Laboratories Code: br-NEtFOSAA	N-ethyl Perfluorooctane sulfonamidoacetic acid	50	200		1000
HFPO-DA	Wellington Laboratories Code: HFPO-DA	Hexafluoropropylene oxide dimer acid	50	200		1000
DONA	Wellington Laboratories Code: NaDONA	4,8-dioxa-3H-perfluorononanoic acid	47.1	200		942
9Cl-PF3ONS	Wellington Laboratories Code: 9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanone-1-sulfonate	46.6	200		932
11Cl-PF3OUdS	Wellington Laboratories Code: 11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonate	47.1	200		942

Solvent: Methanol

PFAS Matrix Spike Solution 400 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (ng/mL)	Volume Added (mL)	Final Volume (mL)	Final Conc (ng/mL)
PFAS Matrix Spike Stock Solution	In-house	See above list	1000	2.0	5.0	400

Solvent: Methanol

PFAS MDL Spiking Solution 100 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (ng/mL)	Volume Added (mL)	Final Volume (mL)	Final Conc (ng/mL)
PFAS Matrix Spike Stock Solution	In-house	See above list	1000	0.10	1.0	100

Solvent: Methanol

PFAS-IDA Solution (Surrogate) 500 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
13C4 PFBA	Wellington Laboratories Code: MPFBA	$^{13}C_4$-Perfluorobutanoic acid	50	200	20	500
13C5-PFPeA	Wellington Laboratories Code: MPFPeA	$^{13}C_5$-Perfluoropentanoic acid	50	200		500
13C3-PFBS	Wellington Laboratories Code: M3PFBS	$^{13}C_3$-Perfluorobutanesulfonic acid	46.5	200		465
13C2 PFHxA	Wellington Laboratories Code: MPFHxA	$^{13}C_2$-Perfluorohexanoic acid	50	200		500
13C4 PFHpA	Wellington Laboratories Code: M4PFHpA	$^{13}C_4$-Perfluoroheptanoic acid	50	200		500
18O2 PFHxS	Wellington Laboratories Code: MPFHxS	$^{18}O_2$-Perfluorohexanesulfonic acid	47.3	200		473
13C4 PFOA	Wellington Laboratories Code: MPFOA	$^{13}C_4$-Perfluorooctanoic acid	50.0	200		500
13C5 PFNA	Wellington Laboratories Code: MPFNA	$^{13}C_5$-Perfluorononanoic acid	50.0	200		500
13C4 PFOS	Wellington Laboratories Code: MPFOS	$^{13}C_4$-Perfluorooctanesulfonic acid	47.8	200		478
13C2 PFDA	Wellington Laboratories Code: MPFDA	$^{13}C_2$-Perfluorodecanoic acid	50.0	200		500
13C8 FOSA	Wellington Laboratories Code: M8FOSA-I	$^{13}C_8$-Perfluorooctane sulfonamide	50.0	200		500

13C2 PFUdA	Wellington Laboratories Code: MPFUdA	$^{13}C_2$-Perfluoroundecanoic acid	50.0	200		500
13C2 PFDoA	Wellington Laboratories Code: MPFDoA	$^{13}C_2$-Perfluorododecanoic acid	50.0	200		500
13C2 PFTeDA	Wellington Laboratories Code: MPFTeDA	$^{13}C_2$-Perfluorotetradecanoic acid	50.0	200		500
13C2 PFHxDA	Wellington Laboratories Code: MPFHxDA	$^{13}C_2$-Perfluorohexadecanoic acid	50.0	200		500
M2-4:2FTS	Wellington Laboratories Code: M2-4:2FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-hexane sulfonate (4:2)	46.7	200		467
M2-6:2FTS	Wellington Laboratories Code: M2-6:2FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-octane sulfonate (6:2)	47.5	200		475
M2-8:2FTS	Wellington Laboratories Code: M2-8:2FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-decane sulfonate (8:2)	47.9	200		479
d3-NMeFOSAA	Wellington Laboratories Code: d3-M-MeFOSAA	N-methyl-d_3-perfluoro-1-octane sulfonamidoacetic acid	50.0	200		500
d5-NEtFOSAA	Wellington Laboratories Code: d5-M-EtFOSAA	N-ethyl-d_5-perfluoro-1-octane sulfonamidoacetic acid	50.0	200		500
M3HFPO-DA	Wellington Laboratories Code: M3HFPO-DA	$^{13}C_3$-Hexafluoropropylene oxide dimer acid	50.0	200		500

Solvent: Methanol

PFAS Internal Standard Stock Solution 5000 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
13C2 PFOA	Wellington Laboratories Code: M2PFOA	$^{13}C_2$-Perfluorooctanoic acid	50.0	400	4	5000

Solvent: Methanol

PFAS Internal Standard Spiking Solution 1250 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (mL)	Final Volume (mL)	Final Conc (ng/mL)
PFAS Internal Standard Stock Solution	In-house	$^{13}C_2$-Perfluorooctanoic acid	5.0	2.0	8.0	1250

Solvent: Methanol

PFAS-IDA-IS Calibration Standards Level 1-Level 6

ICAL Level	Vol of PFAS LCS/Matrix Spike Stock (µL)	Vol of PFAS MDL Spiking Solution (µL)	Nominal Conc of PFAS (ng/mL)	Vol of PFAS-IDA Solution (µL)	Conc of IDA (ng/mL)	Vol of 0.5ppm PFAS-IS Stock Solution (µL)	Conc of IS (ng/mL)	Vol of 80/20 MeOH/H2O (µL)	Final Vol (mL)
1	0	2	0.050	10	1.25	4	1.25	3988	4.0
2	0	2	0.10	5	1.25	2	1.25	1993	2.0
3	0	10	0.50	5	1.25	2	1.25	1985	2.0
4	12	0	1.0	30	1.25	12	1.25	11958	12.0
5	30	0	2.5	30	1.25	12	1.25	11940	12.0
6	20	0	10.0	5	1.25	2	1.25	1975	2.0

The solvent is 80/20 Methanol/Water.

Appendix C: Equations

Initial Calibration Curve Evaluation:

The linear curve uses the following function:

Equation 1

$$y = bx + c$$

Where:

y = $\frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$
x = concentration
b = slope
c = intercept

The quadratic curve uses the following function:

Equation 2

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

The external standard method uses the following equation:

Equation 3

$$ResponseFactor = \frac{Peak\ Area}{Concentration\ of\ Solution(ng/mL)}$$

Equation 4

$$\text{Concentration, ng/mL} = \frac{y - c}{b}$$

Equation 5

$$\text{Concentration, ng/mL} = \frac{-b + \sqrt{b^2 - 4a(c - y)}}{2a}$$

Where:

y = $\frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$
x = concentration
a = curvature
b = slope
c = intercept

Water Sample Result Calculation:

Equation 6

$$\text{Concentration, ng/L} = \frac{C_{ex} V_t}{V_o}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L)

IDA Recovery Calculation:

Equation 8

$$\%\,\mathrm{Recovery} = \frac{A_t Q_{is}}{A_{is} Q_t RRF_{IDA}} X100$$

Where ng/g = µg/kg and:

RF_{IDA} = Response Factor for IDA compound
A_t = Area response for IDA compound
A_{IS} = Area Response for IS compound
Q_{IS} = Amount of IS added
Q_t = Amount of IDA added

Calibration Factor (CF_x) = $\dfrac{\text{Peak area or height}_{(x)}}{\text{Standard concentration}_{(\mu g/L)}}$

Mean Calibration Factor ($\overline{CF}$) = $\dfrac{\sum_{i=1}^{n} CF_i}{n}$

where: n = number of calibration levels

Standard Deviation of the Calibration Factor (SD) = $\sqrt{\dfrac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)2}{n-1}}$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =

$$\frac{SD}{\overline{\overline{CF}}} \times 100\%$$

Percent Difference (%D) = $\dfrac{CF_v - \overline{CF}}{\overline{\overline{CF}}} \times 100\%$

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift = $\dfrac{\text{Calculated Concentration – Theoretical Concentration}}{\text{Theoretical Concentration}}$ x 100%

Percent Recovery (%R) = $\frac{C_s}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD = $\frac{C_s - C_u}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD) = $\frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$

where: C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$C_{extract}$ (µg/L) = $\frac{\text{Peak Area (or Height)}}{\overline{\text{CF}}}$

Note: The concentrations of the 3-5 peaks chosen for quantificaton is calculated and the average is then taken for final calculation.

Appendix D: Analytes applied for Secondary Certification with NJDEP

Compound Name	Abbreviation	CAS #
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	PFUdA (PFUnA)	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA (PFTA)	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorooctanesulfonic acid	PFOS	1763-23-1

Soil & GW Limits for 1,4-Dioxane

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
SO - 1,4-Dioxane	Semivolatile Organic Compounds (GC/MS)	8270E	3546	1,4-Dioxane	123-91-1	0.0330	0.0289		mg/Kg	31	81	30	31	81	30		
GW - 1,4-Dioxane	Semivolatile Organic Compounds (GC/MS SIM / Isotope Dilution)	8270E_SIM_MS_ID	3510C_LVI	1,4-Dioxane	123-91-1	0.200	0.0160		ug/L	10	200	50	70	130	20		

Soil & GW PFAS Limits - Burlington lab

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
SO - PFAS	Fluorinated Alkyl Substances	PFC_IDA	Shake_Bath_14D	Perfluorobutanoic acid (PFBA)	375-22-4	0.500	0.161		ug/Kg	70	130	20	70	130	20		
				Perfluoropentanoic acid (PFPeA)	2706-90-3	0.200	0.0390		ug/Kg	70	130	20	70	130	20		
				Perfluorohexanoic acid (PFHxA)	307-24-4	0.200	0.0220		ug/Kg	70	130	20	70	130	20		
				Perfluoroheptanoic acid (PFHpA)	375-85-9	0.200	0.0200		ug/Kg	70	130	20	70	130	20		
				Perfluorooctanoic acid (PFOA)	335-67-1	0.200	0.0250		ug/Kg	70	130	20	70	130	20		
				Perfluorononanoic acid (PFNA)	375-95-1	0.200	0.0180		ug/Kg	70	130	20	70	130	20		
				Perfluorodecanoic acid (PFDA)	335-76-2	0.200	0.0120		ug/Kg	70	130	20	70	130	20		
				Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.200	0.0200		ug/Kg	70	130	20	70	130	20		
				Perfluorododecanoic acid (PFDoA)	307-55-1	0.200	0.0210		ug/Kg	70	130	20	70	130	20		
				Perfluorotridecanoic acid (PFTriA)	72629-94-8	0.200	0.0150		ug/Kg	70	130	20	70	130	20		
				Perfluorotetradecanoic acid (PFTeA)	376-06-7	0.200	0.0230		ug/Kg	70	130	20	70	130	20		
				Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.200	0.00930		ug/Kg	70	130	20	70	130	20		
				Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.200	0.0140		ug/Kg	70	130	20	70	130	20		
				Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	0.200	0.0150		ug/Kg	70	130	20	70	130	20		
				Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.200	0.0160		ug/Kg	70	130	20	70	130	20		
				Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.200	0.0120		ug/Kg	70	130	20	70	130	20		
				Perfluorooctanesulfonamide (PFOSA)	754-91-6	0.200	0.0170		ug/Kg	70	130	20	70	130	20		
				N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	2.00	0.0370		ug/Kg	70	130	20	70	130	20		
				N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	2.00	0.0460		ug/Kg	70	130	20	70	130	20		
				1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2)	27619-97-2	2.00	0.0310		ug/Kg	70	130	20	70	130	20		
				1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2)	39108-34-4	2.00	0.0160		ug/Kg	70	130	20	70	130	20		
				18O2 PFHxS	STL00994				ug/Kg								
				13C4 PFHpA	STL01892				ug/Kg								
				13C4 PFOA	STL00990				ug/Kg								
				13C4 PFOS	STL00991				ug/Kg								
				13C5 PFNA	STL00995				ug/Kg								
				13C4 PFBA	STL00992				ug/Kg								
				13C2 PFHxA	STL00993				ug/Kg								
				13C2 PFDA	STL00996				ug/Kg								
				13C2 PFUnA	STL00997				ug/Kg								
				13C2 PFDoA	STL00998				ug/Kg								
				13C8 FOSA	STL01056				ug/Kg								
				13C5 PFPeA	STL01893				ug/Kg								
				13C2 PFTeDA	STL02116				ug/Kg								
				d3-NMeFOSAA	STL02118				ug/Kg								
				d5-NEtFOSAA	STL02117				ug/Kg								
				M2-6:2 FTS	STL02279				ug/Kg								
				M2-8:2 FTS	STL02280				ug/Kg								
				13C3 PFBS	STL02337				ug/Kg								
				13C2 PFOA	STL00623				ug/Kg								

GW - PFAS	Fluorinated Alkyl Substances	PFC_IDA	3535_IVWT	Perfluorobutanoic acid (PFBA)	375-22-4	5.00	0.893	1.20	ng/L	50	150	30	40	160	30		
				Perfluoropentanoic acid (PFPeA)	2706-90-3	2.00	0.474	1.20	ng/L	50	150	30	40	160	30		
				Perfluorohexanoic acid (PFHxA)	307-24-4	2.00	0.452	1.20	ng/L	70	130	20	40	160	20		
				Perfluoroheptanoic acid (PFHpA)	375-85-9	2.00	0.238	1.20	ng/L	70	130	20	40	160	20		
				Perfluorooctanoic acid (PFOA)	335-67-1	2.00	0.424	1.20	ng/L	70	130	20	40	160	20		
				Perfluorononanoic acid (PFNA)	375-95-1	2.00	0.281	1.20	ng/L	70	130	20	40	160	20		
				Perfluorodecanoic acid (PFDA)	335-76-2	2.00	0.304	1.20	ng/L	70	130	20	40	160	20		
				Perfluoroundecanoic acid (PFUnA)	2058-94-8	2.00	0.344	1.20	ng/L	70	130	20	40	160	20		
				Perfluorododecanoic acid (PFDoA)	307-55-1	2.00	0.385	1.20	ng/L	70	130	20	40	160	20		
				Perfluorotridecanoic acid (PFTriA)	72629-94-8	2.00	0.434	1.20	ng/L	70	130	20	40	160	20		
				Perfluorotetradecanoic acid (PFTeA)	376-06-7	2.00	0.632	1.20	ng/L	70	130	20	40	160	20		
				Perfluorobutanesulfonic acid (PFBS)	375-73-5	2.00	0.250	1.06	ng/L	70	130	20	40	160	20		
				Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2.00	0.302	1.09	ng/L	70	130	20	40	160	20		
				Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2.00	0.234	1.14	ng/L	50	150	30	40	160	30		
				Perfluorooctanesulfonic acid (PFOS)	1763-23-1	2.00	0.291	1.11	ng/L	70	130	20	40	160	20		
				Perfluorodecanesulfonic acid (PFDS)	335-77-3	2.00	0.306	1.16	ng/L	50	150	30	40	160	30		
				Perfluorooctanesulfonamide (PFOSA)	754-91-6	2.00	0.577	1.20	ng/L	50	150	30	40	160	30		
				N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	5.00	0.903	1.20	ng/L	70	130	20	40	160	20		
				N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	5.00	0.743	1.20	ng/L	70	130	20	40	160	20		
				1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2)	27619-97-2	5.00	1.10	1.14	ng/L	50	150	30	40	160	30		
				1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2)	39108-34-4	2.00	0.390	1.15	ng/L	50	150	30	40	160	30		
				18O2 PFHxS	STL00994				ng/L				25	150			
				13C4 PFHpA	STL01892				ng/L				25	150			
				13C4 PFOA	STL00990				ng/L				25	150			
				13C4 PFOS	STL00991				ng/L				25	150			
				13C5 PFNA	STL00995				ng/L				25	150			
				13C4 PFBA	STL00992				ng/L				25	150			
				13C2 PFHxA	STL00993				ng/L				25	150			
				13C2 PFDA	STL00996				ng/L				25	150			
				13C2 PFUnA	STL00997				ng/L				25	150			
				13C2 PFDoA	STL00998				ng/L				25	150			
				13C8 FOSA	STL01056				ng/L				25	150			
				13C5 PFPeA	STL01893				ng/L				25	150			
				13C2 PFTeDA	STL02116				ng/L				25	150			
				d3-NMeFOSAA	STL02118				ng/L				25	150			
				d5-NEtFOSAA	STL02117				ng/L				25	150			
				M2-6:2 FTS	STL02279				ng/L				25	150			
				M2-8:2 FTS	STL02280				ng/L				25	150			
				13C3 PFBS	STL02337				ng/L				25	150			
				13C2 PFOA	STL00623				ng/L				25	150			

ATTACHMENT 4

Roux’s Standard Operating Procedures

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for decontamination of all field equipment potentially exposed to contamination during drilling, and soil and water sampling. The objective of decontamination is to ensure that all drilling, and soil-sampling and water-sampling equipment is decontaminated (free of potential contaminants): 1) prior to being brought onsite to avoid the introduction of potential contaminants to the site; 2) between drilling and sampling events/activities onsite to eliminate the potential for cross-contamination between boreholes and/or wells; and 3) prior to the removal of equipment from the site to prevent the transportation of potentially contaminated equipment offsite.

In considering decontamination procedures, state and federal regulatory agency requirements must be considered because of potential variability between state and federal requirements and because of variability in the requirements of individual states. Decontamination procedures must be in compliance with state and/or federal protocols in order that regulatory agency(ies) scrutiny of the procedures and data collected do not result in non acceptance (invalidation) of the work undertaken and data collected.

2.0 PROCEDURE FOR DRILLING EQUIPMENT

The following is a minimum decontamination procedure for drilling equipment. Drilling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

2.1 The rig and all associated equipment should be properly decontaminated by the contractor before arriving at the test site.

2.2 The augers, drilling casings, rods, samplers, tools, rig, and any piece of equipment that can come in contact (directly or indirectly) with the soil, will be steam cleaned onsite prior to set up for drilling to ensure proper decontamination.

2.3 The same steam cleaning procedures will be followed between boreholes (at a fixed on-site location[s], if appropriate) and before leaving the site at the end of the study.

2.4 All on-site steam cleaning (decontamination) activities will be monitored and documented by a member(s) of the staff of Roux Associates, Inc.

2.5 If drilling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat drilling equipment, then special decontamination procedures may have to be utilized before steam cleaning (e.g., hexane scrub and wash).

2.6 Containment of decontamination fluids may be necessary (e.g., rinseate from steam cleaning) or will be required (e.g., hexane), and disposal must be in accordance with state and/or federal procedures.

3.0 PROCEDURE FOR SOIL-SAMPLING EQUIPMENT

The following is a minimum decontamination procedure for soil-sampling equipment (e.g., split spoons, stainless-steel spatulas). Soil-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

3.1 Wear disposable gloves while cleaning equipment to avoid cross-contamination and change gloves as needed.

3.2 Steam clean the sampler or rinse with potable water. If soil-sampling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat sampling equipment, then special decontamination procedures may have to be utilized before steam cleaning and washing in detergent solution (e.g., hexane scrub and wash).

3.3 Prepare a non-phosphate, laboratory-grade detergent solution and distilled or potable water in a clean bucket.

3.4 Disassemble the sampler, as necessary and immerse all parts and other sampling equipment in the solution.

3.5 Scrub all equipment in the bucket with a brush to remove any adhering particles.

3.6 Rinse all equipment with copious amounts of potable water followed by distilled or deionized water.

3.7 Place clean equipment on a clean plastic sheet (e.g., polyethylene)

3.8 Reassemble the cleaned sampler, as necessary.

3.9 Transfer the sampler to the driller (or helper) making sure that this individual is also wearing clean gloves, or wrap the equipment with a suitable material (e.g., plastic bag, aluminum foil.

As part of the decontamination procedure for soil-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

4.0 PROCEDURE FOR WATER-SAMPLING EQUIPMENT

The following is a decontamination procedure for water-sampling equipment (e.g., bailers, pumps). Water-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

4.1 Decontamination procedures for bailers follow:

a. Wear disposable gloves while cleaning bailer to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a bucket.

c. Disassemble bailer (if applicable) and discard cord in an appropriate manner, and scrub each part of the bailer with a brush and solution.

d. Rinse with potable water and reassemble bailer.

e. Rinse with copious amounts of distilled or deionized water.

f. Air dry.

g. Wrap equipment with a suitable material (e.g., clean plastic bag, aluminum foil).

h. Rinse bailer at least three times with distilled or deionized water before use.

4.2 Decontamination procedures for pumps follow:

a. Wear disposable gloves while cleaning pump to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a clean bucket, clean garbage can, or clean 55-gallon drum.

c. Flush the pump and discharge hose (if not disposable) with the detergent solution, and discard disposable tubing and/or cord in an appropriate manner.

d. Flush the pump and discharge hose (if not disposable) with potable water.

e. Place the pump on clear plastic sheeting.

f. Wipe any pump-related equipment (e.g., electrical lines, cables, discharge hose) that entered the well with a clean cloth and detergent solution, and rinse or wipe with a clean cloth and potable water.

g. Air dry.

h. Wrap equipment with a suitable material (e.g., clean plastic bag).

As part of the decontamination procedure for water-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

STANDARD OPERATING PROCEDURE 5.1
FOR COLLECTION OF SOIL SAMPLES FOR LABORATORY ANALYSIS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from split-spoon samplers during drilling, hand auger samples, grab samples from stockpiled soils, surface samples, test pit samples, etc.

2.0 CONSIDERATIONS

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth the water content should be noted, since generally “soil sampling” is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a 0 to 6 inch depth interval. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. For samples at greater depths a decontaminated bucket auger or power auger may be needed to advance the hole to the point of sample collection. Another clean bucket auger should then be used to collect the sample. To collect samples at depths of greater than approximately six feet the use of a drill rig and split spoon samples will usually be necessary. In some situations, sample locations are accessed with the use of a backhoe.

3.0 MATERIALS/EQUIPMENT

a. A work plan which outlines soil sampling requirements.

b. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

c. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, distilled water, regulatory-required reagents, aluminum foil, plastic sheeting, etc.).

d. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

e. Stainless steel spoons or spatulas.

f. Disposable sampling gloves.

g. Laboratory-supplied sample containers with labels.

h. Cooler with blue or wet ice.

i. Plastic sheeting.

j. Black pen and indelible marker.

k. Zip-lock bags and packing material.

l. Tape measure.

m. Paper towels or clean rags.

n. Masking and packing tape.

o. Overnight (express) mail forms.

4.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and plastic sheeting will be changed after each use and discarded in an appropriate manner.

5.0 PROCEDURE

5.1 Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the decontamination SOP. If samples are to be collected at depth, then the boring must be advanced with thoroughly cleaned equipment to the desired sampling horizon and a different thoroughly cleaned sampler must be used to collect the sample.

5.2 Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon, extract the soil sample from the sampler, measure the recovery, and separate the wash from the true sample. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

5.3 Place the sample in a laboratory-supplied, pre-cleaned sample container. This should be done as quickly as possible and this is especially important when sampling for volatile organic compounds (VOCs). Samples to be analyzed for VOCs must be collected prior to other constituents.

5.4 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.

5.5 Using the remaining portion of soil from the sampler, log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.).

5.6 If soil samples are to be composited in the field, then equal portions from selected locations will be placed on a clean plastic sheet and homogenized. Alternately, several samples may be submitted to the laboratory for compositing by weight. The method used is dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work plan. Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.

5.7 After the sample has been collected, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler at 4°C.

5.8 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a zip-lock bag to the laboratory. A custody seal is placed on the cooler prior to shipment.

5.9 Samples collected from Monday to Friday are to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.10 The field notebook and appropriate forms should include, but not be limited to the following: client name, site location, sample location, sample depth, sample identification, date and time collected, sampler's name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.

5.11 All reusable sampling equipment must be thoroughly cleaned in accordance with the decontamination SOP. Following the final decontamination (after all samples are collected) the sampling equipment is wrapped in aluminum foil. Discard any gloves, foil, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sample handling which will allow consistent and accurate results. Valid chemistry data are integral to investigations that characterize media-quality conditions. Thus, this SOP is designed to ensure that once samples are collected, they are preserved, packed and delivered in a manner which will maintain sample integrity to as great an extent as possible. The procedures outlined are applicable to most sampling events and any required modifications must be clearly described in the work plan.

2.0 CONSIDERATIONS

Sample containers, sampling equipment decontamination, quality assurance/quality control (QA/QC), sample preservation, and sample handling are all components of this SOP.

2.1 Sample Containers

Prior to collection of a sample, considerations must be given to the type of container that will be used to store and transport the sample. The type and number of containers selected is usually based on factors such as sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. In most cases, the overriding considerations will be the analytical methodology, or the state or federal regulatory requirements because these regulations generally encompass the other factors. The sample container selected is usually based on some combination of the following criteria:

a. Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizer to leach into the sample.

In some instances, however, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of the glass containers in an aqueous matrix, plastic bottles (e.g., nalgene) must be used for samples collected for metals analysis. A separate, plastic container should accompany glass containers if metals analysis is to be performed along with other analyses. Likewise, other sample characteristics may dictate that glass cannot be used. For example, in the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds and create adsorptive sites on the container's surface.

b. Volume of the Container

The volume of sample to be collected will be dictated by the analysis being performed and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual laboratories may provide larger volume containers for various analytes to ensure sufficient quantities for duplicates or other QC checks.

To facilitate transfer of the sample from the sampler into the container and to minimize spillage and sample disturbance, wide-mouth containers are recommended. Aqueous volatile organic samples must be placed into 40-milliliter (ml) glass vials with polytetrafluoroethylene (PTFE) (e.g., TeflonTM) septums. Non-aqueous volatile organic samples should be collected in the same type of vials or in 4-ounce (oz) wide-mouth jars provided by the laboratory. These jars should have PTFE-lined screw caps.

c. Color of Container

Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. If amber containers are not available, then containers holding samples should be protected from light (i.e., place in cooler with ice immediately after filling).

d. Container Closures

Container closures must screw on and off the containers and form a leak-proof seal. Container caps must not be removed until the container is ready to be filled with the sample, and the container cap must be replaced (securely) immediately after filling it. Closures should be constructed of a material which is inert with respect to the sampled material, such as PTFE (e.g., TeflonTM). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE sheeting. If soil or sediment samples are being collected, the threads of the container must be wiped clean with a dedicated paper towel or cloth so the cap can be threaded properly.

e. Decontamination of Sample Containers

Sample containers must be laboratory cleaned by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample. Sample containers must be carefully examined to ensure that all containers appear clean. Do not mistake the preservative as unwanted residue. The bottles should not be field cleaned. If there is any question regarding the integrity of the bottle, then the laboratory must be contacted immediately and the bottle(s) replaced.

f. Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the laboratory waiting to be packed for shipment or in the field waiting to be filled with sample, care must be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near solvents, gasoline, or other equipment that is a potential source of cross-contamination. When under chain of custody, sample bottles must be secured in locked vehicles, and custody sealed in shuttles or in the presence of authorized personnel. Information which documents that proper storage and transport procedures have been followed must be included in the field notebook and on appropriate field forms.

2.2 Decontamination of Sampling Equipment

Proper decontamination of all re-usable sampling equipment is critical for all sampling episodes. The SOP for Decontamination of Field Equipment and SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for decontamination of various types of equipment.

2.3 Quality Assurance/Quality Control Samples

QA/QC samples are intended to provide control over the proper collection and tracking of environmental measurements, and subsequent review, interpretation and validation of generated analytical data. The SOPs for Collection of Quality Control Samples, for Evaluation and Validation of Data, and for Field Record Keeping and Quality Assurance/Quality Control must be referred to for detailed guidance regarding these respective procedures. SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for QA/QC procedures.

2.4 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Generally, this is accomplished under the following two scenarios:

a. Sample bottles are preserved at the laboratory prior to shipment into the field.

b. Preservatives are added in the field immediately after the samples are collected.

Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample could be collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable; however, field sampling teams must always be prepared to add additional preservatives to samples if the aforementioned situations occur. Furthermore, care must be exercised not to overfill sample bottles containing preservatives to prevent the sample and preservative from spilling and therefore diluting the preservative (i.e., not having enough preservative for the volume of sample).

When samples are preserved after collection, special care must be taken. The transportation and handling of concentrated acids in the field requires additional preparation and adherence to appropriate preservation procedures. All preservation acids used in the field should be trace-metal or higher-grade.

2.5 Sample Handling

After the proper sample bottles have been received under chain-of-custody, properly decontaminated equipment has been used to collect the sample, and appropriate preservatives have been added to maintain sample integrity, the final step for the field personnel is checking the sample bottles prior to proper packing and delivery of the samples to the laboratory.

All samples should be organized and the labels checked for accuracy. The caps should be checked for tightness and any 40-ml volatile organic compound (VOC) bottles must be checked for bubbles. Each sample bottle must be placed in an individual "zip-lock" bag to protect the label, and placed on ice. The bottles must be carefully packed to prevent breakage during transport. When several bottles have been collected for an individual sample, they should not be placed adjacent to each other in the cooler to prevent possible breakage of all bottles for a given sample. If there are any samples which are known or suspected to be highly contaminated, these should be placed in an individual cooler under separate chain-of-custody to prevent possible cross contamination. Sufficient ice (wet or blue packs) should be placed in the cooler to maintain the temperature at 4 degrees Celsius (°C) until delivery at the laboratory. Consult the work plan to determine if a particular ice is specified as the preservation for transportation (e.g., the United States Environmental Protection Agency does not like the use of blue packs because they claim that the samples will not hold at 4°C). Blue ice packs will not be used to transport samples being analyzed for Per- and Polyfluoroalkyl Substances (PFAS). If additional coolers are required, then they should be purchased. The chain-of-custody form should be properly completed, placed in a "zip-lock" bag, and placed in the cooler. One copy must be maintained for the project files. The cooler should be sealed with packing tape and a custody seal. The custody seal number should be noted in the field book. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time. If overnight mail is utilized, then the shipping bill must be maintained for the files and the laboratory must be called the following day to confirm receipt.

3.0 EQUIPMENT AND MATERIALS

3.1 General equipment and materials may include, but not necessarily be limited to, the following:

a. Sample bottles of proper size and type with labels.

b. Cooler with ice (wet or blue pack; no blue packs for PFAS samples).

c. Field notebook, appropriate field form(s), chain-of-custody form(s), custody seals.

d. Black pen and indelible marker.

e. Packing tape, "bubble wrap," and "zip-lock" bags.

f. Overnight (express) mail forms and laboratory address.

g. Health and safety plan (HASP).

h. Work plan/scope of work.

i. Pertinent SOPs for specified tasks and their respective equipment and materials.

3.2 Preservatives for specific samples/analytes as specified by the laboratory. Preservatives must be stored in secure, spillproof glass containers with their content, concentration, and date of preparation and expiration clearly labeled.

3.3 Miscellaneous equipment and materials including, but not necessarily limited to, the following:

a. Graduated pipettes.

b. Pipette bulbs.

c. Litmus paper.

d. Glass stirring rods.

e. Protective goggles.

f. Disposable gloves.

g. Lab apron.

h. First aid kit.

i. Portable eye wash station.

j. Water supply for immediate flushing of spillage, if appropriate.

k. Shovel and container for immediate containerization of spillage-impacted soils, if appropriate.

4.0 PROCEDURE

4.1 Examine all bottles and verify that they are clean and of the proper type, number, and volume for the sampling to be conducted.

4.2 Label bottles carefully and clearly with project name and number, site location, sample identification, date, time, and the sampler's initials using an indelible marker.

4.3 Collect samples in the proper manner (refer to specific sampling SOPs).

4.4 Conduct preservation activities as required after each sample has been collected. Field preservation must be done immediately and must not be done later than 30 minutes after sample collection.

4.5 Conduct QC sampling, as required.

4.6 Seal each container carefully and place in an individual "zip lock" bag.

4.7 Organize and carefully pack all samples in the cooler immediately after collection (e.g., bubble wrap). Insulate samples so that breakage will not occur.

4.8 Complete and place the chain-of-custody form in the cooler after all samples have been collected. Maintain one copy for the project file. If the cooler is to be transferred several times prior to shipment or delivery to the laboratory, it may be easier to tape the chain-of-custody to the exterior of the sealed cooler. When exceptionally hazardous samples are known or suspected to be present, this should be identified on the chain-of-custody as a courtesy to the laboratory personnel.

4.9 Add additional ice as necessary to ensure that it will last until receipt by the laboratory.

4.10 Seal the cooler with packing tape and a custody seal. Record the number of the custody seal in the field notebook and on the field form. If there are any exceptionally hazardous samples, then shipping regulations should be examined to ensure that the sample containers and coolers are in compliance and properly labeled.

4.11 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

4.12 Maintain the shipping bill for the project files if overnight mail is utilized and call the laboratory the following day to confirm receipt.

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 4.4
FOR SAMPLING GROUND-WATER MONITORING WELLS FOR DISSOLVED CONSTITUENTS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the sampling of ground-water monitoring wells for dissolved constituents. As part of the SOP for the sampling of ground-water monitoring wells, sample collection equipment and devices must be considered, and equipment decontamination and pre-sampling procedures (e.g., measuring water levels, sounding wells, and purging wells) must be implemented. Sampling objectives must be firmly established in the work plan before considering the above.

Valid water-chemistry data are integral to a hydrogeologic investigation that characterizes ground-water quality conditions. Water-quality data are used to evaluate both current and historic aquifer chemistry conditions, as well as to estimate future conditions (e.g., trends, migration pathways). Water-quality data can be used to construct ground-water quality maps to illustrate chemical conditions within the flow system, to generate water-quality plots to depict conditions with time and trends, and to perform statistical analyses to quantify data variability, trends, and cleanup levels.

2.0 EQUIPMENT AND MATERIALS

2.1 In order to sample ground water from monitoring wells, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. Bailers (Teflon™ or stainless steel).

b. Pumps (centrifugal, peristaltic, bladder, electric submersible, bilge, hand-operated diaphragm, etc.).

c. Gas-displacement device(s).

d. Air-lift device(s).

e. Teflon™ tape, electrical tape.

f. Appropriate discharge hose.

g. Appropriate discharge tubing (e.g., polypropylene, teflon, etc.) if using a peristaltic pump.

h. Appropriate compressed gas if using bladder-type or gas-displacement device.

i. Portable generator and gasoline or alternate power supply if using an electric submersible pump.

j. Non-absorbent cord (e.g., polypropylene, etc.).

k. Plastic sheeting.

l. Tape measure (stainless steel, steel, fiberglass) with 0.01-foot measurement increments and chalk (blue carpenter's).

m. Electronic water-level indicators (e.g., m-scope, etc.) or electric water-level/product level indicators.

n. Non-phosphate, laboratory-grade detergent.

o. Distilled/Deionized water.

p. Potable water.

q. Paper towels, clean rags.

r. Roux Associates' field forms (e.g., daily log, well inspection checklist, sampling, etc.) and field notebook.

s. Well location and site map.

t. Well keys.

u. Stop watch, digital watch with second increments, or watch with a second hand.

v. Water Well Handbook.

w. Calculator.

x. Black pen and water-proof marker.

y. Tools (e.g., pipe wrenches, screwdrivers, hammer, pliers, flashlight, pen knife, etc.).

z. Appropriate health and safety equipment, as specified in the site health and safety plan (HASP).

aa. pH meter(s) and buffers.

bb. Conductivity meter(s) and standards.

cc. Thermometer(s).

dd. Extra batteries (meters, thermometers, flashlight).

ee. Filtration apparatus, filters, pre-filters.

ff. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

gg. Disposable gloves.

hh. Water jugs.

ii. Laboratory-supplied sample containers with labels.

jj. Cooler(s).

kk. Ice (wet, blue packs).

ll. Masking, duct, and packing tape.

mm. Chain-of-custody form(s) and custody seal(s).

nn. Site sampling and analysis plan (SAP).

oo. Site health and safety plan (HASP).

pp. Packing material (e.g., bubble wrap)

qq. "Zip-lock" plastic bags.

rr. Overnight (express) mail forms.

3.0 DECONTAMINATION

3.1 Make sure all equipment is decontaminated and cleaned before use (refer to the SOP for Decontamination of Field Equipment for detailed decontamination methods, summaries for bailers and pumps are provided below). Use new, clean materials when decontamination is not appropriate (e.g., non-absorbent cord, disposable gloves). Document, and initial and date the decontamination procedures on the appropriate field form and in the field notebook.

a. Decontaminate a bailer by: 1) wearing disposable gloves, 2) disassembling (if appropriate) and scrubbing in a non-phosphate, laboratory-grade detergent and distilled/deionized water solution, and 3) rinsing first with potable water and then distilled/deionized water.

b. Decontaminate a pump by: 1) wearing disposable gloves, 2) flushing the pump and discharge hose (if not disposable) first with a non-phosphate, laboratory-grade detergent and potable water solution in an appropriate container (clean bucket, garbage can, or 55-gallon drum) and then with distilled/deionized water or potable water, and 3) wiping pump-related equipment (e.g., electrical lines, cables, discharge hose) first with a clean cloth and detergent solution and then rinsing or wiping with a clean cloth and distilled/deionized water or potable water.

3.2 Note that the decontamination procedures for bailers and pumps are the minimum that must be performed. Check the work plan to determine if chemicals specified by individual state regulatory agencies must also be used for decontamination procedures (e.g., hexane, nitric acid, acetone, isopropanol, etc.).

4.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers, pH and conductivity meters, etc.). Refer to the specific SOP for field analysis for each respective piece of equipment. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

5.0 PROCEDURE

5.1 Document, and initial and date well identification, pre-sampling information, and problems encountered on the appropriate field form and in the field notebook as needed.

5.2 Inspect the protective casing of the well and the well casing, and note any items of concern such as a missing lock, or bent or damaged casing(s).

5.3 Place plastic sheeting around the well to protect sampling equipment from potential cross contamination.

5.4 Remove the well cap or plug and, if necessary, clean the top of the well off with a clean rag. Place the cap or plug on the plastic sheeting. If the well is not vented, allow several minutes for the water level in the well to equilibrate. If fumes or gases are present, then diagnose these with the proper safety equipment. Never inhale the vapors.

5.5 Measure the depth to water (DTW) from the measuring point (MP) on the well using a steel tape and chalk or an electronic sounding device (m-scope). Refer to the specific SOPs for details regarding the use of a steel tape or a m-scope for measuring water levels. Calculate the water-level elevation. Document, and initial and date the information on the appropriate field form and in the field notebook.

5.6 Measuring the total depth of the well from the MP with a weighted steel tape. Calculate and record the volume of standing water in the well casing on the appropriate field form and in the field notebook.

5.7 Decontaminate the equipment used to measure the water level and sound the well with a non-phosphate, laboratory-grade detergent solution followed by a distilled/deionized water rinse.

5.8 Purge the well prior to sampling (refer to the SOP for Purging a Well). The well should be pumped or bailed to remove the volume of water specified in the work plan. Usually three to five casing volumes are removed if the recharge rate is adequate to accomplish this within a reasonable amount of time.

If the formation cannot produce enough water to sustain purging, then one of two options must be followed. These include: 1) pumping or bailing the well dry, or 2) pumping or bailing the well to "near-dry" conditions (i.e., leaving some water in the well). The option employed must be specified in the work plan and be in accordance with regulatory requirements.

If the well is purged dry, then all the standing water has been removed and upon recovery the well is ready for sampling. However, depending on the rate of recovery and the time needed to complete the sampling round, one of the following procedures may have to be implemented: 1) the well may have to be sampled over a period of more than one day; 2) the well may not yield enough water to collect a complete suite of samples and only select (most important) samples will be collected; or 3) the well may not recover which will preclude sampling. Regardless of the option that must be followed, the sampling procedure must be fully documented. When preparing to conduct a sampling round, review drilling, development and previous sampling information (if available) to identify low-yielding wells in order to purge them first, and potentially allow time for the well to recover for sampling.

5.9 Record the physical appearance of the water (i.e., color, turbidity, odor, etc.) on the appropriate field form and in the field notebook, as it is purged. Note any changes that occur during purging.

5.10 If a bailer is used to collect the sample, then:

a. Flush the decontaminated bailer three times with distilled/deionized water.

b. Tie the non-absorbent cord (polypropylene) to the bailer with a secure knot and then tie the free end of the bailer cord to the protective casing or, if possible, some nearby structure to prevent losing the bailer and cord down the well.

c. Lower the bailer slowly down the well and into the water column to minimize disturbance of the water surface. If a bottom-filling bailer is used, then do not submerge the top of the bailer; however, if a top-filling bailer is used, then submerge the bailer several feet below the water surface.

d. Remove and properly discard one bailer volume from the well to rinse the bailer with well water before sampling. Again, lower the bailer slowly down the well to the appropriate depth depending on the bailer type (as discussed above in 5.11 c). When removing the bailer from the well, do not allow the bailer cord to rest on the ground but coil it on the protective plastic sheeting placed around the well. Certain regulatory agencies require that the first bailer volume collected be utilized for the samples.

5.11 If a pump is used to collect the sample, then use the same pump used to purge the well and, if need be, reduce the discharge rate to facilitate filling sample containers and to avoid problems that can occur while filling sample containers (as listed in Number 5.14, below). Alternately, the purge pump may be removed and a thoroughly decontaminated bailer can be used to collect the sample.

5.12 Remove each appropriate container's cap only when ready to fill each with the water sample, and then replace and secure the cap immediately.

5.13 Fill each appropriate, pre-labeled sample container carefully and cautiously to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in a ice-filled (wet ice or blue pack) cooler for storage. If wet ice is used it is recommended that it be repackaged in zip-lock bags to help keep the cooler dry and the sample labels secure. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

5.14 "Top-off" containers for volatile organic compounds (VOCs) and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that there are no bubbles by turning the container upside down and tapping it gently.

5.15 Filter water samples (Procedure 4.6) collected for dissolved metals analysis prior to preservation to remove the suspended sediment from the sample. If water samples are to be collected for total metals analysis, then collect a second set of samples without field filtering.

In the event that the regulatory agency(ies) want unfiltered samples for metals analysis, a second set of filtered samples should also be collected. Because unfiltered samples are indications of total metals (dissolved and suspended) they are not representative of aquifer conditions because ground water does not transport sediment (except in some rare cases). Thus, the results for dissolved metals in ground water should be based on filtered samples even if both filtered and unfiltered sets are presented in a report.

5.16 Add any necessary preservative(s) to the appropriate container(s) prior to, or after (preferred), the collection of the sample, unless the appropriate preservative(s) have already been added by the laboratory before shipment.

5.17 Collect quality control (QC) samples as required in the work plan to monitor sampling and laboratory performance. Refer to the SOP for Collection of Quality Control Samples.

5.18 Conduct field analyses after sample collection is complete by measuring and recording the temperature, conductivity, pH, etc. (as called for in the work plan). Note and record the "final" physical appearance of the water (after purging and sampling) on an appropriate field form and in the field notebook.

5.19 Wipe the well cap with a clean rag, replace the well cap and protective cover (if present). Lock the protective cover.

5.20 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

5.21 Decontaminate bailers, hoses, and pumps as discussed in the decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with site conditions.

5.22 Complete all necessary field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

5.23 Samples collected from Monday through Friday will be delivered within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Consult the work plan to determine if any of the analytes require a shorter delivery time.

END OF PROCUDURE

APPENDIX D

Site-Specific Health and Safety Plan

Site-Specific Health and Safety Plan

408 West 207th Street
New York, New York
Block 2203 Lot 21

May 7, 2021

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Site-Specific Emergency Information

Emergency Phone Numbers

Most emergency services can be obtained by calling **911**. Where 911 service is not available, use the telephone numbers provided in the below table. The following is a master emergency phone list for use by the project management personnel. A more condensed version of the emergency numbers listed below will be posted throughout project work areas. Emergencies encountered on the site will be responded to by a combination of off-site emergency services and on-site personnel.

Emergency Contact Information			
Site Personnel			
Title	**Contact**		**Telephone**
Office Manager (OM)	Michael Ritorto		631-445-4576
Project Principal (PP)	Jessica Taylor		631-766-0607
Project Manager (PM)	Valerie Sabatasso		516-509-9852
Site Supervisor (SS)	Julia Michaels		631-626-8831
Site Health and Site Safety Officer (SHSO)	Julia Michaels		631-626-8831
Office Health and Safety Manager (OHSM)	Kristina DeLuca		516-830-1189
Corporate Health and Safety Manager (CHSM)	Brian Hobbs		631-807-0193
AllOne Health	Occupational Health Care Management Provider		800-350-4511
Client Emergency Contact			
Outside Assistance			
Agency	**Contact**	**Telephone**	**Address/Location**
Ambulance/emergency medical services (EMS)	Lifecare Transport	911/718-543-3227	100 W Kingsbridge Rd, Bronx, NY
Police	NYPD 34th Precinct	911/212-927-9711	4295 Broadway, New York, NY
Fire	FDNY Engine 95/Ladder 36	911	29 Vermilyea Ave, New York, NY
Site Address	408 & 430 West 207th Street, New York, NY 10034		

Emergency Medical Facility

Route to New York-Presbyterian The Allen Hospital, 5141 Broadway, New York, NY (Figure 5):

- Head northwest on West 207th Street toward 10th Ave (240 feet)
- Turn right onto 10th Avenue (0.5 miles)
- Merge onto Broadway (459 feet)
- Turn left onto W 220th Street (236 feet)

- Turn left (164 feet)
- New York-Presbyterian The Allen Hospital will be on the left

Urgent Care Facility

Route to City MD Fordham Urgent Care Bronx, 388 E Fordham Road, Bronx, NY (Figure 5):

- Head southeast on W 207th Street toward 9th Avenue (0.2 miles)
- Continue onto University Heights Bridge (0.1 miles)
- Continue onto W Fordham Road (1.1 miles)
- City MD will be on the right

1. Introduction

This Site-specific Health and Safety Plan (HASP) has been prepared by Roux Environmental Engineering and Geology, D.P.C. (Roux) for use during the Remedial Action to be completed at the properties occupying Block 2203 Lot 21, in the Borough of Manhattan, City and State of New York (Site, Figure 1). The Remedial Action will include construction oversight and sampling activities being performed by Roux as well as construction activities performed by general contractor. These activities fall within the scope of operations covered by the Occupational Safety and Health Administration (OSHA) standards promulgated at 29 CFR 1910.120 and 29 CFR 1926.65, both commonly referred to as the Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard. In accordance with the HAZWOPER Standard, this Site-specific HASP was prepared to address the safety and health hazards associated with the Phase II ESA activities being performed at the Site by Roux and to provide requirements and procedures for the protection of Roux employees, subcontractor personnel, government oversight personnel, Site personnel, and the general public. It also addresses client- and Site-specific requirements for health and safety.

Implementation of this HASP is the joint responsibilities of the project manager, the Site health and safety officer, and all field staff, with assistance from the project principal and the office health and safety manager. The Project Manager for this project is Valerie Sabatasso, the Site Health and Safety Officer and the Site Supervisor will be Julia Michaels.

This HASP will be introduced to, reviewed, and signed off on by all Roux personnel through a formal training session prior to commencing work. A copy of the HASP will be kept at the Site at all times. The Roux SHSO or PM will be responsible for posting any changes, amendments, memos, etc. to the HASP. Any revisions to this HASP will be signed by appropriate personnel, which can include Roux's PP, CHSM, and SS. Any changes will be announced to all workers at the next safety meeting.

1.1 Roles and Responsibilities

Overall Roles and Responsibilities (R&Rs) of Roux personnel are provided in Roux's Policies and Procedures Manual. Only those R&Rs specific to HASP requirements are listed below.

Project Manager (PM)

The PM has responsibility and authority to direct all work operations. The PM coordinates safety and health functions with the Site Health and Safety Officer (SHSO), has the authority to oversee and monitor the performance of the SHSO, and bears ultimate responsibility for the proper implementation of this HASP.! The! specific duties of the PM are:

- Preparing and coordinating the Site work plan;
- Providing Site supervisor(s) with work assignments and overseeing their performance; Coordinating safety and health efforts with the SSHO;
- Ensuring effective emergency response through coordination with the Emergency Response Coordinator (ERC); and
- Serving as primary Site liaison with public agencies and officials and Site contractors.

Site Health and Safety Officer (SHSO)

The SHSO has the full responsibility and authority to develop and implement this HASP and to verify compliance. The SHSO reports to the Project Manager. The SHSO is on Site or readily accessible to the Site during all work operations and has the authority to halt Site work if unsafe conditions are detected. The specific responsibilities of the SHSO include:

- Managing the safety and health functions on this Site;
- Serving as the Site's point of contact for safety and health matters;
- Ensuring Site monitoring, worker training, and effective selection and use of PPE;
- Assessing Site conditions for unsafe acts and conditions and providing corrective action;
- Assisting the preparation and review of this HASP;
- Maintaining effective safety and health records as described in this HASP; and
- Coordinating with the Site Supervisor(s) and others as necessary for safety and health efforts.

Site Supervisor

The Site Supervisor is responsible for field operations and reports to the Project Manager (PM). The Site Supervisor ensures the implementation of the HASP requirements and procedures in the field. The specific responsibilities of the Site Supervisor include:

- Executing the work plan and schedule as detailed by the PM;
- Coordination with the SHSO on safety and health; and
- Ensuring Site work compliance with the requirements of this HASP.

Employees

All Roux employees are responsible for reading and following all provisions of the Corporate Health and Safety Manual, including this HASP. Employees report to the SS at the project Site. Each employee is also responsible for the following:

- Wearing all appropriate PPE as outlined within this HASP;
- Attending all safety meetings;
- Inspecting tools and equipment prior to use, and taking any defective tools or equipment out of service;
- Appropriately documenting field events as they occur within a logbook or equivalent;
- Properly operating machinery and/or equipment only if trained to do so;
- Stopping work operations if unsafe conditions exist;
- Identifying and mitigating hazards when observed;
- Reporting all incidents and near misses to the Roux SHSO and SS immediately; and
- Knowing where emergency equipment is located (e.g. first aid kit, fire extinguisher).

Subcontractors and Visitors

Subcontractors and visitors are responsible for complying with the same health and safety requirements. It is the responsibility of all to make sure subcontractors and visitors comply and uphold the HASP. Subcontractors and visitors have the following additional responsibilities:

- Designating a qualified safety representative for the project that can make the necessary changes in work practices, as necessary;
- Attending all safety meetings while participating in Roux Site work activities;
- Reporting all incidents and near misses to Roux SHSO and SS immediately;
- Conducting initial and periodic equipment inspections in accordance with manufacturer and regulatory guidelines; and
- Providing copies of all Safety Data Sheets (SDS) to Roux SHSO for materials brought to the Site.

2. Background

The Site is located in the Inwood section of the Borough of Manhattan, City and State of New York. The Site is currently occupied by a parking lot.

2.1 Site Description

The Site is currently developed with an asphalt-paved parking lot. Nearby properties include residential and commercial buildings. The 207 Street Train Yard Facility is adjacent to the north of the Site. The proposed future use of the Site includes residential and commercial facility spaces.

2.2 Site History

Based on Roux's review of historical reports and documentation, the Site was undeveloped until 1926. From 1926 through 1969, the northern portion was occupied by a three-story commercial structure and an adjoining large swimming pool. An automobile garage was present and operated from 1926 through 1968. Also, from 1947 to 1968 a gasoline filling station was located on the northeastern area of the lot. By 1969, all structures had been demolished and construction for the paved parking lot areas were completed and remain present today.

2.3 Known and Potential Releases of Hazardous Substances at the Site

Based on a review of the historic data, there are no known releases.

3. Scope of Work

Based on information gathered as a result of previous ESAs, the purpose of this sampling is to collect more data in order to determine eligibility of the Site for the Brownfields Cleanup Program. The eligibility sampling scope of work includes the following:

- Drilling oversight and collection of soil samples. If there are any changes with the scope a revision of the HASP will be required to address any new hazards.

4. Site Control

This Site control program is designed to reduce the spread of hazardous substances from contaminated areas to clean areas, to identify and isolate contaminated areas of the Site, to facilitate emergency evacuation and medical care, to prevent unauthorized entry to the Site, and to deter vandalism and theft.

4.1 Site Map

A map of this Site, showing Site boundaries, designated work zones, and points of entry and exit is provided in **Figure 2**.

4.2 Site Access

Access to the Site is restricted to reduce the potential for exposure to its safety and health hazards. Since the Site is an active grocery store and parking lot, an exclusion zone will be put up around the work area.

4.3 Buddy System

Site workers use the buddy system. The buddy system means that personnel work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of an emergency. The responsibilities of workers using the buddy system include:

- Remaining in close visual contact with partner;
- Providing partner with assistance as needed or requested;
- Observing partner for signs of cold stress or other difficulties;
- Periodically checking the integrity of partner's PPE; and
- Notifying the Site personnel if emergency assistance is needed.

4.4 Site Communications

The following communication equipment is used to support on-site communication: visual hand signals will be used during use of the drill rig, and workers will have cell phones on-Site. Should multiple operations be occurring at the Site concurrently radios shall be issued for communication if determined to be necessary.

As applicable, hand signals will be used according to the following:

Hand Signals

SIGNAL	MEANING
Hand gripping throat	Out of air, can't breathe
Grip partner's wrist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	I'm all right, okay
Thumbs down	No, negative

A current list of emergency contact numbers is included in the Site-Specific Emergency Information at the beginning of this HASP.

4.5 Site Work Zones

The SOW does not require the implementation of work zones; however, should the need arise, this section provides details for the proper execution of work zones at this Site.

This Site is divided into three (3) major zones, described below. These zones are characterized by the likely presence or absence of biological, chemical, or physical hazards and the activities performed within them. Zone boundaries are clearly marked at all times and the flow of personnel among the zones is controlled. The Site is monitored for changing conditions that may warrant adjustment of zone boundaries. Zone boundaries are adjusted as necessary to protect personnel and clean areas. Whenever boundaries are adjusted, zone markings are also changed and workers are immediately notified of the change.

Exclusion Zone

The area where contamination exists is the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered part of the EZ. This zone will be clearly delineated by chain link fencing, caution tape, cones or other effective barriers, as necessary. Safety tape may be used as a secondary delineation within the EZ. The zone delineation markings may be opened in areas for varying lengths of time to accommodate equipment operation or specific construction activities. The SHSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy (co-worker);
- Required minimum level PPE;
- Medical authorization;
- Training certification; and
- Requirement to be in the zone.

Contamination Reduction Zone

A Contamination Reduction Zone (CRZ) is established between the exclusion zone and the support zone. The CRZ contains the Contamination Reduction Corridor (CRC) and provides an area for decontamination of personnel and equipment. The CRZ will be used for general Site entry and egress in addition to access for heavy equipment and emergency support services. Personnel are not allowed in the CRZ without:

- A buddy (co-worker)
- Appropriate PPE
- Medical authorization
- Training certification
- Requirement to be in the zone

Support Zone

The Support Zone (SZ) is an uncontaminated area that will be the field support area for the Site operations. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel or materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

5. Job Hazard Evaluation

Roux's work at the Site is expected to entail a variety of physical, chemical, and biological hazards, all of which must be sufficiently managed to allow the work to be performed safely. Some of the hazards are Site-specific (i.e., they are associated with the nature, physical characteristics, and/or routine operation of the Site itself), while others are activity-specific (i.e., they are associated with [or arise from] the particular activity being performed). The various hazards can be grouped into the following categories:

- **Caught/Crushed** – the potential to become caught in, under, between, or by an object or parts of an object, such as equipment with parts that open and close or move up and down ("pinch points") or equipment that rotates, and the accompanying potential to have body parts cut, mangled, or crushed thereby.
- **Contact** – the potential to be struck by or against moving or stationary objects that can cause physical injury, such as heavy machinery, overhead piping, moving vehicles, falling objects, and equipment (including tools and hand-held equipment) or infrastructure with the ability to cut or impale.
- **Energy Sources** – the potential for bodily harm associated with energy sources, most notably electricity, but also including latent energy sources such as compressed air and equipment under tension (which when released could cause injurious contact or a fall).
- **Ergonomics** – the potential for musculoskeletal injury associated with lifting/carrying, pushing/pulling, bending, reaching, and other physical activity attributable to poor body position/mechanics, repetitive motion, and/or vibration.
- **Exposure** – the potential for injury/illness due to physical, chemical, or biological exposures in the work environment, including but not limited to temperature extremes, solar radiation, and noise (physical), chemical splashes and hazardous atmospheres (chemical), and animal/insect bites and poisonous plants (biological).
- **Falls** – the potential to slip or trip and thus fall or drop a load, resulting in bodily injury to oneself or others.

The foregoing is intended to provide Roux employees with a general awareness of the hazards involved with Site work. A more detailed review of the potential hazards associated with each specific activity planned for the Site (or on-going activity, as the case may be) is provided in the activity-specific Job Safety Analysis (JSA) forms in **Appendix A**. As can be seen in the JSA forms, the hazards are identified by category per the above, and specific measures designed to mitigate/manage those hazards are also identified. In preparing the JSA forms, all categories of hazards were considered, and all anticipated potential hazards were identified to the extent possible based on the experience of the personnel preparing and reviewing the JSA forms. However, there is always the possibility for an unanticipated hazard to arise, potentially as condition change over the course of the workday. Roux personnel must maintain a continual awareness of potential hazards in the work zone, regardless of whether the hazard is identified in the JSA form. Particular attention should be paid to hazards associated with exposure to hazardous substances (see **Table 1** for a listing of the hazardous substances most likely to be encountered in environmental media at the Site) and to Site personnel being located "in the line of fire" with respect to moving equipment, pinch points, and latent energy (e.g., being located or having body parts located within the swing radius of an excavator, between two sections of pipe being connected, below a piece of suspended equipment, or adjacent to a compressed air line).

5.1 Hazard Communication and Overall Site Information Program

The information in the JSAs and safety data sheets is made available to all employees and subcontractors who could be affected by it prior to the time they begin their work activities. Modifications to JSAs are communicated during routine pre-work briefings.

The information in the JSAs and Safety Data Sheets (SDSs) is made available to all employees and subcontractors who could be affected by an exposure to the hazards covered in them prior to the time they begin their work activities. Modifications to JSAs are communicated during routine pre-work briefings, and periodically updated as needed in the HASP. SDSs will be maintained by the SHSO/SS for new chemicals brought on-site as needed. Copies of SDSs can be found in **Appendix B**.

5.2 Noise

Noise is associated with the operation of heavy equipment, power tools, pumps, and generators. Noise is also a potential hazard when working near operating equipment such as excavators, drill rigs or pole drivers. High noise (i.e., < 85 dBA) operations may be evaluated by the SHSO utilizing a type 2 handheld sound level meter (SLM) operating on the "A"-weighted scale with slow response because this scale most closely resembles human response to noise and complies with OSHA 29 CFR 1910.95. Hearing protection is required in areas with noise exposure greater than 85 dBA. Double hearing protection (ear plugs and earmuffs) are required in areas where the noise exposure is more than 95 dBA. Noise exposure will be controlled by hearing protection as described above or by maintaining set-backs from high-noise equipment, as warranted. Personnel handling heavy equipment and using power tools that produce noise levels exceeding those described levels above are required by OSHA 29 CFR 1910.95 to wear the appropriate Noise Reduction Rating (NRR) level of hearing protection. Appropriate hearing protection will be evaluated by the SHSO as necessary in consultation with the OHSM and CHSM.

5.3 Biological Hazards

Biological hazards that may potentially be present at a Site, include poisonous plants, insects (ticks, spiders, bees), animals (snakes, dogs), etc. Information on biological hazards can be found within Roux's Biological Hazard Awareness Management Program located within Roux's Corporate Health and Safety Manual. There is also potential for transmission and/or exposure to SARS-CoV-2, the virus that causes COVID-19. Prior to beginning work, on-Site protocols shall be established by the project team, including subcontractors, in accordance with federal, state, county, city, and/or other guidance, as applicable and consistent with **Appendix C**. Government guidance/orders generally consist of implementation of the following protocols/procedures (or some variation thereof):

- Self-monitoring for symptoms;
- Fitness check for work each day;
- Limiting businesses to "essential" operations;
- Social distancing (generally 6 feet);
- Cloth face masks/ coverings;
- Hand washing/ disinfectant use; and
- Care/ awareness of surroundings (public spaces, equipment, hotel rooms, rental cars).

Additional guidance on minimizing potential exposure to SARS-CoV-2, including a JSA, are included in **Appendix C**.

6. Emergency Response Plan

This emergency response plan details actions to be taken in the event of Site emergencies. The PM and SHSO is responsible for the implementation of emergency response procedures onsite. The SHSO/PM provides specific direction for emergency action based upon information available regarding the incident and response capabilities and initiates emergency procedures and notification of appropriate authorities. In the event of an emergency, Site personnel are evacuated and do not participate in emergency response activities, response is facilitated through external emergency services.

6.1 Emergency Response

The SHSO, after investigating the incident and relevant information, shall determine the level of response required for containment, rescue and medical care. Limited on-site emergency response activities could occur therefore the SHSO is responsible for notifying external emergency response agencies. The SHSO provides relevant information to the responding organizations, including but not limited to the hazards associated with the emergency incident, potential containment problems, and missing Site personnel.

6.2 Emergency Alerting and Evacuation

If evacuation notice is given, Site workers leave the worksite, if possible, by way of the nearest exit. Appropriate primary and alternate evacuation routes and assembly areas have been identified and are shown on the Site Plan with Emergency Muster Area (**Figure 2**). The routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by SHSO/PM.

Personnel exiting the Site gather at a designated assembly point. To determine that everyone has successfully exited the Site, personnel will be accounted for at the assembly point. If any worker cannot be accounted for, notification is given to the SHSO, PM, and any arriving response authorities so that appropriate action can be initiated. Subcontractors on this Site have coordinated their emergency response plans to ensure that these plans are compatible and potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

6.3 Emergency Medical Treatment and First Aid

In the event of a work-related injury or illness, employees are required to follow the procedures outlined below. All work-place injury and illness situations require Roux's Project and Corporate Management Team to be notified when an injury/illness incident occurs, and communication with the contracted Occupational Health Care Management Provider, AllOne Health (AOH), is initiated. The Injury/Illness Notification Flowchart is provided below and within Roux's Incident Investigation and Reporting program included within Roux's Corporate Health and Safety Manual.

If on-Site personnel require any medical treatment, the following steps will be taken:

a. Notify Roux's Project and Corporate Management Team for any work-related injury and/or illness occurrence, and communicate with the contracted Occupational Health Care Management Provider, AOH, immediately following the notifications provided above.

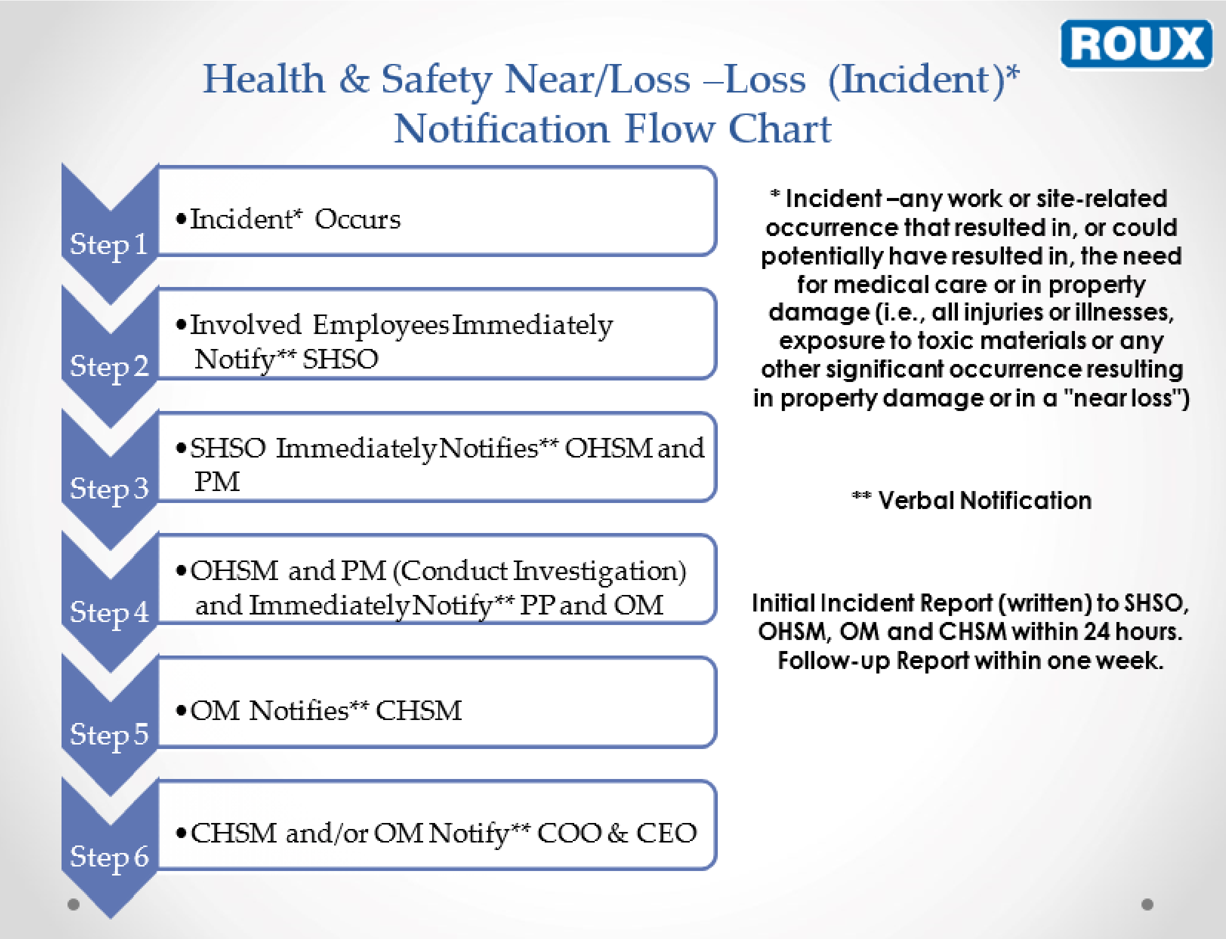
b. Based on discussions with the Project Team, Corporate Management and the AOH evaluation, if medical attention beyond onsite First Aid is warranted, transport the injured / ill person (IP) to the

Urgent Care Center, or notify the Fire Department or Ambulance Emergency service and request an ambulance or transport the victim to the hospital, and continue communications with Corporate Management Team. An Urgent Care/Hospital Route map with location to City MD Fordham Urgent Care Bronx and the New York – Presbyterian The Allen Hospital is included as **Figure 3**.

c. Decontaminate to the extent possible prior to administration of first aid or movement to medical or emergency facilities.

d. First aid medical support will be provided by onsite personnel trained and certified in First Aid, Cardio Pulmonary Resuscitation (CPR), Automatic External Defibrillation (AED), and Blood-Borne Pathogens (BBP) Awareness, until relieved by emergency medical services (EMS).

e. The SHSO and Project Manager will perform a Loss Investigation (LI) and the Project Team will complete the final Loss Report. If a Roux employee is involved in a vehicular incident, the employee must also complete the Accord Automobile Loss Notice.



ROUX

Health & Safety Near/Loss –Loss (Incident)*
Notification Flow Chart

- Step 1 • Incident* Occurs
- Step 2 • Involved Employees Immediately Notify** SHSO
- Step 3 • SHSO Immediately Notifies** OHSM and PM
- Step 4 • OHSM and PM (Conduct Investigation) and Immediately Notify** PP and OM
- Step 5 • OM Notifies** CHSM
- Step 6 • CHSM and/or OM Notify** COO & CEO

* Incident –any work or site-related occurrence that resulted in, or could potentially have resulted in, the need for medical care or in property damage (i.e., all injuries or illnesses, exposure to toxic materials or any other significant occurrence resulting in property damage or in a "near loss")

** Verbal Notification

Initial Incident Report (written) to SHSO, OHSM, OM and CHSM within 24 hours. Follow-up Report within one week.

6.4 Adverse Weather Conditions

In the event of adverse weather conditions, the SHSO or project principal will determine if work can continue without sacrificing the health and 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 conditions;
- Limited visibility; and
- Electrical storm potential.

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lightning. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

6.5 Electrical Storm Guidelines

In the event that lightning and/or thunder are observed while working onsite, all onsite activities shall stop and personnel shall seek proper shelter (e.g., substantial building, enclosed vehicle, etc.). Work shall not resume until the threat of lighting has subsided and no lightning or thunder has been observed for 30 minutes. If the possibility of lightning is forecast for the day, advise the onsite personnel on the risks and proper procedure at the pre-work safety briefing. Continuously monitor for changing weather conditions and allow enough time to properly stop work if lightning is forecast.

7. Safety Procedures

This section of the HASP presents the specific safety procedures to be implemented during Roux's activities at the Site in order to protect the health and safety of various on-site personnel. Minimum OSHA-mandated procedures are presented first, followed by client- and Site-specific procedures. Lastly, activity-specific procedures are discussed. These Site and activity-specific procedures supplement the general safety procedures included in Roux's Corporate Health and Safety Manual, which also must be followed in their entirely.

7.1 Training

At a minimum, Site personnel who will perform work in areas where there exists the potential for toxic exposure will be health and safety-trained prior to performing work onsite per OSHA 29 CFR 1910.120(e) and 29 CFR 1926.65(e). More specifically, all Roux, subcontractor, and other personnel engaged in sampling and remedial activities at the Site and who are exposed or potentially exposed to hazardous substances, health hazards, or safety hazards must have received at a minimum the 40 hour initial HAZWOPER training consistent with the requirements of 29CFR 1910.120(e)(3)(i) training and a minimum of 3 days' actual field experience under the direct supervision of a trained experienced supervisor, plus 8 hours of refresher training on an annual basis. Depending on tasks performed, less training may be permitted. Evidence of such training must be maintained at the Site at all times. Furthermore, all on-Site management and supervisory personnel directly responsible for or who supervise the employees engaged in Site remedial operations, must have received an additional 8 hours of specialized training at the time of job assignment on topics including, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques, plus 8 hours of refresher training on an annual basis.

Roux personnel training records are maintained in a corporate database with records available upon request from either the OHSM/SHSO/CHSM or Human Resources Department.

7.2 Site-Specific Safety Briefings for Visitors

A site-specific briefing is provided to all site visitors who enter this site beyond the site entry point. For visitors, the site-specific briefing provides information about site hazards, the site lay-out including work zones and places of refuge, the emergency alarm system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

7.3 HASP Information and Site-Specific Briefings for Workers

Site personnel review this HASP and are provided a Site-specific tailgate briefing prior to the commencement of work to ensure employees are familiar with this HASP and the information and requirements it contains, as well as the relevant JSAs included in **Appendix A**. Additional briefings are provided as necessary to notify employees of any changes to this HASP as a result of information gathered during on-going Site characterization and analysis of changing conditions. Conditions for which we schedule additional briefings include, but are not limited to: changes in site conditions, changes in the work schedule/plan, newly discovered hazards, and incidents occurring during Site work.

7.4 Medical Surveillance

The medical surveillance section of the Health and Safety Plan describes how worker health status is monitored at this site. Medical surveillance is used when there is the potential for worker exposure to hazardous substance at levels above OSHA permissible exposure limits or other published limits. The purpose of a medical surveillance program is to medically monitor worker health to ensure that personnel are not adversely affected by site hazards. The provisions for medical surveillance at this site are based on the site characterization and job hazard analysis found in Section 4 of this HASP and are consistent with OSHA requirements in 29 CFR 1910.120(f) as applicable.

7.4.1 Site Medical Surveillance Program

Medical surveillance requirements are based on a worker's potential for exposure as determined by the site characterization and job hazard analysis documented in Section 4 and JSAs within **Appendix A** of this HASP and in compliance with the requirements of 29 CFR 1910.120(f)(2). Based on site information and use of direct reading instruments, limited use of respirators (less than 30 days per year), and the absence of an employee-staffed HAZMAT team, a limited medical surveillance program is required and implemented at this site. The medical surveillance program provides that:

1. Workers assigned to tasks requiring the use of respirators receive medical examinations in accordance with 29 CFR 1910.134(e) to ensure they are physically capable to perform the work and use the equipment, and
2. If a worker is injured, becomes ill, or develops signs or symptoms of possible over-exposure to hazardous substance or health hazards, medical examinations are provided to that worker as soon as possible after the occurrence and as required by the attending physician.
3. These medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided to workers free of cost, without loss of pay, and at a reasonable time and place. In addition, the need to implement a more comprehensive medical surveillance program will be re-evaluated after any apparent over-exposure.

7.4.2 Medical Recordkeeping Procedures

Medical recordkeeping procedures are consistent with the requirements of 29 CFR 1910.1020 and are described in the company's overall safety and health program. A copy of that program is available at our Islandia, New York office.

The following items are maintained in worker medical records:

- Respirator fit test and selection;
- Physician's medical opinion of fitness for duty (pre-placement, periodic, termination);
- Physician's medical opinion of fitness for respirator protection (pre-placement, periodic); and
- Exposure monitoring results.

7.4.3 Program Review

The medical program is reviewed to ensure its effectiveness. The Corporate Health and Safety Manager in coordination with the Human Resources Director is responsible for this review. At minimum, this review consists of:

- Review of accident and injury records and medical records to determine whether the causes of accidents and illness were promptly investigated and whether corrective measures were taken wherever possible;
- Evaluation of the appropriateness of required medical tests based on site exposures; and
- Review of emergency treatment procedures and emergency contacts list to ensure they were site-specific, effective, and current.

7.5 Personnel Protection

Site safety and health hazards are eliminated or reduced to the greatest extent possible through engineering controls and work practices. Where hazards are still present, a combination of engineering controls, work practices and PPE are used to protect employees. Appropriate personal protective equipment (PPE) shall be worn by Site personnel when there is a potential exposure to chemical hazards or physical hazards (e.g., falling objects, flying particles, sharp edges, electricity, and noise), as determined by the SHSO. The level of personal protection, type and kind of equipment selected will depend on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors will be made before work can be safely executed.

Roux maintains a comprehensive written PPE program that addresses proper PPE selection, use, maintenance, storage, fit and inspection. Roux's PPE program can be found within **Appendix D**. PPE to be used at the Site will meet the appropriate American National Standards Institute (ANSI) standards and the following OSHA (General/Construction Industry) standards for minimum PPE requirements.

The minimum level of PPE for entry onto the Site is Level D. The following equipment shall be worn:

- Work uniform (long pants, sleeved shirt);
- Hard hat;
- Steel or composite toe work boots;
- Safety Glasses (must comply with one of the following ANSI/ISEA Z87.1-2010, ANSI Z87.1-2003, ANSI Z87.1-2003);
- Boot Covers (as needed);
- Hearing protection (as needed);
- High visibility clothing (shirt/vest); and
- Hand protection (e.g., minimum cut resistance meeting ANSI 105-2000 Level 2).

Note that jewelry shall be removed or appropriately secured to prevent it from becoming caught in rotating equipment or unexpectedly snagged on a fixed object (e.g., wrist watches, bracelets, rings, chains and necklaces, open earrings). Do not wear loose clothing and all shoulder-length hair should be tied back.

Site specific PPE ensembles and materials are identified within task specific JSAs located within **Appendix A**, and any upgrades or downgrades of the level of protection (i.e., not specified in the JSA) must be approved by the PP and immediately communicated to all Roux personnel and subcontractors as applicable. PPE is used in accordance with manufacturer's recommendations.

7.5.1 Hearing Conservation

Hearing protection is made available when noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA. Hearing protection is required when the 8-hour time weighted average sound level ≥ 90 dBA. Where noise exposure meets or exceeds this level, noise is listed as a physical hazard in the JSA for the tasks/operation, and hearing protection is included as one of the control measures (PPE).

7.6 Monitoring

An air monitoring program is important to the safety of on- and off-Site personnel. A preliminary survey, to establish background conditions in the immediate sampling area, may be made prior to the initiation of Site work including, but not limited to, monitoring wind direction and approximate temperature during all invasive Site activities. This survey will be conducted with the appropriate air monitoring instrument(s) as warranted by the field activity. Once this survey has been complete, any change in the type of PPE will be determined.

Air monitoring may be performed to verify that the proper level of equipment is used and to determine if increased protection or work stoppage is required. The following equipment may be used to monitor conditions:

- Photoionization Detector (PID)

Monitoring equipment will be calibrated in accordance with applicable regulatory requirements and manufacturer specifications. Below are monitoring action levels for Site-specific chemicals of concern. In the event that PID readings above the thresholds identified below are sustained for 5 minutes in the breathing zone, worker protection will require upgrading following notification to the OHSM and applicable parties (e.g., client, board of health, regulators, etc.).

7.6.1 Action Levels for Air Monitoring

PPE can remain at Level D if breathing zone VOC concentrations are less than 5 ppm and benzene is non-detect. Personnel are required to evacuate the Site when breathing zone VOC readings exceed 25 ppm.

The following tables include summaries of the air monitoring, work practices, and action levels for the expected contaminants. The action levels to initiate testing with colorimetric tubes for airborne volatiles is 1 ppm (PID reading) and is based on the Permissible Exposure Limit (PEL) for benzene (1 ppm). The colorimetric tubes are used to confirm the presence or absence of specific constituents, and they do not provide a measured concentration.

Air Monitoring Summary and Action Levels Organic Vapors	
PID Reading in Breathing Zone (ppm)[1]	**Action**
0-1 ppm above background[2]	Continue monitoring
1-5 ppm sustained 60 seconds	Continue monitoring, if applicable initiate additional collection of benzene using colorimetric tubes.
<5 ppm and no presence of benzene	Continue Monitoring, ventilate space

Air Monitoring Summary and Action Levels Organic Vapors	
PID Reading in Breathing Zone (ppm)[1]	**Action**
≥ 5 ppm - ≤ 25 ppm and no presence of benzene	Ventilate space until PID reads < 5 ppm. If < 5 ppm cannot be achieved, upgrade to Level C[3].
≥ 25 ppm	Ventilate space and evacuate area.

[1] Based on relative response/sensitivity of PID to benzene.

[2] Background concentrations should be established at the beginning of each work day. It may be necessary to re-establish background concentrations and ambient conditions vary through the day.

[3] Measured air concentrations of known organic vapors will be reduced by the respirator to one half of the PEL or lower, and the individual and combined compound concentrations shall be within the service limit of the respirator cartridge.

7.6.2 Air Monitoring Equipment and Calibration

A PID calibrated to an appropriate calibration mixture will be used to detect organic vapors in and around the work areas. Monitoring will be conducted in and around all work areas and at the workers breathing zone before activities commence to establish a background level, then at 15-minute intervals throughout the day. All equipment will be calibrated according to the manufacturer's recommendation. A calibration log will be maintained and will include the name of the person who performed the calibration, the date and time calibrated, and the instrument reading at the time of calibration. A manual bellows pump or equivalent with colorimetric tubes for formaldehyde will be utilized to determine the course of action related to upgrading or downgrading the level of respiratory protection, as applicable.

If air monitoring data indicate safe levels of potentially harmful constituents at consistent intervals (5-minute intervals), then monitoring can be conducted less frequently (every 30 minutes). This determination will be made by the onsite SHSO. Monitoring data, including background readings and calibration records, will be documented. Work to be performed on-Site will conform to Roux's Standard Operating Procedures (SOPs). Conformance with these guidelines as well as the guidelines described in this HASP will aid in mitigating the physical and chemical hazards mentioned throughout this HASP.

7.7 Tailgate Safety Meetings

A designated Site worker will provide daily safety briefings (e.g., tailgate meetings) including, but not limited to, the following scenarios:

- When new operations are to be conducted;
- Whenever changes in work practices must be implemented; and
- When new conditions are identified and/or information becomes available.

Daily safety briefings shall be recorded on the Roux Daily Tailgate Health and Safety Meeting Log/Daily Site Safety Checklist, and all completed forms will become a part of the project file.

7.8 Spill Containment

Spill containment equipment and procedures should, at a minimum, meet the requirements of the facility's Spill Prevention, Control and Countermeasure Plan, if applicable. Otherwise, spill containment equipment and procedures must be considered depending on the task including, but no limited to, chemical/product transfer points and handling.

7.8.1 Initial Spill Notification and Response

Any worker who discovers a hazardous substance spill will immediately notify Jessica Taylor, Project Principal. The worker will, to his/her best ability, report the hazardous substance involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, and any associated injuries without compromising their own safety.

7.8.2 Spill Evaluation and Response

Julia Michaels/Site Supervisor and Site Health and Safety Officer is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area will be isolated and demarcated to the extent possible. If necessary to protect nearby community members, notification of the appropriate authorities is made by the PM as appropriate. On-Site response is limited to small spills (e.g., <10 gallons); large spills require external emergency responders who will be contacted by the SHSO.

7.9 Decontamination

The decontamination section of the HASP describes how personnel and equipment are decontaminated when they leave the Exclusion Zone. This section also describes how residual waste from decontamination processes is disposed. The site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment. These procedures minimize worker contact with contaminants and protect against the transfer of contaminants to clean areas of the site and off-site. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. Decontamination is facilitated within the CRZ at this site, if applicable.

7.9.1 Decontamination Procedures for Personnel and PPE

The following are general decontamination procedures established and implemented at this site.

1. Decontamination is required for all workers exiting a contaminated area. Personnel may re-enter the SZ only after undergoing the decontamination procedures described below in the next section.
2. Protective clothing is decontaminated, cleaned, laundered, maintained and/or replaced as needed to ensure its effectiveness.
3. PPE used at this site that requires maintenance or parts replacement is decontaminated prior to repairs, or
4. PPE used at this site is decontaminated or prepared for disposal on the premises. Personnel who handle contaminated equipment have been trained in the proper means to do so to avoid hazardous exposure.
5. This site uses an off-site laundry for decontamination of PPE. The site has informed that facility of the hazards associated with contaminated PPE from this site.
6. The site requires and trains workers that if their permeable clothing is splashed or becomes wetted with a hazardous substance, they will immediately exit the work zone, perform applicable decontamination procedures, shower, and change into uncontaminated clothing.
7. Procedures for disposal of decontamination waste meet applicable local, State, and Federal regulations.

7.9.2 Decontamination Procedures for Equipment

All tools, equipment, and machinery from the EZ or CRZ are decontaminated in the CRZ prior to removal to the SZ. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities.

General Equipment Decontamination Procedures:

1. Decontamination is required for all equipment exiting a contaminated area. Equipment may re-enter the SZ only after undergoing the equipment decontamination procedures.
2. Vehicles that travel regularly between the contaminated and clean areas of the site are carefully decontaminated each time they exit the EZ and the effectiveness of that decontamination is monitored to reduce the likelihood that contamination will be spread to other parts of the site.
3. Particular attention is given to decontaminating tires, scoops, and other parts of heavy equipment that are directly exposed to contaminants and contaminated soil.

The following items may be used to decontaminate equipment:

- Fresh water rinse;
- Non-phosphorus detergent wash;
- Distilled water rinse;
- Acetone rinse;
- Distilled water rinse; and
- A steam cleaner or pressure washer (heavy equipment only).

7.9.3 Monitoring the Effectiveness of Decontamination Procedures

Visual examination and sampling are used to evaluate the effectiveness of decontamination procedures. Visual examination is used to ensure that procedures are implemented as described and that they appear to control the spread of contaminants under changing site conditions. Visual examination is also used to inspect for signs of residual contamination or for contaminant permeation of PPE.

Personnel who work in contaminated areas of the site, either the Contamination Reduction Zone (CRZ) or the Exclusion Zone, are trained in the principles and practices of decontamination described in this section of the HASP and in related SOPs. If site procedures are changed as a result of inspection and monitoring, all affected employees are notified of these changes.

7.10 Confined Space Entry

Confined entry will not be performed at the Site.

The following is a list of the safety requirements for confined space entry at the Site:

- **ROUX PERSONNEL ARE NOT AUTHORIZED TO ENTER AN OSHA PERMIT REQUIRED CONFINED SPACE;**
- Currently the scope of work **DOES NOT** require personnel to enter permitted confined space for this project; and
- Any changes to the field activities that may necessitate confined space entry will be reported to the Project Principal and OHSM.

Confined space is defined as any space, depression, or enclosure that:

- Has limited opening for entry and egress;
- Is large enough for and employee to enter and perform assigned work; and
- Is not intended for continuous occupancy.

A permit required confined space is one that meets the definition of a confined space and has one or more of the following characteristics:

- May contain or produce life-threatening atmospheres due to oxygen deficiency the presence of toxic, flammable, or corrosive contaminants;
- Contains a material that has the potential for engulfment;
- Has an internal configuration that may cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; and
- Contains any other serious safety or health hazards.

Although Roux personnel will not perform confined space entry, it is expected that subcontractors performing cleaning and mitigation and/or remedial measures activities may be required to enter structures that are considered to be a permit required confined space. Permitting of the confined space as well as hazard mitigation for entry will be completed by the subcontractor in accordance with 1910.146.

7.11 Client and Site-Specific

In addition to the OSHA-specific procedures discussed above, there may be client and site-specific safety procedures that must be adhered to during the performance of remedial activities at the Site.

7.12 Unusual or Significant Risks

Field activities that appear to have unusual or significant risks that cannot be adequately managed with existing risk tools such as LPS, HASPs, traffic safety plans, work permits, design and O&M practices, equipment HAZOPS or other safety tools must be referred to the CHSM to help with the assessment and management of the associated potential safety risks. Examples include the use of explosives for demolition, use of firearms to control wildlife, rappelling, demolition over water, diving, etc.

7.13 Activity-Specific Hazards

In addition to the general hazards discussed above, there are activity-specific hazards associated with each work activity planned for the Site. An activity-specific JSA has been completed for each of the activities planned for the Site. JSAs are provided in **Appendix A**. In the event that new work activities or tasks are planned, JSAs will be developed and implemented prior to performing the new activities. In the absence of a JSA, the personnel performing work must prepare a field JSA and receive clearance from a designated competent safety official prior to performing any task with significant risk. In emergency situations where time is critical SPSAs will be utilized to identify the task, associated hazards and mitigative actions to take. For lower risk activities (as deemed by the discretion of a Competent Person) where a JSA is determined to not be needed, the individual(s) conducting the activities must perform SPSAs prior to and during the work.

7.13.1 Electrical and Other Utility Assessment and Accommodations

Roux shall perform a site walk to identify any potential overhead electrical or utility lines. All applicable guidelines will be followed in the vicinity of overhead power and utility lines (see Section 7.13.3 below). Roux has also reviewed all available Site maps showing buried utility lines to identify potential hazards, which revealed that no underground hazards are known to exist in the vicinity of the areas of the Site pertinent to this HASP.

Roux subcontractor, AARCO called in a request to 811 to the prior to digging activities.

7.13.2 Subsurface Work

Subsurface work activities will require adherence to Roux's Corporate Subsurface Utility Clearance Management program found within **Appendix E**.

7.13.2.1 Excavations and Trenching

Excavation/trenching will not be part of this phase of work.

7.13.3 Heavy Equipment

Use of heavy equipment at the Site will require adherence to Roux's Corporate Heavy Equipment Exclusion Zone Management Program found within **Appendix F**. Additionally, operation of the drill rig/other heavy equipment will maintain clearances from overhead power lines in accordance with OSHA 29 CFR1926.1408 Table A Minimum Clearance Distances provided below.

Minimum Required Clearances for Energized Overhead Power Lines

Nominal System Voltage of Power Line (K V)	Minimum Required Clearance (feet)
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

1 kilovolt (KV) = 1,000 volts

7.14 Heat Stress

The National Oceanic and Atmospheric Administration records average minimum/maximum temperatures of 27-83degrees Fahrenheit during the year in Inwood, New York.

7.14.1 Heat Stress

Heat stress is a significant potential hazard and can be associated with heavy physical activity and/or the use of personal protective equipment in hot weather environments. Heat cramps are brought on by prolonged exposure to heat. As an individual sweats, water and salts are lost by the body resulting in painful muscle cramps. The signs and symptoms of heat stress are as follows:

- Severe muscle cramps, usually in the legs and abdomen;

- Exhaustion, often to the point of collapse; and
- Dizziness or periods of faintness.

First aid treatment includes, but is not limited to, shade, rest, and fluid replacement. Typically, the individual should recover within one-half hour while being monitored constantly. If the individual has not improved substantially within 30 minutes and the body temperature has not decreased, the individual should be transported to a hospital for medical attention.

7.14.2 Heat Exhaustion

Heat exhaustion may occur in a healthy individual who has been exposed to excessive heat while working or exercising. The circulatory system of the individual fails as blood collects near the skin to rid the body of excess heat through transference. The signs and symptoms of heat exhaustion are as follows:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin with heavy perspiration;
- Skin appears pale;
- Fatigue and weakness;
- Dizziness; and
- Elevated body temperature.

First aid treatment includes, but is not limited to, cooling the victim, elevating the feet, and replacing fluids.

If the individual is not substantially improved within 30 minutes and the body temperature has not decreased, the individual should be transported to the hospital for medical attention.

7.14.3 Heat Stroke

Heat stroke occurs when an individual is exposed to excessive heat and stops sweating. This condition is classified as a MEDICAL EMERGENCY requiring immediate cooling of the victim and transport to a medical facility. The signs and symptoms of heat stroke are as follows:

- Dry, hot red skin;
- Body temperature approaching or above 105 degrees F;
- Confusion, altered mental state, slurred speech;
- Seizures;
- Large (dilated) pupils; and
- Loss of consciousness – the individual may go into a coma.

First aid treatment requires immediate cooling and transportation to a medical facility. Heat stress is a significant hazard if any type of protective equipment (semi-permeable or impermeable) that prevents evaporative cooling when worn in hot weather environments.

7.15 Cold Stress

Cold stress is a danger at low temperatures and when the wind-chill factor is low. Prevention of cold-related illnesses is a function of whole-body protection. Adequate insulating clothing must be used when the air temperature is below 60°F. A work/rest regimen will be initiated when ambient temperatures and protective clothing cause a stressful situation. In addition, reduced work periods followed by rest in a warm area may be necessary in extreme conditions. The signs and symptoms of cold stress include the following:

- Severe shivering;
- Abnormal behavior;
- Slowing;
- Weakness;
- Stumbling or repeated falling;
- Inability to walk;
- Collapse; and/or
- Unconsciousness.

First aid requires removing the victim from the cold environment and seeking medical attention immediately. Also, prevent further body heat loss by covering the victim lightly with blankets. Do not cover the victim's face. If the victim is still conscious, administer hot drinks and encourage activity such as walking, wrapped in a blanket.

8. Field Team Review

Each person performing work at or visiting this site shall sign this section after site-specific training is completed and before being permitted to access the CRZ or Exclusion Zone.

I have read and understand this Site-Specific Health and Safety Plan. I will comply with the provision contained therein.

Site/Project: Taconic Inwood Lot 21

Name & Company	Signature	Date

9. Approvals

By their signature, the undersigned certify that this HASP is approved and will be utilized at the

Taconic Inwood Lot 21 Site.

Julia Michaels – Site Health and Safety Officer	Date
Kristina DeLuca - Office Health and Safety Manager	Date
Valerie Sabatasso – Project Manager	Date
Jessica Taylor – Project Principal	Date

TABLES

1. Toxicological Properties of Hazardous Substances Present at the Site

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at MHANY Chestnut Commons, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Acenaphthene	83-32-9	None established	None established	None established	None established	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system	Eyes, skin, respiratory system	Brown solid
Acenaphthylene	208-96-8	None Established	None established	None established	None established	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system	Eyes, skin, respiratory system	Yellow Solid Fl. Pt.=251°F
Arsenic (inorganic)	7440-38-2 (metal)	TWA 0.01 mg/m3	Ca C 0.002 mg/m3 [15-min]	TWA 0.010 mg/m3	Ca [5 mg/m3 (as As)]	Inhalation; ingestion; skin absorption; skin and/or eye contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]	Liver, kidneys, skin, lungs, lymphatic sys	Metal: sliver-gray or tin-white, brittle, odorless solid BP: sublimes
Barium	7440-39-3	TWA 0.5 mg/m3	None established	TWA 0.5 mg/m3	None established	Inhalation, ingestion, skin contact	Irritation skin, respiratory system, digestive system	Skin, eyes, respiratory system	Yellow white powder BP: 1640 C
Benzene	71-43-2	TWA 0.5 ppm STEL 2.5 ppm	Ca TWA 0.1 ppm STEL 1 ppm	TWA 1 ppm ST 5 ppm	Ca [500 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	Colorless to light yellow liquid with an aromatic odor [Note: Solid below 42 °F] BP: 176°F Fl.Pt. = 12°F LEL: 1.2% UEL: 7.8% Class B Flammable liquid
Benzo[a]anthracene	56-55-3	None established [skin cancer]	None established	None established	None established	Inhalation; ingestion; skin absorption; skin and/or eye contact	Irritation eyes, skin, respiratory system, CNS; skin cancer	Skin	Pale Yellow crystal, solid BP: 438 C
Benzo[a]pyrene	50-32-8	None established [cancer]	TWA 0.1 mg/m3	TWA 0.2 mg/m3	None established	Inhalation; ingestion; skin absorption; skin and/or eye contact	POISON. This material is an experimental carcinogen, mutagen, tumorigen, neoplastigen and teratogen. It is a probable carcinogen in humans and a known human mutagen. IARC Group 2A carcinogen. It is believed to cause bladder, skin and lung cancer. Exposure to it may damage the developing fetus. May cause reproductive damage. Skin, respiratory and eye irritant or burns.	Skin, eye, bladder, lung, reproductive	Yellow crystals or powder [found in cigarette smoke, coal tar, fuel exhaust gas and in many other sources] BP: 495 C
Benzo[b]fluoranthene	205-99-2	None established [cancer]	TWA 0.1 mg/m3	TWA 0.2 mg/m3	None established	Inhalation; ingestion; skin and/or eye contact	No data were identified on the toxicity of benzo[b]fluoranthene to humans. Based on results of studies in animals, IARC concluded that benzo[b]fluoranthene is possibly carcinogenic to humans	Respiratory system, skin, bladder, kidneys	Off-white to tan powder
Benzo[k]fluoranthene	207-08-9	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory tract, gastrointestinal; fatal if swallowed, inhaled, absorbed through the skin; vomiting, nausea, diarrhea	Lungs, respiratory system	Yellow crystals BP: 480 C
Benzo(g,h,i)perylene	191-24-2	None established	None established	California permisible exposure limits for chemical contaminants (Title 8, Article 107) PEL 0.2 mg/m3	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory tract, very toxic to aquatic life with long lasting effects	Eyes, skin, respiratory system	Pale Yellow -Green Crystals BP: 550°C
Beryllium	7440-41-7 (metal)	TWA 0.00005 mg/m^3	Ca C 0.0005 mg/m^3	TWA 0.002 mg/m^3 C 0.005 mg/m^3 (30 minutes) with a maximum peak of 0.025 mg/m^3	Ca [4 mg/m^3 (as Be)]	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 eyes; dermatitis; [potential occupational carcinogen]	Eyes, skin, respiratory system	Metal: A hard, brittle, gray-white solid. BP: 4532°F
Cadmium	7440-43-9 (metal)	TWA 0.01 mg/m^3	Ca	TWA 0.005 mg/m^3	Ca [9 mg/m^3 (as Cd)]	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]	respiratory system, kidneys, prostate, blood	Metal: Silver-white, blue-tinged lustrous, odorless solid. BP: 1409°F
Carbon Tetrachloride	56-23-5	TWA 5 ppm STEL 10 ppm	Ca ST 2 ppm (12.6 mg/m3) [60 minute]	TWA 10 ppm C 25 ppm 200 ppm (5-minute maximum peak in any 4 hours)	Ca [200 ppm]	inhalation, skin absorbtion, ingestion, skin and/or eye contact	irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]	central nervous system, eyes, lungs, liver, kidneys, skin	Colorless liquid with a characteristic ether-like odor. BP: 170°F
Carbon Monoxide	630-08-0	TWA 25 ppm	TWA 35 ppm C 200 ppm	TWA 50 ppm	1,200 ppm	inhalation	Carboxyhemogloemia	Blood	Colorless, odorless gas

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at MHANY Chestnut Commons, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Chromium	7440-47-3	TWA 0.5 mg/m^3 (metal and Cr III compounds) TWA 0.05 mg/m^3 (water-soluble Cr VI compounds) TWA 0.01 mg/m^3 (insoluble Cr IV compounds)	TWA 0.5 mg/m^3	TWA 1 mg/m^3	250 mg/m^3 (as Cr)	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; lung fibrosis (histologic)	Eyes, skin, respiratory system	Blue-white to steel-gray, lustrous, brittle, hard, odorless solid. BP: 4788°F
Chrysene; Phenanthrene; Pyrene; Coal tar pitch volatiles	65996-93-2	TWA 0.2 mg/m3	Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m^3 (benzene-soluble fraction)	Ca [80 mg/m^3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue. Combustible Solids
Coal Tar Pitch Volatiles; Chrysene; Phenanthrene; Pyrene	65996-93-2	TWA 0.2 mg/m^3	Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m^3 (benzene-soluble fraction)	Ca [80 mg/m^3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue. Combustible Solids
1,1-Dichloroethane	75-34-3	TWA 100 ppm	TWA 100 ppm (400 mg/m^3)	TWA 100 ppm (400 mg/m^3)	3000 ppm	inhalation, ingestion, skin and/or eye contact	Irritation skin; central nervous system depression; liver, kidney, lung damage	Skin, liver, kidneys, lungs, central nervous system	Colorless, oily liquid with a chloroform-like odor. BP: 135°F Fl.P: 2°F UEL: 11.4% LEL: 5.4%
1,2-Dichloroethane (Ethylene Dichloride)	107-06-2	TWA 10 ppm	Ca TWA 1 ppm (4 mg/m^3) STEL 2 ppm (8 mg/m^3)	TWA 50 ppm C 100 ppm 200 ppm [5-minute maximum peak in any 3 hours]	Ca [50 ppm]	inhalation, ingestion, skin absorption, skin and/or eye contact	Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]	Eyes, skin, kidneys, liver, central nervous system, cardiovascular system	Colorless liquid with a pleasant, chloroform-like odor. [Note: Decomposes slowly, becomes acidic & darkens in color.] BP: 182°F Fl.P: 56°F UEL: 16% LEL: 6.2% Class IB Flammable Liquid
1,2-Dichloroethene (total)	540-59-0	TWA 200 ppm	TWA 200 ppm (790 mg/m^3)	TWA 200 ppm (790 mg/m^3)	1000 ppm	inhalation, ingestion, skin and/or eye contact	Irritation eyes, respiratory system; central nervous system depression	Eyes, respiratory system, central nervous system	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor BP: 118-140°F Fl.P: 36-39°F UEL: 12.8% LEL: 5.6% Class IB Flammable Liquid
cis-1,2-Dichloroethene	156-59-2	TWA 200 ppm	TWA 200 ppm	TWA 200 ppm	None established	inhalation, skin absorption, ingestion	Harmful if swallowed, inhaled, or absorbed through skin. Irritant. Narcotic. Suspected carcinogen	Skin	Colorless liquid BP: 60 C Fl.P: 4 C UEL: 12.8% LEL: 9.7 %
trans-1,2-Dichloroethene	156-60-5	TWA 200 ppm	None established	TWA 200 ppm STEL 250 ppm (skin)	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Narcotic. Irritation eyes, skin, respiratory tract, mucous membrane; CNS depression.	Respiratory tract, mucous membrane, eyes, skin, CNS	Colorless liquid with a fruity pleasant odor BP: 48°C Fl.P 6C UEL: 12.8% LEL: 9.7%
Dibenzo[a,h]anthracene	53-70-3	None established	None established	None established	None established	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin	Eyes, skin; skin photosensitization.	Colorless crystalline powder BP: 524°C
Dibenzofuran	132-64-9								
Diesel Fuel #2	68476-34-6	TWA 100 mg/m^3; Skin notation	None established	Designated as an OSHA Select Carcinogen	None established	ingestion, skin and/or eye contact	Kidney damage; potential lung damage; suspected carcinogen; irritation of eyes, skin, respiratory tract; dizziness, headache, nausea; chemical pneumonitis (from aspiration of liquid); dry, red skin; irritant contact dermatitis; eye redness, pain.	Eyes, skin, kidneys	Clear yellow brown combustible liquid; floats on water; distinct diesel petroleum hydrocarbon odor. BP: 356-716°F Fl.P: 154.4-165.2°F LEL: 0.6% UEL: 7.0%
Ethylbenzene	100-41-4	TWA 20 ppm	TWA 100 ppm (435 mg/m^3) STEL 125 ppm (545 mg/m^3)	TWA 100 ppm (435 mg/m^3)	800 ppm [10%LEL]	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eyes, skin, respiratory system, central nervous system	Colorless liquid with an aromatic odor. BP: 277°F Fl.P: 55°F UEL: 6.7% LEL: 0.8% Class IB Flammable Liquid
Fluoranthene	206-44-0	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; possible burns; heart and liver injury, pulmonary edema, respiratory arrest, gastrointestinal disturbances.	Heart, liver, lungs.	Yellow needles.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at MHANY Chestnut Commons, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Fuel Oil #2	68476-30-2	TWA 100 mg/m3; Skin notation	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; CNS effects; nausea, vomiting, headache, cramping, dizziness, weakness, loss of coordination,, drowsiness; kidney, liver damage	Eyes, skin, CNS	Clear or yellow to red oily liquid, kerosene-like odor BP: 347 - 689 °F UEL:5-6% LEL: 0.7-1.0%
Gasoline	8006-61-9	TWA 300 ppm STEL 500 ppm	Carcinogen	None established	Ca [IDLH value has not been determined]	Skin absorption; inhalation; ingestion; skin and/or eye contact	Eyes and skin irritation, mucous membrane; dermatitis; headache; listlessness, blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis; possible liver, kidney damage [Potential occupational carcinogen]	Eyes, skin, respiratory system, CNS, Liver, Kidneys	Clear liquid with a characteristic odor, aromatic Fl.Pt. = -45°F LEL = 1.4% UEL = 7.6% Class 1B Flammable Liquid
Hydrogen Sulfide	7783-06-4	TWA 1 ppm STEL 5 ppm	C 10 ppm (15 mg/m^3) [10-minute]	C 20 ppm 50 ppm [10-minute maximum peak]	100 ppm	inhalation, skin and/or eye contact	Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite	Eyes, respiratory system, central nervous system	Colorless gas with a strong odor of rotten eggs. BP: -77°F UEL: 44.0% LEL: 4.0% Flammable Gas
Indeno[1,2,3-cd]pyrene	193-39-5	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; possible human carcinogen (skin); weakness; affect liver, lung tissue, renal tissue; impairment of blood forming tissue	Skin	Fluorescent green-yellow crystalline solid BP: 536 C
Lead (inorganic)	7439-92-1	TWA 0.05 mg/m^3	TWA (8-hour) 0.050 mg/m^3	TWA 0.050 mg/m^3	100 mg/m^3 (as Pb)	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 eyes; hypertension	Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. BP: 3164°F Noncombustible Solid in bulk form
Mercury (organo) alkyl compounds (as Hg)	7439-97-6	TWA 0.01 mg/m^3 STEL 0.03 mg/m^3 [skin]	TWA 0.01 mg/m^3 STEL 0.03 mg/m^3 [skin]	TWA 0.01 mg/m^3 C 0.04 mg/m^3	2 mg/m^3 (as Hg)	inhalation, skin absorption, ingestion, skin and/or eye contact	Paresthesia; ataxia, dysarthria; vision, hearing disturbance; spasticity, jerking limbs; dizziness; salivation; lacrimation (discharge of tears); nausea, vomiting, diarrhea, constipation; skin burns; emotional disturbance; kidney injury; possible teratogenic effects	Eyes, skin, central nervous system, peripheral nervous system, kidneys	Appearance and odor vary depending upon the specific (organo) alkyl mercury compound
Mercury compounds [except (organo) alkyls] (as Hg) Mercury	7439-97-6	TWA 0.025 mg/m^3 (elemental and inorganic forms)	Hg Vapor: TWA 0.05 mg/m^3 [skin] Other: C 0.1 mg/m3 [skin]	TWA 0.1 mg/m^3	10 mg/m^3 (as Hg)	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, central nervous system, kidneys	Metal: Silver-white, heavy, odorless liquid. [Note: "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.] BP: 674°F
Methylene Chloride (Dichloromethane)	75-09-2	TWA 50 ppm, A3 - suspected human carcinogen	Ca	TWA 25 ppm STEL 125 ppm	Ca [2300 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]	Eyes, skin, cardiovascular system, central nervous system	Colorless liquid with a chloroform-like odor BP: 104°F UEL: 23% LEL: 13%
Naphtha (Rubber Solvent)	8030-30-6	None established	TWA 100 ppm (400 mg/m^3)	TWA 100 ppm (400 mg/m^3)	1000 ppm [10%LEL]	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose; dizziness, drowsiness; dermatitis; in animals: liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Reddish-brown, mobile liquid with an aromatic odor BP: 320-428°F Fl.P: 100-109°F Class II Combustible Liquid
Naphthalene	91-20-3	TWA 10 ppm [skin]	TWA 10 ppm (50 mg/m^3) STEL 15 ppm (75 mg/m^3)	TWA 10 ppm (50 mg/m^3)	250 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, central nervous system	Colorless to brown solid with an odor of mothballs. BP: 424°F Fl.P: 174°F UEL: 5.9% LEL: 0.9%
Petroleum hydrocarbons(Petroleum distillates)	8002-05-9	None established	TWA 350 mg/m^3 C 1800 mg/m^3 [15 min]	TWA 500 ppm (2000 mg/m^3)	1,100 [10% LEL]	Inhalation; ingestion; skin and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, drowsiness, headache, nausea; dried/cracked skin; chemical pneumonitis	CNS, eyes, respiratory system, skin	Colorless liquid with a gasoline or kerosene-like odor BP: 86-460°F Fl. Pt = -40 to -86°F UEL: 5.9% LEL: 1.1% Flammable liquid
Polychlorinated Biphenyls (PCBs) (Chlorodiphenyl (42% Chlorine))	53469-21-9	TWA 1 mg/m^3	Ca TWA 0.001 mg/m^3	0.5 mg/m^3	5 ppm	Dermal; inhalation; ingestion; skin and/or eye contact	Irritation eyes; chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Eyes, skin, liver, respiratory system	Colorless to light-colored, viscous liquid, hydrocarbon odor, BP: 617 - 734°F, non-flammable, LEL: NA, UEL: NA
Selenium	7782-49-2	TWA 0.2 mg/m^3	TWA 0.2 mg/m^3	TWA 0.2 mg/m^3	1 mg/m^3 (as Se)	inhalation, ingestion, skin and/or eye contact	Irritation 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	Eyes, skin, respiratory system, liver, kidneys, blood, spleen	Amorphous or crystalline, red to gray solid. [Note: Occurs as an impurity in most sulfide ores.] BP: 1265°F

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at MHANY Chestnut Commons, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Silver	7440-22-4 (metal)	TWA 0.1 mg/m^3 (metal, dust, fume) TWA 0.01 mg/m^3 (Soluble compounds, as Ag)	TWA 0.01 mg/m^3	TWA 0.01 mg/m^3	10 mg/m^3 (as Ag)	inhalation, ingestion, skin and/or eye contact	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	Metal: White, lustrous solid BP: 3632°F
Tetrachloroethene	127-18-4	TWA 25 ppm STEL 100 ppm listed as A3, animal carcinogen	Ca Minimize workplace exposure concentrations	TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm	Ca [150 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, central nervous system	Colorless liquid with a mild, chloroform-like odor. BP: 250°F Noncombustible Liquid
Toluene	108-88-3	TWA 20 ppm	TWA 100 ppm (375 mg/m^3) STEL 150 ppm (560 mg/m^3)	TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)	500 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless liquid with a sweet, pungent, benzene-like odor. BP: 232°F Fl.P: 40°F UEL: 7.1% LEL: 1.1% Class IB Flammable Liquid
1,1,1-Trichloroethane (Methyl Chloroform)	71-55-6	TWA 350 ppm STEL 450 ppm	C 350 ppm (1900 mg/m^3) [15-minute]	TWA 350 ppm (1900 mg/m^3)	700 ppm	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, central nervous system, cardiovascular system, liver	Colorless liquid with a mild, chloroform-like odor. BP: 165°F UEL: 12.5% LEL: 7.5%
Trichloroethene	79-01-6	TWA 10 ppm STEL 25 ppm	Ca	TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	Ca [1000 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system	Colorless liquid (unless dyed blue) with a chloroform-like odor. BP: 189°F UEL(77°F): 10.5% LEL(77°F): 8%
Vinyl Chloride	75-01-4	TWA 1 ppm	Carcinogen	TWA 1 ppm C 5 ppm [15-minute]	Ca [IDLH value has not been determined]	inhalation, skin, and/or eye contact (liquid)	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	Liver, central nervous system, blood, respiratory system, lymphatic system	Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. BP: 7°F UEL: 33.0% LEL: 3.6% Flammable Gas
Xylene (m, o & p isomers)	108-38-3, 95-47-6, 106-42-3	TWA 100 ppm STEL 150 ppm	TWA 100 ppm (435 mg/m^3)	TWA 100 ppm (435 mg/m^3)	900 ppm	Skin absorption, inhalation, ingestion, skin, and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys	Colorless liquid with an aromatic odor BP: 282°F, 292°F, 281°F Fl. Pt. 82°F, 90°F, 81°F LEL: 1.1%, 0.9%, 1.1% UEL: 7.0%, 6.7%, 7.0% Class C Flammable Liquid
Zinc Oxide	1314-13-2	TWA 2 mg/m3 STEL 10 mg/m^3	None established	TWA 10 mg/m3 (for zinc oxide fume)	None established	skin and/or eye contact, inhalation, ingestion	Irritation eyes, skin, respiratory tract; gastrointestinal disturbances	Eyes, skin, respiratory system,	Bluish gray solid BP: 1664.6°F Flammable

References

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Proctor, N.H., J.P. Hughes and M.L. Fischman, 1989. Chemical Hazards of the Workplace. Van Nostrand Reinhold. New York.

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2017 TLVs® and BEIs®, American Conference of Industrial Hygienists

Abbreviations:

ACGIH – American Conference of Governmental Industrial Hygienists.
BP – boiling point at 1 atmosphere, °F
C – Ceiling, is a concentration that should not be exceeded during and part of the working exposure.
CAS# - Chemical Abstracts Service registry number which is unique for each chemical.
Ft Pt. – Flash point
IDLH - Immediately Dangerous to Life and Health concentrations represent the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
LEL – Lower explosive (flammable) limit in air, % by volume (at room temperature)
mg/m^3 – Milligrams of substance per cubic meter of air
NIOSH - National Institute for Occupational Safety and Health.
OSHA – Occupational Safety and Health Administration
PEL - OSHA Permissible Exposure Limit (usually) a time weighted average concentration that must not be exceeded during any 8 hour work shift of a 40 hr work week.
ppm – parts per million
REL – NIOSH Recommended Limit indicated a time weighted average concentration that must not be exceeded during any 10 hour work shift of a 40 hr work week
SG - Specific Gravity
STEL – Short-term exposure limit (ST)
TLV - ACGIH Threshold Limit Values (usually 8 hour time weighted average concentrations).
TWA – 8-hour, time-weighted average
UEL – Upper explosive (flammable) limit in air, % by volume (at room temperature)
VP - Vapor Pressure

FIGURES

1. Site Location Map
2. Site Plan with Emergency Muster Area
3. Routes to Urgent Care and Hospital

QUADRANGLE LOCATION

SOURCE:
USGS; 2016, Central Park, NY-NJ
7.5 Minute Topographic Quadrangle

0 2000'

N

Title:

SITE LOCATION MAP

BLOCK 2203 LOT 21
408 WEST 207TH STREET NEW
YORK, NEW YORK

Prepared for:

!HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: V.S.	Date: 07JUN19	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	1
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y107.01.CDR		

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N

LEGEND

🟨 EMERGENCY MUSTER AREA

🟥 SITE BOUNDARY

75 0 75'

Title:

SITE PLAN WITH EMERGENCY MUSTER AREA

BLOCK 2203 LOT 21
408WEST 207TH STREET
NEW YORK. NEW YORK

Prepared for:

HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: V.S.	Date: 05/07/21	FIGURE 2
Prepared by: M.S.R.	Scale: AS SHOWN	
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y107.2R2.mxd		

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N

1,000 0 1,000'

DIRECTIONS TO HOSPITAL

1. HEAD NORTHWEST ON WEST 207TH STREET TOWARD 10TH AVE
2. TURN RIGHT ONTO 10TH AVENUE
3. MERGE ONTO BROADWAY
4. TURN LEFT ONTO W 220TH STREET
5. TURN LEFT
6. MOUNT SINAI HOSPITAL WILL BE ON THE LEFT

DIRECTIONS TO CITYMD

1. HEAD SOUTHEAST ON W 207TH STREET TOWARD 9TH AVENUE
2. CONTINUE ONTO UNIVERSITY HEIGHTS BRIDGE
3. CONTINUE ONTO W FORDHAM ROAD
4. CITY MD WILL BE ON THE RIGHT

Title:

EMERGENCY ROUTE MAP

BLOCK 2203 LOT 21
408 WEST 207TH STREET
NEW YORK. NEW YORK

Prepared for:

!HARLEM RIVER NINTH AVENUE DEVELOPMENT LLC

ROUX

Compiled by: V.S.	Date: 06/07/19	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	3
Project Mgr: V.S.	Project: 2477.0008Y000	
File: 2477.0008Y107.2.mxd		

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APPENDICES

A. Job Safety Analysis (JSA) Forms
B. SDSs for Chemicals Used
C. COVID-19 Interim Health and Safety Guidance
D. Personal Protective Equipment (PPE) Management Program
E. Subsurface Utility Clearance Management Program
F. Heavy Equipment Exclusion Zone Policy

APPENDIX A

Job Safety Analysis (JSA) Forms

JOB SAFETY ANALYSIS	**Cntrl. No.**	DATE:	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE	WORK ACTIVITY (Description)

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☐ HARD HAT
☐ LIFELINE / BODY HARNESS
☐ SAFETY GLASSES
☐ GOGGLES
☐ FACE SHIELD
☐ HEARING PROTECTION
☐ SAFETY SHOES
☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☐ PPE CLOTHING:
☐ GLOVES:
☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment:

Commitment to LPS – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE: A _ foot exclusion zone will be maintained around (indicate equipment).

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. [INSERT JOB STEP]	**1a. CONTACT:** [INSERT HAZARD]	1a.
	1b. CAUGHT: [INSERT HAZARD]	1b.
	1c. FALL: [INSERT HAZARD]	1c.
	1d. EXPOSURE: [INSERT HAZARD]	1d.
	1e. EXERTION: [INSERT HAZARD]	1e.
	1f. ENERGY SOURCE: [INSERT HAZARD]	1f.
2. [INSERT JOB STEP]	**2a. CONTACT:** [INSERT HAZARD]	2a.
	2b. CAUGHT: [INSERT HAZARD]	2b.

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into five types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

	2c. FALL: [INSERT HAZARD]	2c.
	2d. EXPOSURE: [INSERT HAZARD]	2d.
	2e. EXERTION: [INSERT HAZARD]	2e.
	2f. ENERGY SOURCE: [INSERT HAZARD]	2f.

---

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into five types: Contact - victim is struck by or strikes an object;
Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

JOB SAFETY ANALYSIS **Ctrl. No. GEN-011**	DATE: 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Construction - Excavation**	WORK ACTIVITY (Description) **Excavation / Trenching**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
David Kaiser	Senior Engineer	Brian Hobbs	Corporate Health & Safety Manager
Ian Holst	Senior Engineer		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☒ LONG SLEEVED SHIRT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☐ GOGGLES
☐ FACE SHIELD
☒ HEARING PROTECTION
☒ SAFETY SHOES: Steel-toe boots
☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility long sleeved clothing
☒ GLOVES: Leather or cut resistant
☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Jackhammer, Excavator, Backhoe, Hand Tools, Photoionization Detector, barrels, 42” traffic cones, snow fencing, telescoping poles, temporary chain link fence, ladders, shovels, digging bars, power tools (cut-off saw), Two-way radios, Sheeting, Trench box, Retractable lanyard, Harness

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around equipment in motion and outside the swing/tip radius.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Pre-Clearance Protocol.	**1a. CONTACT:** Damage to underground utility.	1a. Confirm that (if applicable) “Call Before You Dig” and local utility companies were contacted prior to trenching in order to confirm utility mark outs. Must have a case # before digging.
	1b. ENERGY SOURCE/CONTACT: Property damage; Pressurized water mains may cause lacerations or broken bones. Pressurized gas mains may explode causing serious injury, or death. Underground electric may cause severe burns, shock, or death.	1b. Pre-clearing of the trenching location must be conducted to a minimum of 5 vertical feet below the ground surface (10 feet minimum for Critical Zone) using hand tools (shovel and non-metallic dig bar) prior to trenching. Supervisor should be contacted to discuss appropriate pre-clearing depth. Complete subsurface clearance checklist.
	1c. FALL: Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones.	1c. Be aware of the conditions when walking or loading equipment and working. Walk within established pathway avoiding uneven surfaces. Remove potential slip/trip/fall hazards.
2. Set up work zone.	**2a. CONTACT/CAUGHT:** Cuts/lacerations from equipment. Broken bones from contact by vehicle.	2a. Isolate work area from hazards with cones, barricades, and snow fencing, telescoping poles or temporary chain link fence. Utilize a flag person when necessary (i.e., third party traffic in area). Install traffic signs in roadways and for detours. Spotters will maintain and enforce exclusion zone.
	2b. FALL: Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones.	2b. See 1c.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.
[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards, energy source; Energy Source – electricity, pressure, compression/tension.
[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Trenching Activity.	**3a. CONTACT:** Serious injury including broken bones, muscle strains or tears, and possibly death due to contact with machine. **3b. FALL:** Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones **3c. EXPOSURE:** Noise, Dust, Concrete- Asphalt, petroleum hydrocarbon vapors may cause damage to ears and lungs	3a. Spotter(s) required for all heavy equipment operation. No worker shall be allowed inside the exclusion zone or along the trench/excavation area while any equipment is in operation. A minimum exclusion zone greater than the length of the equipment boom must be established. Workers only allowed in exclusion zone if the operator is in “Hands Off “mode. Operator will not operate equipment until worker is out of exclusion zone. Spotters and operators will have radios for communication, when either loses sight of one another, and/or in case of emergency. 3b. Any trench/excavation deeper than 3’ must have a ladder within 25’ of any worker in the excavation. At least 3‘(rungs) of the ladder shall be above the top of the excavation. All spoil piles shall be maintained 2’ minimum from edge of excavation. 3b. Any trench/excavation deeper than 6’ must have fall protection, retractable lanyard for ladder use, and 42” high guardrails along the edge of the trench/excavation. 3c. Air monitoring using a calibrated photoionization detector (PID) will be used to monitor the breathing zone of the work area. If a reading of >5ppm is recorded, the oversight personnel must temporarily cease work and instruct all Site personnel to step away from the area of elevated readings.
4. Setting Trench protections if necessary.	**4a. CAUGHT:** Injury due to contact with failed trench, may include muscle strains or tears, abrasions or lacerations, broken bones and possibly death. **4b. CONTACT/CAUGHT:** Injury due to rigging activities and entering exclusion zone during lifting and/or transport of shoring/trench box/material may include muscle strains or tears, abrasions or lacerations, broken bones and possibly death. **4c. FALL:** Possible injury due to fall into excavation may include muscle strains or tears, abrasions or lacerations, or broken bones.	4a. To prevent cave-ins and avoid caught by/between, excavations over 4’ in depth, unless working in stable rock, shall have engineer approved shoring, sheeting or trench box. Top of protection shall be at least 2’ above top of excavation. 4b. Use only inspected rigging with 2, 3 or 4 lift points; wear cut-resistant gloves. Rigging to be hooked up to factory installed hook up points on equipment. Control load with non-conductive tag lines with workers out of exclusion zone. Don’t stand underneath suspended load; wear steel toed boots and hard hat. 4c. Shoring to be set and sides will be backfilled to avoid fall hazards before workers are allowed to enter area. Operator will be in “HANDS OFF” mode before workers enter work area to unhook rigging. An inspected ladder extending 3’ above top of the shoring will be used to enter and exit the shoring. Workers will use three points of contact when using the ladder.
5. Secure/Leave Site. If backfilling, see excavation backfilling and compaction JSA for potential hazards and critical actions.	**5a. FALL:** Potential Slip, Trip or Fall - may cause muscle strains or tears, abrasions or lacerations, or broken bones.	5a. See 1c. 5a. All open excavations must be backfilled or secured prior to departure with steel plates, orange construction fence or temporary chain link fencing.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-019**	DATE: 8/6/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Site Walk and Inspection**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Sara Barrientos	Staff Geologist	Brian Hobbs	Corporate Health and Safety Manager
		Joe Duminuco	Vice President

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION: ear plugs as necessary ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: High-visibility vest or high-vis outerwear	☒ GLOVES: Leather/cut-resistant/chemical resistant ☒ OTHER: Tyvek and rubber boots as necessary, dust mask as necessary

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Site map, emergency contact list, documentation of urgent care/hospital routes and / or guide familiar with Site, operating cell phone or walkie-talkie if Site allows.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE (EZ): A minimum 10' exclusion zone will be maintained around equipment.

SITE SECURITY: Prior to site inspection verify appropriate method to address Site Security concerns as it relates to potential criminal activity, homeless population, and/or isolation concerns. Work with the Project Principal and/or Project Manager to address appropriately.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Check in with Site contact.	**1a. CONTACT/EXPOSURE/FALL:** Personal injury caused by lack of site specific hazards.	1a. Inquire about hazards and other activities taking place at the Site. 1a. Inform Site contact of work scope, timeline and location(s). 1a. Discuss emergency evacuation procedures and muster points with Site contact.
2. Traversing the Site	**2a. CONTACT:** Property damage and personal injury caused by obstructions/vehicles or unauthorized personnel at remote Sites.	2a. All equipment must be stowed and secured prior to moving. 2a. Maintain speed limit as posted on-site. 2a. When possible drive on established roadways. 2a. Yield to all pedestrians. 2a. Use pull-through spots or back into parking spots. 2a. Don high visibility clothing/safety vest. If working at remote Site, add orange accessories during hunting season.
	2b. FALL: Uneven terrain and weather conditions. Overgrown shrubs and vines. Equipment in the work zone.	2b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 2b. When possible, use established pathways and walk on stable, secure ground. 2b. Communicate traversing hazards with others.
	2c. OVEREXERTION: Muscle strain while carrying equipment.	2c. When carrying equipment to/from work area, use proper lifting techniques; keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Use mechanical assistance or make multiple trips to carry equipment.
	2d. EXPOSURE: Biological hazards – ticks; bees/wasps; poison ivy; insects; (Ticks are most active any time the temperature is above freezing, typically from March to November.)	2d. Inspect area to avoid contact with biological hazards. 2d. Ticks: • Treat outer clothing including pants, shirts, socks, boots and hats the evening before with Permethrin (allowing at least two hours before use). • Apply DEET to exposed skin before travelling to the Site and reapply after two hours. • Check for ticks during and after work. 2d. Bees: • Use bee spray as appropriate to deter/eliminate bees. • Protect exposed skin with insect repellent. 2d. Poison Ivy:

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

	2e. EXPOSURE: Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	• Identify areas of poison ivy and spray with weed killer. Don Tyvek and rubber boots while traversing poison ivy areas. • If skin contacts poison ivy, wash skin thoroughly with soap and water. 2e. Wear sunscreen with SPF 15 or greater on exposed skin whenever 30 minutes or more of sun exposure is expected. 2e. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 2e. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 2e. Wear appropriate rain gear as needed. 2e. Take frequent breaks if tired, wet, or cold/hot. Drink water. 2e. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
3. Walking near heavy equipment and machinery.	**3a. CONTACT:** Personal injury from Site and roadway traffic. Personal injury from flying debris **3b. OVEREXERTION:** Personal injury from lifting/moving/rotating equipment. **3c. EXPOSURE:** Hearing damage from noise generating equipment/processes. Inhalation/exposure to hazardous vapors and or dust. **3d. EXPOSURE:** Working in a remote area.	3a. See 2a. 3a. Maintain an exclusion zone of at least 10'-25' feet from all engaged equipment. 3a. Keep body parts out of the line of fire of pinch points. 3a. Wear appropriate PPE always. 3b. See 2c. 3c. Wear hearing protection if >85 dBA. (i.e. noise levels which require you to raise your voice to communicate) 3c. Always wear leather gloves when handling any tools or equipment. 3c. Always wear appropriate PPE based off chemicals present. 3d. Use the "buddy system" whenever possible. If working alone, contact PM upon arrival/departure, as well as during work activities prior to commencing work if applicable. 3d. Always carry a communication (i.e., cell phone, walkie-talkie) or directional (i.e., map, compass, etc.) device when traversing remote areas.
4. Working in adverse weather conditions.	**4a. EXPOSURE:** Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	4a. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 4a. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 4a. Wear appropriate rain gear as needed. 4a. Take frequent breaks if tired, wet, or cold/hot. Drink water. 4a. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
5. Departing Site.	**5a. EXPOSURE:** Exposure to unnecessary hazards should personnel believe Roux is on-Site during an emergency and conduct a search.	5a. Sign out or notify Site contact and Roux Project Manager of your departure.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-019**	DATE: 8/6/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Site Walk and Inspection**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Sara Barrientos	Staff Geologist	Brian Hobbs	Corporate Health and Safety Manager
		Joe Duminuco	Vice President

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION: ear plugs as necessary ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: High-visibility vest or high-vis outerwear	☒ GLOVES: Leather/cut-resistant/chemical resistant ☒ OTHER: Tyvek and rubber boots as necessary, dust mask as necessary

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Site map, emergency contact list, documentation of urgent care/hospital routes and / or guide familiar with Site, operating cell phone or walkie-talkie if Site allows.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE (EZ): A minimum 10’ exclusion zone will be maintained around equipment.

SITE SECURITY: Prior to site inspection verify appropriate method to address Site Security concerns as it relates to potential criminal activity, homeless population, and/or isolation concerns. Work with the Project Principal and/or Project Manager to address appropriately.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Check in with Site contact.	**1a. CONTACT/EXPOSURE/FALL:** Personal injury caused by lack of site specific hazards.	1a. Inquire about hazards and other activities taking place at the Site. 1a. Inform Site contact of work scope, timeline and location(s). 1a. Discuss emergency evacuation procedures and muster points with Site contact.
2. Traversing the Site	**2a. CONTACT:** Property damage and personal injury caused by obstructions/vehicles or unauthorized personnel at remote Sites.	2a. All equipment must be stowed and secured prior to moving. 2a. Maintain speed limit as posted on-site. 2a. When possible drive on established roadways. 2a. Yield to all pedestrians. 2a. Use pull-through spots or back into parking spots. 2a. Don high visibility clothing/safety vest. If working at remote Site, add orange accessories during hunting season.
	2b. FALL: Uneven terrain and weather conditions. Overgrown shrubs and vines. Equipment in the work zone.	2b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 2b. When possible, use established pathways and walk on stable, secure ground. 2b. Communicate traversing hazards with others.
	2c. OVEREXERTION: Muscle strain while carrying equipment.	2c. When carrying equipment to/from work area, use proper lifting techniques; keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Use mechanical assistance or make multiple trips to carry equipment.
	2d. EXPOSURE: Biological hazards – ticks; bees/wasps; poison ivy; insects; (Ticks are most active any time the temperature is above freezing, typically from March to November.)	2d. Inspect area to avoid contact with biological hazards. 2d. Ticks: • Treat outer clothing including pants, shirts, socks, boots and hats the evening before with Permethrin (allowing at least two hours before use). • Apply DEET to exposed skin before travelling to the Site and reapply after two hours. • Check for ticks during and after work. 2d. Bees: • Use bee spray as appropriate to deter/eliminate bees. • Protect exposed skin with insect repellent. 2d. Poison Ivy:

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	2e. EXPOSURE: Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	- Identify areas of poison ivy and spray with weed killer. Don Tyvek and rubber boots while traversing poison ivy areas. - If skin contacts poison ivy, wash skin thoroughly with soap and water. 2e. Wear sunscreen with SPF 15 or greater on exposed skin whenever 30 minutes or more of sun exposure is expected. 2e. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 2e. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 2e. Wear appropriate rain gear as needed. 2e. Take frequent breaks if tired, wet, or cold/hot. Drink water. 2e. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
3. Walking near heavy equipment and machinery.	**3a. CONTACT:** Personal injury from Site and roadway traffic. Personal injury from flying debris **3b. OVEREXERTION:** Personal injury from lifting/moving/rotating equipment. **3c. EXPOSURE:** Hearing damage from noise generating equipment/processes. Inhalation/exposure to hazardous vapors and or dust. **3d. EXPOSURE:** Working in a remote area.	3a. See 2a. 3a. Maintain an exclusion zone of at least 10'-25' feet from all engaged equipment. 3a. Keep body parts out of the line of fire of pinch points. 3a. Wear appropriate PPE always. 3b. See 2c. 3c. Wear hearing protection if >85 dBA. (i.e. noise levels which require you to raise your voice to communicate) 3c. Always wear leather gloves when handling any tools or equipment. 3c. Always wear appropriate PPE based off chemicals present. 3d. Use the "buddy system" whenever possible. If working alone, contact PM upon arrival/departure, as well as during work activities prior to commencing work if applicable. 3d. Always carry a communication (i.e., cell phone, walkie-talkie) or directional (i.e., map, compass, etc.) device when traversing remote areas.
4. Working in adverse weather conditions.	**4a. EXPOSURE:** Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	4a. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 4a. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 4a. Wear appropriate rain gear as needed. 4a. Take frequent breaks if tired, wet, or cold/hot. Drink water. 4a. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
5. Departing Site.	**5a. EXPOSURE:** Exposure to unnecessary hazards should personnel believe Roux is on-Site during an emergency and conduct a search.	5a. Sign out or notify Site contact and Roux Project Manager of your departure.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-009**	DATE: 1/4/2018	☐ NEW ☒ REVISED	PAGE 1 of 1

JSA TYPE CATEGORY **Generic**	WORK TYPE **O&M**	WORK ACTIVITY (Description) **Movement of 55-Gallon Drums/Drum Handling with Mobile Carrier**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Michael Sarni	Technician	Brian Hobbs	Senior Health & Safety Manager
		Joe Gentile	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES: Cut-resistant gloves
☒ HARD HAT	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	☐ OTHER:
☐ LIFELINE / BODY HARNESS	☐ HEARING PROTECTION	☒ PPE CLOTHING: Fluorescent long sleeve shirt or long sleeve shirt and reflective safety vest.	
☒ SAFETY GLASSES	☒ SAFETY SHOES: Steel or composite toe		

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Mobile Drum Carrier, safety cones, and caution tape

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around heavy equipment (i.e. forklift).

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Preparing for and Inspection of Drum	**1a. FALL:** Tripping/falling due to uneven surface. Loose debris/garbage in work area.	1a. Clear area of loose garbage and debris. Inspect 55-gal drums for proper condition, labeling, check drum ring and bolts for tightness, inspect mobile drum carrier. 1a. Do a Test Lift to get a general sense of the weight of the drum. 1a. Inspect and use established pathways to avoid uneven terrain, weather-related hazards (i.e., debris, puddles, ice, etc.), and other obstructions. 1a. Secure work area and coordinate and communicate the planned work activities with other personnel working in the area. 1a. Delineate work area with 42” safety cones.
	1b. CONTACT/EXPOSURE: Drums could potentially be damaged or contain hazardous material. Mobile drum carrier could potentially be in poor working condition causing malfunctioning during operation.	1b. Prior to inspecting drums don cut-resistant gloves. If drum is not properly labeled, do not open and cease all drum transport activities. Immediately contact project manager and inform him/her of drum situation. 1b. Do not continue drum transport activities until further actions are determined by the project manager. 1b. If the drum is properly labeled, but leaking, improperly sealed or in poor condition, place drum in an over-pack drum. 1b. Inspect mobile drum carrier to ensure its overall integrity. Look for rust marks or potential weak points where the drum carrier could malfunction. Inspect the wheels to ensure that they easily turn and nothing is impeding their movement.
	1c. EXERTION/CAUGHT: Potential pinching/exertion hazards while securing ring/ tightening bolts	1c. Keep back straight and knees slightly bent while securing drum ring/tightening bolt. Wear cut-resistant gloves.
2. Position drum clamp tightly in between drum ribs, securing drum clamp to drum with chain	**2a. CAUGHT:** Pinching fingers between drum clamp and handle/chain.	2a. Attach drum clamp with chain and tighten until snug. Do not place hands between drum clamp and drum as the chain is tightened; wear cut resistant gloves. Keep face away from drum when handling in case of escaping vapors.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Disengage safety latches on handle, pull handle down until drum is lifted off ground and safety latches are reengaged; slightly suspending drum off the ground	**3a. EXERTION/ CONTACT:** Potential muscle strain associated with lifting/engaging drum/handle. Drum could shift/slip downward and crush toes. **3b. CAUGHT:** Fingers could be pinched while engaging/disengaging safety latches on handle	3a. Ascertain whether the drum is overweight; if it is, then two people are needed to lower handle while drum is secured with clamp so that safety latches can be engaged. Keep body out of the line of fire of the handle (do not position head above handle) as it is being pushed down. Do not allow feet/toes to be positioned under the drum as it is being lifted; wear steel/composite toe boots. 3b. Wear cut-resistant gloves while disengaging/reengaging safety latches. 3b. Avoid placing hands in pinch points.
4. Transport drums to designated location and disengage drum clamp (repeat Step 3 in reverse order)	**4a. FALL:** Tripping/ falling due to obstructions and uneven terrain. Potential for drum to fall during transport.	4a. Ensure transport path is free of potential obstructions that may cause the drum/carrier to become unstable. Position drum clamp between the ribs on the drum to prevent possible slipping.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-015**	DATE: 1/4/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Mobilization/Demobilization**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Rebecca Lowy	Staff Assistant Geologist	Brian Hobbs	Senior Health & Safety Manager
Tally Sodre	OHSM	Joe Gentile	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION (as needed) ☒ SAFETY SHOES: Steel Toe or composite toe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest of high-visibility clothing; long sleeve shirt; long pants	☒ GLOVES: Leather, nitrile, and cut resistant (as needed) ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: None

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around equipment in use..

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Mobilize/demobilize and establish work area	**1a. FALL:** Slip/trips/falls from obstructions, uneven terrain, weather conditions, heavy loads, and/or poor housekeeping.	1a. Use 3 points-of-contact/ensure secure footing when entering and exiting vehicle. 1a. Inspect walking path for uneven terrain, steep hills, obstructions, and/or weather-related hazards (i.e., ice, snow, and puddles) prior to mobilizing equipment. Use established pathways. Walk on stable/secure ground. 1a. Do not climb over stored materials/equipment; walk around. Practice good housekeeping; organize and store equipment neatly in one area at its lowest potential energy. 1a. Wear boots with adequate treads. 1a. Delineate unsafe areas with 42” cones, caution tape and/or flagging.
	1b. CONTACT: Personal injury and/or property damage caused by being struck by Site traffic or equipment used in Site activities.	1b. Observe and maintain the posted speed limits. 1b. When first arriving onsite, park vehicles in designated parking space and/or out of the way locations. Use parking brake on all vehicles and tire chocks on work trucks and trailers. 1b. Check in with Site Manager/Supervisor to ensure coordination with other Site activities and to discuss any special hazards. Ensure that short-service employees (SSE) are identified. 1b. Identify potential traffic sources. 1b. Wear PPE including high visibility clothing or reflective vest. 1b. Use a spotter while moving work vehicles; plan ahead to avoid backing whenever possible. 1b. Maintain a minimum 10’ exclusion zone when vehicles are in motion. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver-to-spotter visibility. 1b. Delineate work area with 42” cones, flags, caution tape, and/or other barriers. 1b. Position “Work Area” signs at Site entrances, if possible, or at either side of work area.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
		1b. Position largest vehicle to protect against oncoming traffic. 1b. Face traffic, maintain eye contact with oncoming vehicles, use a spotter, and establish a safe exit route. 1b. Observe potential overhead and ground surface features that may interfere with moving equipment. Clear the path of physical hazards prior to initiating mobilization.
	1c. CAUGHT: Personal injury from pinch points and being in line-of-fire of vehicle and/or equipment.	1c. Make sure driver has engaged parking brake and placed wheel chocks in a position to prevent movement. Be sure that vehicle is parked in front/down gradient (positioned to best block oncoming traffic) of work area. 1c. Wear leather gloves when handling any tools or equipment. Wear cut-resistant gloves (Kevlar or similar) when handling sharp objects/cutting tools/glass. 1c. Keep body parts away from line-of-fire of equipment. 1c. Always carry tools by the handles and/or designated carrier. Ensure sharp-edged tools are sheathed/secure. 1c. Remove any loose jewelry. Avoid wearing loose clothing and/or ensure loose clothing is secure. 1c. Secure all items on the equipment, tighten up any items or features that have potential to shift or break during mobilization.
	1d. OVEREXERTION: Muscle strains while lifting/carrying equipment.	1d. Use body positioning and lifting techniques that avoid muscle strain; keep back straight, lift with legs, turn with whole body, keep load close to body, and never reach with a load. 1d. Ensure that loads are balanced. Use assistance (mechanical or additional person) to carry equipment that is either unwieldy or over 50 lbs.
	1e. EXPOSURE: Personal injury from exposure to biological and environmental hazards.	1e. Inspect area to avoid contact with biological hazards (i.e. poisonous plants, stinging insects, ticks, etc.). 1e. Wear long sleeved clothes treated with Permethrin, apply insect repellant containing DEET to exposed skin, and inspect clothes and skin for ticks during and after work. 1e. Apply sunscreen (SPF 15+) if exposure to sun for 30 minutes or more is expected.
	1f. EXPOSURE: Weather related injuries.	1f. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, nausea, rapid and shallow breathing). Take breaks in cool places and hydrate as needed. 1f. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks in warm areas as needed. 1f. Wear clothing appropriate for weather and temperature conditions (e.g., rain jackets, snow pants, multiple layers). 1f. If lightning is observed, wait 30 minutes in a sheltered location (car is acceptable) before resuming work.
	1g. EXPOSURE: Personal injury from noise hazards.	1g. Wear hearing protection if sound levels exceed 85 dBA (if you must raise your voice for normal conversation).

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JOB SAFETYANALYSIS **Ctrl. No. GEN-020**	DATE: 1/4/2018	☐NEW ☒REVISED	PAGE 1 of 2
JSA TYPE CATEGORY: **GENERIC**	WORK TYPE: **Gauging & Sampling**	WORK ACTIVITY (Description): **Soil Sampling**	

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
MaryBeth Lyons	Project Scientist	Brian Hobbs	Senior Health & Safety Manager
		Joe Gentile	Corporate Health and Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☒ FLAME RESISTANT CLOTHING (as needed)
☐ GOGGLES
☐ FACE SHIELD:
☒ HEARING PROTECTION: (as needed)
☒ SAFETY SHOES: Composite-toe or steel toe boots
☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing
☒ GLOVES: Leather, Nitrile and cut resistant
☒ OTHER: Insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Recommended Equipment: 42” traffic cones, caution tape, trowel

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs.

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around moving equipment, if present.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Secure location	**1a. CONTACT:** Personnel and vehicular traffic may enter the work area.	1a. If in an area with foot or vehicle traffic, delineate the work area with 42” traffic cones and/or caution tape to prevent exposure to traffic and inform others of work activity. 1a. Wear reflective vest and/or high visibility clothing. 1a. Face the direction of any vehicular traffic. Position vehicle to protect worker from traffic. 1a. Communicate work activity with adjacent work areas.
	1b. FALL: Tripping/falling due to uneven terrain or entry/exit from excavations.	1b. Inspect pathways and work area for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions. 1b. Use established pathways and walk on stable, secure ground. 1b. Stage equipment and tools in a convenient, stable, and orderly manner. Store equipment at lowest potential energy. 1b. Roux employees should stay 5 feet from in-progress excavations and trenches. Should entry to an excavation be required (when stabilization is complete), ladders must be employed for steep embankments, excavations, pits, and trenches.
	1c. EXPOSURE: Exposure to sun and excessive heat, possibly causing sunburn, heat exhaustion or heat stroke. Exposure to cold temperatures possibly causing cold stress. Skin burn as a result of fire, if applicable. Exposure to explosive vapors due to tank farm operations. Exposure to airborne dust due to high wind speeds. Biological hazards - ticks, bees/wasps, poison ivy, thorns, insects, etc.	1c. Wear sunscreen with an SPF 15 or greater whenever 30 minutes or more of exposure is expected. 1c. Use a tent to shade the work area from direct sunlight particularly when warm temperatures are expected. 1c. Be aware of the location of all Site personnel. 1c. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). 1c. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). 1c. Take breaks for rest and water as necessary. Move to an area that is well shaded or a climate controlled area (i.e., car, site trailer, etc.). 1c. No open flames/heat sources. 1c. Flame retardant clothing must be worn when specified by Site policy. 1c. Cell phones should be disabled when specified by Site policy. 1c. Pre-treat field clothing with Permethrin prior to site visit to kill ticks and insects. 1c. Wear long sleeved shirts and tuck in (or tape) pant legs into socks or boots to prevent ticks from reaching skin. 1c. Spray insect repellant containing DEET on exposed skin when working in overgrown areas of the Site. 1c. Inspect area to avoid contact with biological hazards. 1c. Wear cut-resistant gloves when handling branches, shrubs, etc. that may lie within the walking path. 1c. Wear spoggles if the average wind speeds are above 15 mph. 1c. Personnel shall examine themselves and co-worker’s outer clothing for ticks periodically when onsite. 1c. If skin comes in contact with poison ivy, wash skin thoroughly with soap and water. If rash persists after washing, immediately notify your supervisor, the OM and OHSM for possible consultation with a physician at an approved Occupational Health Clinic.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
2. Collect Soil Sample	**2a. CONTACT:** Personal injury from pinch points, cuts, and abrasions from sampling equipment tools, and material within soil sample. Personal injury from contact with moving equipment while sampling. Personal injury from contact with glass sample jars.	2a. Wear cut-resistant (i.e., Kevlar) gloves under chemical-resistant (nitrile) disposable gloves when handling soil samples and sampling jars. 2a. Where possible, use trowel or equivalent tool to avoid contact with soil. 2a. If sampling from bucket of heavy equipment, ensure all equipment is off and operator utilizes the “show me your hands” policy. 2a. See 1a.
	2b. EXPOSURE: Exposure to contamination (impacted soil) and/or lab preservatives.	2b. Wear chemical-resistant (nitrile) disposable gloves over cut resistant gloves to protect hands when handling samples; use containment material or plastic sheeting to protect surrounding areas. 2b. Wear safety glasses to protect eyes from dust or air-borne contaminants that may results from disturbing the soil. 2b. Where possible, remain upgradient from sample location if collecting soil sample from stockpile, drill rig, etc. to avoid breathing contaminant vapors, if they are present. 2b. When collecting soil sample from hand auger, put large zip lock bag over entire auger to prevent spillage of soil on to the ground. 2b. Open sample jars slowly and fill carefully to avoid contact with preservatives.
	2c. EXERTION: Exertion due to repetitive motion and ergonomics.	2c. Utilize a table or raised surface for soil sampling if multiple soil samples are going to be taken to minimize repetitive bending motion.
3. Decontaminate equipment	**3a. EXPOSURE/CONTACT:** Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated vapors and/or soil).	3a. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3a. Use an absorbent pad to clean spills. 3a. Properly dispose of used materials/PPE in provided drums in designated drum storage area. 3a. Remain upwind of sample and avoid breathing contaminant vapors, if they are present.
	3b. EXPOSURE: Chemicals in cleaning solution including ammonia.	3b. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3b. Work on the upwind side of decontamination area. 3b. Use an absorbent pad to clean spills. 3b. Properly dispose of used materials/PPE in provided drums in designated drum storage area. Ensure that all drums are properly labeled and secured.

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APPENDIX B

SDSs for Chemicals Used

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer	**Supplier**
Alconox, Inc. 30 Glenn Street White Plains, NY 10603 1-914-948-4040	Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:

Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:
Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:
Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection

8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.

Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD. QTY:** None

US DOT
Limited Quantity Exception: None

Bulk:	Non Bulk:
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards** :	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

14.8 Transport/Additional information:

Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

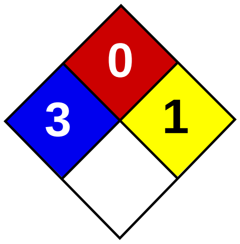
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

NFPA: 1-0-0

HMIS: 1-0-0



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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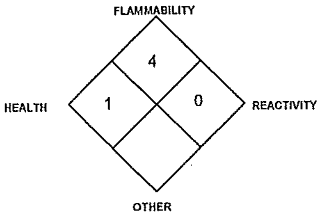
MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

NFPA RATING



PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS:	**ISOBUTYLENE - C_4H_8** Document Number: Isobutylene
PRODUCT USE:	For general analytical/synthetic chemical uses.
SUPPLIER/MANUFACTURER'S NAME: ADDRESS:	MESA Specialty Gases & Equipment 3619 Pendleton Avenue, Suite C Santa Ana, CA 92704
BUSINESS PHONE: EMERGENCY PHONE:	1-714-434-7102 INFOTRAC: 1-800-535-5053
DATE OF PREPARATION:	May 10, 1999

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Isobutylene	115-11-7	> 99.0%	There are no specific exposure limits for Isobutylene. Isobutylene is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					
Maximum Impurities		< 1.0%	None of the trace impurities in this mixture contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established C = Ceiling Limit See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Isobutylene is a colorless, liquefied, flammable gas with an unpleasant odor similar to burning coal. The liquefied gas rapidly turns into a gas at standard atmospheric temperatures and pressures. Isobutylene is an asphyxiant and presents a significant health hazard by displacing the oxygen in the atmosphere. Rapid evaporation of liquid from the cylinder may cause frostbite. Both the liquid and gas pose a serious fire hazard when accidentally released. The gas is heavier than air and may travel to a source of ignition and flash back to a leak or open container. Flame or high temperature impinging on a localized area of a cylinder of Isobutylene can cause the cylinder to rupture without activating the cylinder's relief devices. Provide adequate fire protection during emergency response situations.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant route of overexposure for this gas is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

INHALATION: High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of overexposure, death may occur. Isobutylene also has some degree of anesthetic action and can be mildly irritating to the mucous membranes. The effects associated with various levels of oxygen are as follows:

CONCENTRATION	**SYMPTOMS OF EXPOSURE**
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

OTHER POTENTIAL HEALTH EFFECTS: Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH (BLUE)	1
FLAMMABILITY (RED)	4
REACTIVITY (YELLOW)	0
PROTECTIVE EQUIPMENT	B

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

See Section 16 for Definition of Ratings

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. Overexposure to Isobutylene may cause the following health effects:

ACUTE: The most significant hazard associated with this gas is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, headache, dizziness, and nausea. At high concentrations, unconsciousness or death may occur. Contact with liquefied gas or rapidly expanding gases may cause frostbite.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to Isobutylene.

TARGET ORGANS: Respiratory system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO ISOBUTYLENE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant Personal Protective equipment should be worn. Adequate fire protection must be provided during rescue situations.

4. FIRST-AID MEASURES (Continued)

Remove victim(s) to fresh air as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

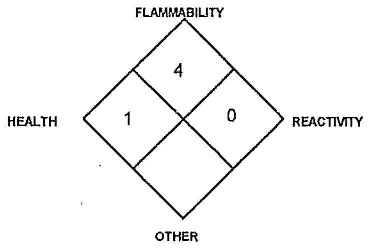
FLASH POINT (Closed Cup): -10°C (< 14°F)
AUTOIGNITION TEMPERATURE: 465°C (869°F)
FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 1.8%
Upper (UEL): 9.6%

FIRE EXTINGUISHING MATERIALS: Extinguish Isobutylene fires by shutting off the source of the gas. Use water spray or a foam agent to cool fire-exposed containers, structures, and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this material may ignite and produce toxic gases, including carbon monoxide and carbon dioxide.

NFPA RATING



See Section 16 for Definition of Ratings

DANGER! Fires impinging (direct flame) on the outside surface of unprotected pressure storage vessels of Isobutylene can be very dangerous. Direct flame exposure on the cylinder wall can cause an explosion either by BLEVE (Boiling Liquid Expanding Vapor Explosion), or by exothermic decomposition. This is a catastrophic failure of the vessel releasing the contents into a massive fireball and explosion. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the vessel. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Static discharge may cause Isobutylene to ignite explosively if released.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. The best fire-fighting technique may be simply to let the burning gas escape from the pressurized cylinder, tank car, or pipeline. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. In this case, increase ventilation (in enclosed areas) to prevent flammable or explosive mixture formation. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Because of the potential for a BLEVE, evacuation of non-emergency personnel is essential. If water is not available for cooling or protection of vessel exposures, evacuate the area. Refer to the North American Emergency Response Guidebook for additional information. Other information for pre-planning can be found in the American Petroleum Institute Publications 2510 and 2510A.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area, protect people, and respond with trained personnel. Adequate fire protection must be provided. Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves resistant to tears, and Self-Contained Breathing Apparatus.**

Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut off with water spray. Allow the gas to dissipate. Monitor the surrounding area for combustible gas levels and oxygen. Combustible gas concentration must be below 10% of the LEL (LEL = 1.8%) prior to entry. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in place or remove it to a safe area and allow the gas to be released there.

THIS IS AN EXTREMELY FLAMMABLE GAS. Protection of all personnel and the area must be maintained.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Isobutylene IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Isobutylene could occur without any significant warning symptoms.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Isolate from oxidizers such as oxygen, chlorine, or fluorine. Use a check valve or trap in the discharge line to prevent hazardous backflow. Post "No Smoking or Open Flame" signs in storage and use areas. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to situations in which cylinders are being used:

Before Use: Move cylinders with a suitable hand truck. Do not drag, slide, or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap, if provided, in place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

After Use: Close main cylinder valve. Replace valve protection cap, if provided. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Isobutylene. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers.* Additionally, refer to CGA Bulletin SB-2 "*Oxygen Deficient Atmospheres*".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Local exhaust ventilation is preferred, because it prevents Isobutylene dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the presence of potentially explosive air-gas mixtures and level of oxygen.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Maintain level of gas below the level listed in Section 2 (Composition and Information on Ingredients). Use supplied air respiratory protection if oxygen levels are below 19.5% or during emergency response to a release of Isobutylene. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards.

EYE PROTECTION: Splash goggles or safety glasses, for protection from rapidly expanding gases and splashes of liquid Isobutylene.

HAND PROTECTION: Wear gloves resistant to tears when handling cylinders of Isobutylene. Use low-temperature protective gloves (e.g., Kevlar) when working with containers of liquid Isobutylene.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well as fire retardant items.

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY @ 21.1°C (70°F): 2.396 kg/m^3 (0.1496 lb/ft^3)
SPECIFIC GRAVITY (air = 1): 1.997
SOLUBILITY IN WATER: Insoluble.
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not established.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
pH: Not applicable.
FREEZING POINT: -140°C (-220.6°F)
BOILING POINT @ 1 atm: -6.9°C (19.6°F)
EXPANSION RATIO: Not applicable
VAPOR PRESSURE (psia): 39
SPECIFIC VOLUME (ft^3/lb): 6.7

APPEARANCE AND COLOR: Colorless gas with the unpleasant odor of burning coal. The liquid is also colorless and has the same unpleasant odor of burning coal.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: When ignited in the presence of oxygen, this gas will burn to produce carbon monoxide and carbon dioxide.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong oxidizers (e.g., chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks, and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is for pure Isobutylene.

ISOBUTYLENE:
LC_{50} (rat, inhalation) = 620 g/m^3/4 hours
LC_{50} (mouse, inhalation) = 415 g/m^3/2 hours

SUSPECTED CANCER AGENT: Isobutylene is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA, and therefore is neither considered to be nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Isobutylene may be mildly irritating to the mucous membranes. In addition, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Isobutylene is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Isobutylene on the human reproductive system.

Mutagenicity: No mutagenic effects have been described for Isobutylene.
Embryotoxicity: No embryotoxic effects have been described for Isobutylene.
Teratogenicity: No teratogenic effects have been described for Isobutylene.
Reproductive Toxicity: No reproductive toxicity effects have been described for Isobutylene.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by overexposure to Isobutylene.

11. TOXICOLOGICAL INFORMATION (Continued)

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treat symptoms and eliminate exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Isobutylene.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen-deficient environments. No adverse effect is anticipated to occur to plant life, except for frost produced in the presence of rapidly expanding gases. See Section 11, Toxicological Information, for additional information on effects on animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of Isobutylene on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to MESA Specialty Gases & Equipment Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

For Isobutylene Gas:
PROPER SHIPPING NAME: Isobutylene
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1055
PACKING GROUP: Not Applicable
DOT LABEL(S) REQUIRED: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115

Alternate Description:
PROPER SHIPPING NAME: Petroleum gases, liquefied
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1075
PACKING GROUP: Not Applicable
DOT LABEL(S) REQUIRED: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115
MARINE POLLUTANT: Isobutylene is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Isobutylene is not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

CANADIAN DSL/NDSL INVENTORY STATUS: Isobutylene is on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Isobutylene is listed on the TSCA Inventory.

15. REGULATORY INFORMATION (Continued)

OTHER U.S. FEDERAL REGULATIONS: Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 lb. Depending on specific operations involving the use of Isobutylene, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Isobutylene is not listed in Appendix A; however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lb (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

U.S. STATE REGULATORY INFORMATION: Isobutylene is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Liquefied Petroleum Gas.
California - Permissible Exposure Limits for Chemical Contaminants: Liquefied Petroleum Gas.
Florida - Substance List: Isobutylene.
Illinois - Toxic Substance List: No.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Isobutylene.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: Liquefied Petroleum Gas.
Missouri - Employer Information/Toxic Substance List: No.
New Jersey - Right to Know Hazardous Substance List: Isobutylene.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: Isobutylene.
Rhode Island - Hazardous Substance List: Liquefied Petroleum Gas.
Texas - Hazardous Substance List: Liquefied Petroleum Gas.
West Virginia - Hazardous Substance List: Liquefied Petroleum Gas.
Wisconsin - Toxic and Hazardous Substances: Liquefied Petroleum Gas.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Isobutylene is not on the California Proposition 65 lists.

LABELING:

DANGER:
FLAMMABLE LIQUID AND GAS UNDER PRESSURE.
CAN FORM EXPLOSIVE MIXTURES WITH AIR.
MAY CAUSE FROSTBITE.

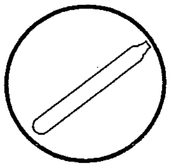
Keep away from heat, flames, and sparks.
Store and use with adequate ventilation.
Cylinder temperature should not exceed 52°C (125°F).
Do not get liquid in eyes, on skin, or clothing.
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

FIRST AID:
IF INHALED, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF FROSTBITE, obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

CANADIAN WHMIS SYMBOLS:
Class A: Compressed Gas
Class B1: Flammable Gas



16. OTHER INFORMATION

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. MESA Specialty Gases & Equipment assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, MESA Specialty Gases & Equipment assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:
ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.
OSHA - U.S. Occupational Safety and Health Administration. **PEL** - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.
IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (OSHA). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:
HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).
NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury).

NATIONAL FIRE PROTECTION ASSOCIATION (Continued): Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:
Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:
Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:
This section explains the impact of various laws and regulations on the material. EPA is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDSL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA or Superfund**); and various state regulations.

SAFETY DATA SHEET

Version 4.20
Revision Date 11/07/2017
Print Date 10/06/2018

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	:	Trizma® base
Product Number	:	T1503
Brand	:	Sigma
CAS-No.	:	77-86-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	:	+1 800-325-5832
Fax	:	+1 800-325-5052

1.4 Emergency telephone number

Emergency Phone #	:	+1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

Not a hazardous substance or mixture.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms	:	2-Amino-2-(hydroxymethyl)-1,3-propanediol THAM Trometamol Tris base Tris(hydroxymethyl)aminomethane
Formula	:	$C_4H_{11}NO_3$
Molecular weight	:	121.14 g/mol
CAS-No.	:	77-86-1
EC-No.	:	201-064-4
Registration number	:	01-2119957659-16-XXXX

No components need to be disclosed according to the applicable regulations.

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions
No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up
Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Hygroscopic. Store under inert gas.
Storage class (TRGS 510): 13: Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls

General industrial hygiene practice.

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

No special environmental precautions required.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: crystalline Colour: colourlesswhite
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	10.5 - 12

e)	Melting point/freezing point	Melting point/range: 168 °C (334 °F)
f)	Initial boiling point and boiling range	288 °C (550 °F) at 1,013 hPa (760 mmHg) - Decomposes below the boiling point.
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	Does not sustain combustion.
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	No data available
n)	Water solubility	678 g/l at 20 °C (68 °F)
o)	Partition coefficient: n-octanol/water	log Pow: -2.31 at 20 °C (68 °F)
p)	Auto-ignition temperature	The substance or mixture is not classified as self heating.
q)	Decomposition temperature	No data available
r)	Viscosity	Not applicable
s)	Explosive properties	Not explosive
t)	Oxidizing properties	The substance or mixture is not classified as oxidizing.

9.2 Other safety information

Bulk density	800 kg/m3
Dissociation constant	8.22 at 25 °C (77 °F)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
hygroscopic

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Nitrogen oxides (NOx)
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - > 5,000 mg/kg
(OECD Test Guideline 425)

Inhalation: No data available

LD50 Dermal - Rat - > 5,000 mg/kg
(OECD Test Guideline 402)

No data available

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation
(OECD Test Guideline 405)

Respiratory or skin sensitisation
Buehler Test - Guinea pig
Does not cause skin sensitisation.
(OECD Test Guideline 406)

Germ cell mutagenicity
Result: Not mutagenic in Ames Test

in vitro assay
Result: negative
In vitro tests did not show mutagenic effects

Result: In vivo tests did not show any chromosomal changes.

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information

Repeated dose toxicity	Rat - Oral - Subacute toxicity - NOAEL : 1,000 mg/kg

RTECS: TY2900000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to daphnia and other aquatic	EC50 - Daphnia (water flea) - > 980 mg/l - 48 h

invertebrates	
Toxicity to algae	EC50 - Algae - 397 mg/l - 72 h
	NOEC - Algae - 100 mg/l - 72 h

12.2 Persistence and degradability

Biodegradability	Result: - Readily biodegradable. (OECD Test Guideline 301F)

12.3 Bioaccumulative potential

No bioaccumulation is to be expected (log Pow <= 4).

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

12.6 Other adverse effects

No data available

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13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

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14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

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15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
No SARA Hazards

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Tris (hydroxymethyl) aminomethane	77-86-1	

	CAS-No.	Revision Date
Tris (hydroxymethyl) aminomethane	77-86-1	

New Jersey Right To Know Components

	CAS-No.	Revision Date

Tris (hydroxymethyl) aminomethane	77-86-1

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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16. OTHER INFORMATION

HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.20 Revision Date: 11/07/2017 Print Date: 10/06/2018

APPENDIX C

COVID-19 Interim Health and Safety Guidance

COVID-19 INTERIM HEALTH AND SAFETY GUIDANCE

CORPORATE HEALTH AND SAFETY MANAGER	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**03/2020**
REVISION DATE	:	**10/08/2020**
REVISION NUMBER	:	**5**

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1. PURPOSE

This guidance has been implemented to establish work practices, administrative procedures, and engineering controls to minimize potential exposure to SARS-CoV-2, the virus that causes COVID-19. The following guidance has been developed based on local, state and federal recommendations/requirements regarding COVID-19. The purpose of this document is to supplement existing site-specific Health and Safety Plans (HASPs) and provide interim health and safety guidance to minimize potential exposure to SARS-CoV-2. Should additional scientific information or regulatory information change, this document shall be updated accordingly.

2. SCOPE AND APPLICABILITY

This guidance covers all Roux employees and the subcontractors that Roux oversees. Site specific HASPs shall be developed to incorporate elements of mitigative measures against COVID-19 exposure. If work cannot be carried out in compliance with this guidance, the project shall be further evaluated by the Project Principal (PP), Office Manager (OM), and Corporate Health and Safety Manager (CHSM) prior to work authorization.

Roux subcontractors are required to review, comply with, and implement Roux's COVID-19 Interim Health and Safety Guidance while on site. Subcontractors may implement additional preventative measures as they see fit. All work shall be conducted in a manner consistent with the federal, state, and local guidance as it relates to COVID-19.

3. BACKGROUND

What is COVID-19?

COVID-19 is a respiratory illness that can spread from person to person. The virus that causes COVID-19 is a novel coronavirus that was first identified during an investigation into an outbreak in Wuhan, China. This virus continues to spread internationally and within the United States. There is currently no vaccine to prevent COVID-19.

What are the symptoms of COVID-19?

Reported illnesses have ranged from mild symptoms to severe illness and death for confirmed COVID-19 cases. Symptoms may appear 2 to 14 days following exposure to the virus. People with these symptoms or combinations of symptoms may have COVID-19:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

This list is not all possible symptoms. The CDC will continue to update this list as they learn more about the virus. For an updated symptom list please reference the following link for CDC Symptoms of Coronavirus.

If someone develops emergency warning signs for COVID-19, they should be instructed to get medical attention immediately. Emergency warning signs can include those listed below; however, this list is not all inclusive. Please consult your medical provider for any other symptoms that are severe or concerning.

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Bluish lips or face

How does COVID-19 spread?[1]

SARS-COV-2 spreads very easily from person to person during close contact.

Individuals who are within close contact (within 6 feet) of a person with COVID-19 or have direct contact with that person are at greatest risk of infection.

- When people with COVID-19 cough, sneeze, sing, talk, or breathe they produce respiratory droplets. These droplets can range in size from larger droplets (some of which are visible) to smaller droplets. Small droplets can also form particles when they dry very quickly in the airstream.
- Infections occur mainly through exposure to respiratory droplets when a person is in close contact with someone who has COVID-19.
- Respiratory droplets cause infection when they are inhaled or deposited on mucous membranes, such as those that line the inside of the nose and mouth.
- As the respiratory droplets travel further from the person with COVID-19, the concentration of these droplets decreases. Larger droplets fall out of the air due to gravity. Smaller droplets and particles spread apart in the air.
- With passing time, the amount of infectious virus in respiratory droplets also decreases.

SARS-CoV-2 can sometimes spread by airborne transmission under certain circumstances.

Some infections can be spread by exposure to virus in small droplets and particles that can linger in the air for minutes to hours. These viruses may be able to infect people who are further than 6 feet away from the person who is infected or after that person has left the space. This kind of spread is referred to as **airborne transmission** and is an important way that infections like tuberculosis, measles, and chicken pox are spread.

- There is evidence that under certain conditions, people with COVID-19 seem to have infected others who were more than 6 feet away. These transmissions occurred within enclosed spaces that had inadequate ventilation. Sometimes the infected person was breathing heavily, for example while singing or exercising.
    - Under these circumstances, scientists believe the amount of infectious smaller droplet and particles produced by the people with COVID-19 became concentrated enough to spread the virus to other people. The people who were infected were in the same space during the same time or shortly after the person with COVID-19 had left.
- Available data indicate it is much more common for the virus that causes COVID-19 to spread through close contact with a person who has COVID-19 than through airborne transmission.[2]

Spread from contact with contaminated surfaces or objects is less common.

Respiratory droplets can also land on surfaces and objects. It is possible that a person could get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or eyes. Spread from touching surfaces is not thought to be a common way that COVID-19 spreads.

4. TRAINING REQUIREMENTS

All employees with potential exposure to COVID-19 shall be provided training that incorporates COVID-19 exposure mitigation strategies, such as implementation of proper social distancing, personal hygiene (e.g., handwashing), as well as disinfection procedures, as outlined by CDC guidelines.

5. EXPOSURE RISK POTENTIAL

Worker risk of occupational exposure to COVID-19 can vary from very high, high, medium, or lower (caution) risk. This level of exposure is dependent on several factors, which can include industry type; need for contact within

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[1] How COVID-19 Spreads https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html#edn1

[2] Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission | CDC https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html

6 feet of people known to be or suspected of being infected with COVID-19; density of work environment; and industrial setting (i.e., healthcare building, occupied interior work area, minimal ventilation).

Provided below is background risk level information taken from the U.S. Department of Labor Occupational Safety and Health Administration Guidance on preparing workplaces for COVID-19. Risk evaluations for each project shall be conducted by the PP and OM in consultation with the CHSM to ensure Roux employees and subcontractors remain within the lower exposure (caution) category. If it is identified there is a medium exposure risk or higher, further evaluation and mitigative measures shall be evaluated to reduce overall exposure risk prior to work authorization.

Very High Exposure Risk (Activities not conducted by Roux)

Very high exposure risk includes occupations/work activities with high potential for exposure to known or suspected sources of COVID-19 during specific medical, postmortem, or laboratory procedures. This can include but is not limited to:

- Healthcare workers (e.g., doctors, nurses, dentists, paramedics, emergency medical technicians) performing aerosol-generating procedures (e.g., intubation, cough induction procedures, bronchoscopies, some dental procedures and exams, or invasive specimen collection) on known or suspected COVID-19 patients.
- Healthcare or laboratory personnel collecting or handling specimens from known or suspected COVID-19 patients (e.g., manipulating cultures from known or suspected COVID-19 patients).
- Morgue workers performing autopsies, which generally involve aerosol-generating procedures on the bodies of people who are known to have, or suspected of having, COVID-19 at the time of their death.

High Exposure Risk (Activities not conducted by Roux)

High exposure risk occupations/work activities include exposure to known or suspected COVID-19 positive individuals. This can include but not limited to:

- Healthcare delivery and support staff (e.g., doctors, nurses, and other hospital staff who must enter patients' rooms) exposed to known or suspected COVID-19 patients. (Note: when such workers perform aerosol-generating procedures, their exposure risk level becomes very high.)
- Medical transport workers (e.g., ambulance vehicle operators) moving known or suspected COVID-19 patients in enclosed vehicles.
- Mortuary workers involved in preparing (e.g., for burial or cremation) the bodies of people who are known to have, or suspected of having, COVID-19 at the time of their death.

Medium Exposure Risk

Medium exposure risk occupations/work activities include those that require frequent and/or close contact with (i.e., within 6 feet of) people who may be infected with COVID-19, but who are not known or suspected to be COVID-19 positive. For most of our worksites, it is assumed there is on-going community transmission for COVID-19. Therefore, workers who work at sites and may have contact with the general public, other contractors, high-population-density work environments (i.e., greater than 10 people) fall within medium exposure risk group category. This can include, but is not limited to, sampling events that require two or more workers to collect and log samples in close contact or work occurring in an interior space with limited ventilation and several workers present.

Lower Exposure Risk (Caution)

Lower exposure risk (caution) occupations/work activities are those that do not require contact with people known to be or suspected of being COVID-19 positive. During these activities, there is limited contact (i.e., within 6 feet of) the general public or other workers. Workers in this category have minimal occupational contact with the public and other coworkers. This can include construction oversight that does not require close contact as well as sampling or gauging events performed by one worker.

6. COVID-19 HEALTH SCREENING

6.1. Roux Employees

All Roux employees are required to self-attest to a COVID-19 Daily Health Questionnaire which is to be completed at home through a mobile application on scheduled workdays. The purpose of this program is to ensure business continuity as well as mitigate any potential exposure to our employees and others if it is determined employees are at-risk for contracting COVID-19. As part of this self-attestation, all employees are required to take their temperatures daily at home to confirm they do not have a fever ($\geq$ 100.4). Employees who answer yes to any of these questions are instructed to contact their Office Manager and/or Department Head immediately and should not enter the office or go to a field site. Information shall be used to determine appropriate internal response in consultation with the Human Resources Director and Corporate Health and Safety Manager.

Below, you will find our COVID-19 Daily Health Questionnaire that all Roux employees are required to self-attest to **every scheduled workday by 9:30 am.** If employees do not promptly fill out the questionnaire by the time listed above, there will be additional follow up by HR, H&S, and/or OMs.

According to the U.S. Centers for Disease Control and Prevention & the World Health Organization, COVID-19 Symptoms include:

- *Fever ($\geq$100. 4^{o}F) or chills*
- *Cough*
- *Shortness of breath or difficulty breathing*
- *Fatigue*
- *Muscle or body aches*
- *Headache*
- *New loss of taste or smell*
- *Sore throat*
- *Congestion or runny nose*
- *Nausea or vomiting*
- *Diarrhea*

Have you experienced any of the COVID-19 related symptoms noted above in the last 14 days? Please Note: We do not expect employees to answer "yes" to the symptoms question if these are symptoms you normally experience due to another condition or medication.

- *Yes*
- *No*

Have you been in close contact with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 14 days? *Close contact is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g., sharing utensils, being coughed on) from an infected person.*

- *Yes*
- *No*

Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 14 days?

- *Yes*
- *No*

Have you tested positive for COVID-19 within the last 14 days?

- *Yes*
- *No*

6.2. Subcontractors

In an effort to mitigate the risk of transmission of COVID-19, Subcontractors who shall perform work on-site are required to attest to the fitness of their work crew on a daily basis. This requires each worker to self-assess by asking themselves the four questions listed in the section above and also contained within the Roux Subcontractor Work Crew COVID-19 Daily Health Attestation. If any crew member answers "yes" to any of the questions, that worker is not to report to the field site and should seek proper medical advice, in accordance with local, state and federal guidelines.

On a daily basis, the subcontractor supervisor must provide the Subcontractor Work Crew COVID-19 Daily Health Attestation complete with the names of all work crew fit to be on the site for that day (i.e., who have answered "no" to all questions on the self-assessment) to Roux's Project Manager. The Subcontractor must notify Roux if there have been any "yes" responses daily. Subcontractors shall not be required to provide the name or any other personal information of any employee who has answered "yes" to any of the self-assessment questions, however, the subcontractor should provide the date and times that employee has been onsite in the prior 14 days. Records shall be maintained within the project files indicating health screening has been performed, records shall be retained for not less than 14 days following the date of submission. The Roux Subcontractor Work Crew COVID-19 Daily Health Check Attestation can be found within Appendix A.

7. SELF-ISOLATION & QUARANTINE

7.1. Self-Isolation

What if I am asked to self-isolate at home and when can I return from home isolation?

Depending on the situation, if you are COVID-19 positive or suspected to have COVID-19, employees may be required to self-isolate in their homes, as per CDC or local health department guidelines. As per CDC guidance, return from isolation has been broken out into two categories. The first includes confirmed or suspected COVID-19 individuals exhibiting symptoms, and the second includes those who have not had COVID-19 symptoms (i.e., asymptomatic), but tested positive and are under self-isolation. Both categories, along with strategies to return from home isolation, are outlined below.

People with COVID-19 under home isolation:

Accumulating evidence supports ending isolation and precautions for persons with COVID-19 using a symptom-based strategy. Specifically, researchers have reported that people with mild to moderate COVID-19 remain infectious no longer than 10 days after their symptoms began, and those with more severe illness or those who are severely immunocompromised remain infectious no longer than 20 days after their symptoms began. Therefore, CDC has updated the recommendations for discontinuing home isolation as follows:

1. **Persons with COVID-19 who have symptoms** and were directed to care for themselves at home may discontinue isolation under the following conditions:
   a. At least 10 days* have passed since symptom onset;
   b. At least 24 hours have passed since resolution of fever without the use of fever-reducing medications; and
   c. Other symptoms have improved.

* *A limited number of persons with severe illness may produce replication-competent virus beyond 10 days, which may warrant extending the duration of isolation for up to 20 days after symptom onset. Consultation with your healthcare provider will be warranted in such cases of severe illness.*

2. **Persons infected with SARS-CoV-2 who never develop COVID-19 symptoms** may discontinue isolation and other precautions 10 days after the date of their first positive RT-PCR test for SARS-CoV-2 RNA.

7.2. Quarantine

Employees may be required to self-quarantine due to potential exposure with a suspected and/or confirmed COVID-19 positive individual as well as recent travel as per local/state guidelines. People in quarantine should stay home, separate themselves from others, monitor their health, and follow directions from their state or local health department. If Roux employees meet the criteria to self-quarantine based on potential exposure/travel, they are required to self-quarantine for 14 days regardless of local/state exemptions. Even if you test negative for COVID-19 or feel healthy, symptoms may still appear 2 to 14 days after exposure to the virus.

7.2.1. Close Contact Quarantine

Employees who have come into close contact with someone who has COVID-19 are required to self-quarantine for 14 days following their last contact with the COVID-19 positive person. Close contact can be defined as being within 6 feet of someone who has COVID-19 for a total of 15 minutes or more, providing care at home to someone who is sick with COVID-19, having direct physical contact with COVID-19 individual, sharing utensils with COVID-19 individual, and being sneezed/coughed on by someone with COVID-19.

7.2.2. Travel Related Quarantine

All travel out of state must be communicated with the OM and/or Department Head prior to departure. Please note, some state/local entities require submissions of traveler health forms. It is expected all Roux employees will comply with such state/local travel requirements. All employees returning from international and/or cruise ship travel must quarantine for 14 days from the time they have returned home.

Personal Travel

Employees who will be traveling out of state are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact on the business. Based on state/local guidelines you may be required to quarantine for 14 days from the time you have returned home.

Work-Related Travel

The Project Team (i.e., PM & PP) and field staff who will be traveling are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact to the business. Additionally, health and safety considerations shall be reviewed by the OM in consultation with the CHSM regarding logistics and overnight accommodations. Based on state/local guidelines, you may be required to quarantine for 14 days from the time you have returned home.

8. WORKPLACE CONTROLS

During the project planning phase, worksite evaluations shall be carried out by the PP and OM in consultation with the CHSM to determine risk exposure levels for work activities. If it is determined there is a medium exposure risk level or higher, additional workplace controls shall be evaluated and implemented as required in addition to the basic infection prevention measures outlined below in Section 8. Additional workplace controls can include engineering controls (i.e., ventilation, physical barriers), administrative controls (i.e., minimizing contact between workers, rotating shifts, site specific training), and additional personal protective equipment (i.e., respiratory protection). If exposure risk cannot be mitigated, potential project postponement may be necessary at the discretion of the OM in consultation with the CHSM.

A Job Safety Analysis (JSA) has been developed and is provided in Appendix B, which summarizes and applies concepts within this guidance including the infection prevention measures listed below. This JSA shall be required for all field work in areas where there is community-based transmission of COVID-19.

9. INFECTION PREVENTION MEASURES

The following is basic infection prevention and personal hygiene practices which shall be implemented for all Roux field activities as well as in the office setting.

- ***Personal Hygiene***
    - Wash your hands often with soap and water for at least 20 seconds.
        - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% ethanol or 70% isopropanol.
        - Key times to wash your hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
    - Do not touch your eyes, face, nose and mouth with unwashed hands.
    - Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow.
    - Throw potentially contaminated items (e.g., used tissues) in the trash.
- ***Avoid Close Contact/Secondary Contact with People and Potentially Contaminated Surfaces***
    - Apply appropriate social distance (6+ feet).
    - Stop handshaking—use and utilize other noncontact methods for greeting.
    - Do not work in areas with limited ventilation with other Site workers (e.g., small work trailer which lacks HVAC system). If working in a trailer, the following conditions must be met: limited to 4 workers, large enough to have the ability to apply social distance and has open windows and/or operational HVAC to ensure proper ventilation of the workspace.
    - Morning tailgate/safety meetings shall occur outside and not within work trailers.
        - Do not require employees or subcontractors to sign in using the same tailgate form. The Site Supervisor/SHSO should record names of those in attendance on the form.
        - If the Site has more than 10 workers, separate tailgate meetings should be performed in smaller groups.
    - Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g., nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically.
    - If receiving labware or other equipment disinfect to the extent feasible. If there are concerns for contaminating labware please wear appropriate PPE (e.g., gloves) to minimize contact.
    - Contact your lab/equipment vendor to confirm equipment is properly disinfected prior to being shipped.
    - Do not carpool with others (e.g., clients, coworkers).
    - For company owned vehicles limit sharing of vehicles with coworkers. If unable to limit sharing of company owned vehicles, properly disinfect vehicle before driving with a focus on commonly touched surfaces (e.g., steering wheels, shifters, buttons, etc.).
    - Use caution when using public restrooms, portable toilets. Use paper towel as a barrier when touching door handles and faucets.
- ***Cleaning and Disinfecting***
    - Clean and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, sinks, and field equipment (i.e., photo-ionization detector, field equipment).
    - **Hard (Non-porous) Surfaces**
        - If surfaces are dirty, they should be cleaned with a detergent/soap and water prior to disinfection.

        - Refer to the manufacturer's instructions to ensure safe and effective use of the product and wear appropriate personal protective equipment (e.g., gloves, safety glasses, face shield).
        - Many products require:
            - Keeping surface wet for a period of time (i.e., contact time)
                - Refer to manufacturer's instructions outlining adequate contact time.
            - Precautions such as wearing gloves and making sure you have good ventilation during use of the product.
        - Disposable gloves should be removed aseptically and discarded after cleaning. Wash hands immediately following removal of gloves. Refer to Appendix C for how to remove gloves aseptically.
        - For disinfection, diluted household bleach solutions, alcohol solutions with at least 70% alcohol, and most common EPA-registered household disinfectants should be effective.
            - Diluted household bleach solutions can be used if appropriate for the surface. Follow manufacturer's instructions for application and proper ventilation. Check to ensure the product is not past its expiration date. Never mix household bleach with ammonia or any other cleanser. Unexpired household bleach will be effective against coronaviruses when properly diluted. Leave the solution on the surface for at least 1 minute.
                - Prepare a bleach solution by mixing:
                    - 5 tablespoons (1/3 cup) bleach per gallon of water or
                    - 4 teaspoons bleach per quart of water
        - Products with EPA-approved emerging viral pathogen claims are expected to be effective against COVID-19. Follow the manufacturer's instructions for all cleaning and disinfecting products (e.g., concentration, application method and contact time, etc.).
    - **Soft (Porous) Surfaces**
        - For soft (porous) surfaces, remove visible contamination if present and clean with appropriate cleaners indicated for use on the surfaces. After cleaning:
            - Launder items as appropriate in accordance with the manufacturer's instructions. If possible, launder using the warmest appropriate water setting for the item and dry items completely; or
            - Use products with the EPA-approved emerging viral pathogens that claim they are suitable for porous surfaces.
    - **Electronics**
        - For electronics such as tablets, touch screens, keyboards, remote controls, etc. remove visible contamination if present.
            - Follow the manufacturer's instructions for all cleaning and disinfection products.
            - Consider use of wipeable covers for electronics.
            - If no manufacturer guidance is available, consider the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens. Dry surfaces thoroughly to avoid pooling of liquids.
    - ***Linens, Clothing, and Other Items that Go in the Laundry***
        - Although it is unlikely field clothing would become potentially contaminated with COVID-19, it is recommended that field staff regularly launder field clothing following any field event upon returning home.
        - In order to minimize the possibility of dispersing the virus from potentially contaminated clothing, do not shake dirty laundry.
        - Wash items as appropriate in accordance with the manufacturer's instructions. If possible, launder items using the warmest appropriate water setting for the items and dry items completely.
        - Clean and disinfect hampers or other containers used for transporting laundry according to guidance listed above.

10. CLOTH FACE COVERINGS

The CDC recommends the use of cloth face coverings in public settings where other social distancing measures are difficult to maintain, such as grocery stores and pharmacies, and especially in areas of significant community-based transmission. This recommendation is based on recent studies and an understanding that a significant portion of asymptomatic, as well as pre-symptomatic, individuals can shed the virus to others before showing symptoms. Studies indicate that COVID-19 can spread among people interacting in close proximity through speaking, coughing, or sneezing. The purpose of the cloth covering is NOT to provide protection to the wearer, but to protect the wearer from unknowingly infecting others if they are asymptomatic/pre-symptomatic. The use of cloth face coverings is to supplement and NOT replace the existing practices outlined above.

Based on existing studies and on-going recommendations and/or requirements from federal, state, and local entities, Roux is recommending the use of cloth face coverings, when appropriate. Appropriate use is defined when local authorities or clients require the use of cloth face coverings in conjunction with established social distancing, or if an employee elects to use a cloth covering on their own accord. Roux will provide cloth face coverings that shall meet the basic requirements outlined by the CDC guidance.

Cloth Face Coverings should:

- Fit snugly but comfortably against the side of the face;
- Covers your nose and mouth and secure it under your chin;
- Include multiple layers of fabric;
- Allow for breathing without restriction; and
- Be able to be laundered and machine dried with no damage or change to shape.

When donning and doffing the cloth face covering, individuals should avoid touching their eyes, nose, and mouth. Following removal of the cloth face covering, employees should wash their hands immediately using the guidelines described in Section 8 above. Cloth face coverings should be routinely washed depending on the frequency of use.

The CDC does not recommend the use of gaiters or face shields. Evaluation of these face covers is on-going but effectiveness is unknown at this time. Masks with exhalation valves or vents should NOT be worn to help prevent the person wearing the mask from spreading COVID-19 to others (source control).

Note, the cloth face coverings recommended are not surgical masks or N-95 respirators. Those are critical supplies that must continue to be reserved for healthcare workers and other medical first responders, as recommended by current CDC guidance. Should there be a requirement for workers to be in respiratory protection (e.g., full-face respirator w/cartridges, P100, N95 respirators), it shall be addressed during the project pre-planning phase, which includes discussions with the PP and OM in consultation with CHSM.

11. HOTEL SELECTION PROCESS AND OVERNIGHT/REMOTE WORK

Hotel Selection

Due to the current COVID-19 situation, Roux is recommending overnight travel be limited to the extent possible. If there is a project requiring the overnight stay at a hotel, accommodations shall be made only after the hotel and hotel's location have been vetted in accordance with Roux's established guidance as defined below. The Project Team, which includes the Project Manager (PM) and PP along with the OM, in consultation with the CHSM, shall verify the hotel has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the hotel shall include, but are not limited to, measures taken to keep guests safe during their stay, guest room sanitization schedule, training of staff regarding disinfecting protocols using EPA-approved disinfectants, hotel staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial hotel assessment by the Project Team, the OM and the CHSM shall review the hotel assessment findings prior to the CHSM's authorization that the hotel may be used by any Roux employees.

Sample Questions for Evaluating Hotels

1. Is there an established COVID-19 guidance/policy your location is following?
2. What additional measures are being implemented to keep workers and customers safe?; (e.g. signs/placards, social-distancing/mask reminders)
3. Is there a guest room sanitization schedule?
4. Have staff been trained on properly cleaning/disinfecting areas?
5. What types of disinfectants are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Employees staying overnight should abide by the following guidance:

- Ensure you properly disinfect your room upon arrival. This should include a wipe down of all commonly touched surfaces with an approved disinfectant. Use appropriate PPE (e.g., nitrile gloves) when disinfecting surfaces.
- Place the "Do Not Disturb" placard on the room while away and consider limiting hotel housekeeping service to the extent feasible (e.g., not having the room cleaned each day) to minimize potential secondary contact with others.
- Do not spend any more time in hotel common areas (i.e., lobby, hallways, etc.) than is necessary.
- Follow proper Infection Prevention Measures found within Section 8 above.
- Have meals in your hotel room after disinfecting outer package surfaces, as outlined in Section 8 above. Do not eat in public spaces or restaurants.
- If the hotel has a restaurant or café, do not have your meal in a common area; instead order food to be picked up or delivered to your room. If delivered, opt for contactless delivery (left outside the door, delivery person knocks and leaves). Always use your own pen if you need to sign something.
- Employees may also pick up food from takeout locations, order groceries or food for delivery to the hotel. Call local restaurants to order food for delivery (call the hotel lobby for recommendations) or use food ordering apps. Some apps have options for contactless delivery.

12. TRANSPORTATION-RENTAL CARS AND ROUX-OWNED VEHICLES

Rental Cars

Due to the current COVID-19 situation, Roux recommends rental car usage be limited to the extent possible. If there is a project requiring the use of a rental car (e.g. truck/van), accommodations shall be made only after the rental car company and their store's location have been vetted in accordance with Roux's established guidance, as defined below. The Project Team (PM and PP) and OM in consultation with the CHSM shall verify the rental company where you are picking up your vehicle has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the rental car company shall include, but are not limited to, measures to be taken to keep customers safe during pickup/drop-off, rental car disinfection protocols, training of staff regarding disinfecting protocols using EPA-approved disinfectants, rental car company staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial rental car company store assessment by the Project Team, the OM and the CHSM shall review the rental car company assessment findings prior to the CHSM's authorization that the rental car company store may be used by any Roux employees.

Sample Questions for Evaluating Rental Car Companies

1. Is there an established COVID-19 guidance your location is following?
2. What additional measures are being implemented to keep workers and customers safe?
3. Is there a car sanitization schedule?

4. Have staff been trained on properly cleaning/disinfecting vehicles?
5. What types of disinfections are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Upon vehicle pickup, employees shall don nitrile gloves and safety glasses and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

Roux-Owned Vehicles

Due to the current COVID-19 situation, Roux-owned vehicles should be dedicated to individual employees to the extent feasible, and if authorized by the OM. In the case this cannot be accommodated, employees shall don nitrile gloves and safety glasses, and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

APPENDIX A

Roux Subcontractor Work Crew

COVID-19 Daily Health Screening Questionnaire

Subcontractor Work Crew
COVID-19 Daily Health Attestation

Date:

Company Name:

Supervisor Name: Signature:

Project Name:

Site Address:

Number of Workers on site:

Prior to entry onto a field site, the following questions shall be asked by the Subcontractor Supervisor to their work crew.

It is preferred this questionnaire is completed for each individual prior to their arrival at the field site. If the answer to any of these questions is YES, the worker is not to report to the field site and seek proper medical advice, in accordance with CDC Guidelines.

The Subcontractor Supervisor must provide this form on a daily basis to the Roux primary contact for the project and notify Roux of any YES responses.

1. Have you experienced any signs/symptoms of COVID-19 such as fever (≥100.4°F), cough, shortness of breath, chills, fatigue, muscle/body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea/vomiting or diarrhea in the last 14 days?
2. Have you been in close contact* with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 14 days?

*Close contact is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g. sharing utensils, being coughed on) from an infected person.

3. Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 14 days?
4. Have you tested positive for COVID-19 within the last 14 days?

Please list the crew member's names on site for the day.

1.	9.
2.	10.
3.	11.
4.	12.
5.	13.
6.	14.
7.	15.
8.	16.

APPENDIX B

Job Safety Analysis-Working in Areas Affected by COVID-19

JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 04/16/2020	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Fieldwork**	WORK ACTIVITY (Description) **Working in Areas Affected by Coronavirus**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Kristina DeLuca	Health and Safety Specialist	Brian Hobbs	CHSM

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT – In field ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES – In field	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES – Steel/composite toe in fie	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING – High visibility vest in field	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Cloth face covering, nitrile gloves, hand soap, water source, hand sanitizer, disinfectant spray and disinfectant wipes.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

SOCIAL DISTANCING: Maintain 6’ of distance between yourself and all other people at all times. If you do not believe the scope of work can be conducted while maintaining this distance, contact your Project Manager immediately.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Project Preplanning	N/A	• Review and follow COVID-19 CDC, Roux, Client and local orders/protocols. • Ensure all workers are fit for duty - anyone feeling sick should remain at home even if symptoms do not align with COVID-19. If a worker has been in contact with someone potentially positive or positive for COVID-19, contact your Office Manager. • Determine PPE needs and ensure adequate supply of disinfectant wipes/spray, soap and water or hand sanitizer at Site. Due to high demands and limited supply, plan ahead. • Use the minimum number of employees necessary to safely complete the work.
2. Mobilization	**Exposure:** Becoming infected or infecting co-workers	**Personal/Rental/Roux Owned Vehicle** • Do not carpool. • Use the same vehicle every day and do not share with co-workers. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from others. • DO not valet your car or allow others to use your car. If necessary, don nitrile gloves and safety glasses and clean/disinfect all high touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (follow manufacturer’s instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. **Public Transportation** • Public transit should not be used unless absolutely necessary. Consider renting a car rather than taking public transit. If public transit is required, wear appropriate PPE and apply social distancing (6 ft). Use proper donning and doffing procedures for nitrile gloves. Wash hands or use hand sanitizer immediately after. **Hotel Stay (Refer to COVID-19 H&S Guidance for more info)** • If a hotel stay is deemed necessary for the given field work, ensure that you disinfect your room upon initial arrival and returning each day. Disinfect all surfaces of your room with an appropriate disinfectant using nitrile gloves. Use proper donning and doffing procedures for nitrile gloves. • Place the “Do Not Disturb” placard on the room while away and limit housekeeping services to the extent feasible during your stay to minimize the reintroduction and spread of the virus from others. Minimize, or avoid entirely, time spent in hotel common areas (i.e., the lobby, dining areas, gyms, etc.). Wash hands or use hand sanitizer often.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object;
Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards, energy source; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Must occur outside or remotely (i.e. video or conference call). • Maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Do not require employees or subcontractors to sign in, the Site Supervisor shall record names on the attendance form. • If the Site has more than 10 workers, separate tailgate meetings should be performed. • Discuss COVID-19 symptoms with coworkers and subcontractors to ensure fitness for duty. Anyone exhibiting signs or symptoms should be instructed to leave the Site, contact your Project Manager.
4. Site Activities	**Exposure:** Becoming infected or infecting co-workers	• Coordinate field activities at the beginning of the day (i.e. Tailgate meeting) to minimize time spent in crowded spaces or overlap while completing job tasks. • Don cloth face coverings as appropriate. • Apply social distancing (6+ ft) when interacting with others. If anyone comes within 6 ft of you while conducting work and your work prevents you from moving away, politely ask them to move back. If others are unable to move from your space, stop work and leave area. • Do not shake hands or touch others. • Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically (See Appendix B of Roux Interim H&S Guidance for proper glove removal). • If anyone is coughing or sneezing in your vicinity, stop work and leave the area. • Do not work in areas with limited ventilation with others. • Cover your mouth and nose with tissue or paper towel or with your elbow when coughing or sneezing and wash hands or use hand sanitizer immediately after. If sick contact SHSO/PM and leave Site immediately. • Disinfect work surfaces/areas with approved disinfectant you're responsible for (ex: desk, office doorknob, computer, etc.) at least once at the beginning of your shift and at least once at the end of your shift with either sanitizing wipes or disinfectant spray. • Phones should be operated hands free to extent feasible. Sanitize your phone on a regular basis. Disinfection should also take place whenever suspected contaminated material comes in contact with any work surfaces/areas. Wash hands or use hand sanitizer immediately after. • Avoid public spaces and going out to eat by bringing your own lunch to the Site. If performing work in high density urban areas, it is recommended all food must be consumed at or in your vehicle. Wash hands or use hand sanitizer before eating and immediately after.

Primary Infection Prevention Measures

- Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% ethanol or 70% isopropanol. Key times to wash hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
- Do not touch your eyes, face, nose and mouth with unwashed hands.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw potentially contaminated items (e.g. used tissues) in the trash.
- Avoid close contact/secondary contact with people and potentially contaminated surfaces.
    - Apply appropriate social distance (6+ feet).
    - Stop handshaking/touching others and use caution when accessing public spaces.
- Clean and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboard, toilets, sinks and field equipment. If surfaces are dirty, they should be cleaned with soap and water prior to disinfection. If surface cannot be cleaned/disinfected, then wash hands or use sanitizer as soon as possible.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

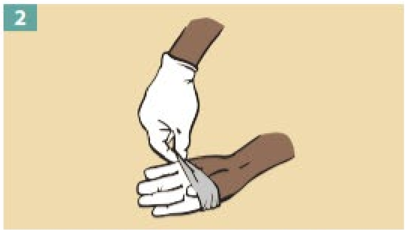
APPENDIX C

How to Remove Gloves

How to Remove Gloves

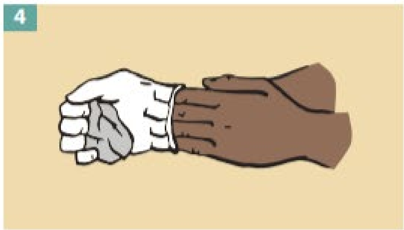
To protect yourself, use the following steps to take off gloves

Grasp the outside of one glove at the wrist.
Do not touch your bare skin.



Peel the glove away from your body,
pulling it inside out.

Hold the glove you just removed in
your gloved hand.



Peel off the second glove by putting your fingers
inside the glove at the top of your wrist.

Turn the second glove inside out while pulling
it away from your body, leaving the first glove
inside the second.

Dispose of the gloves safely. Do not reuse the gloves.

Clean your hands immediately after removing gloves.

APPENDIX D

Personal Protective Equipment (PPE) Management Program

PERSONAL PROTECTIVE EQUIPMENT MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER : **Brian Hobbs, CIH, CSP**

EFFECTIVE DATE : **01/19**

REVISION NUMBER : **4**

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1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following program to establish guidelines for the selection of personal protective equipment (PPE) for use by Roux personnel performing field activities in hazardous environments. PPE is not meant to be a substitute for engineering, work practice, and/or administrative controls, but PPE should be used in conjunction with these controls to protect the employees in the work place. Clothing, body coverings, and other accessories designed to prevent worker exposure to workplace hazards are all types of PPE. To ensure adequate PPE employee-owned PPE is evaluated on a case-by-case basis to insure its adequacy, maintenance and sanitation.

2. SCOPE AND APPLICABILITY

These guidelines apply to all PPE selection decisions to be made in implementing the Roux program. The foundations for this program are the numerous Occupational Health and Safety Administration (OSHA) standards related to PPE cited in 29 CFR 1910 Subpart I, 29 CFR 1926 Subpart E, and the hazardous environment work employee protection requirements under the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and 1926.65. To ensure hazard assessments are documented the levels of protection, types of protection and tasks requiring protection are covered in site-specific Health and Safety Plans (HASPs) and Job Safety Analyses (JSAs).

3. PROCEDURES

Due to the varied nature of site activities and the different potential hazards associated with different sites, several aspects must be considered when selecting PPE. The following text describes PPE selection logic and provides guidelines and requirements for the appropriate selection and use of PPE.

3.1 Introduction

To harm the body, chemicals must first gain entrance. The intact skin and the respiratory tract are usually the first body tissues attacked by chemical contaminants. These tissues provide barriers to some chemicals but in many cases, are damaged themselves or are highly permeable by certain chemical compounds. Personal protective equipment therefore is used to minimize or eliminate chemical compounds coming into contact with these first barrier tissues.

The proper selection of equipment is important in preventing exposures. The PM making the selection will have to take several factors into consideration. The level of protection, type and kind of equipment selected depends on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors must be made before work can be safely carried out.

3.2 Types of PPE

The type and selection of PPE must meet certain general criteria and requirements as required under OSHA 29 CFR 1910.132 and 1926.95. In addition to these general requirements, specific requirements and specifications exist for some types of PPE that form the basis of the protective clothing scheme. Following is a list of the common types of specific PPE and the specific requirements for the PPE type, where applicable:

1. Hard Hats - Regulated by 29 CFR 1910.135 and 1926.100; and, specified in ANSI Z89.1.

2. Face Shields and Safety Glasses - Regulated by 29 CFR 1910.133 and 1926.102; and, specified in ANSI Z87.1.
3. Respiratory Protection - Regulated by 29 CFR 1910.134 and 1926.103.
4. Hand Protection - Not specifically regulated.
5. Foot Protection - Regulated by 29 CFR 1910.136 and 1926.96; and, specified in ANSI Z41.1.
6. Protective Clothing (e.g., fully encapsulated suits, aprons) - Not specifically regulated.

3.3 Protective Clothing Selection Criteria

3.3.1 Chemicals Present

The most important factor in selecting PPE is the determination of what chemicals the employee may be exposed to. On field investigations, the number of chemicals may range from a few to several hundred. The exact chemicals or group of chemicals present at the site (certain groups tend to require similar protection) can be determined by collecting and analyzing samples of the air, soil, water, or other site media. When data are lacking, research into the materials used or stored at the site can be used to infer chemicals possibly on the site.

Once the known or suspected chemicals have been identified, and taking into consideration the type of work to be performed, the most appropriate clothing shall be selected.

Protective garments are made of several different substances for protection against specific chemicals. There is no universal protective material. All will decompose, be permeated by, or otherwise fail to protect under given circumstances. Fortunately, most manufacturers make guides to the use of their products (i.e., Dupont’s Tyvek™ Permeation Guide). These guides are usually for gloves and coveralls and typically provide information regarding chemical degradation rates (failure of the material to maintain structural integrity when in contact with the chemical), and may provide information on the permeation rate (whether or not the material allows the chemical to pass through). When permeation tables are available, they shall be used in conjunction with degradation tables to determine the most appropriate protective material.

During most site work, chemicals are usually in mixed combinations and the protective materials are not in continuous contact with pure chemicals for long periods of time; therefore, the selected material may be adequate for the particular chemical and type of work being performed, yet not the "best" protecting material for all site chemicals and activities. Selection shall depend upon the most hazardous chemicals based on their hazards and concentrations. Sometimes layering, using several different layers of protective materials, affords the best protection.

3.3.2 Concentration of the Chemical(s)

One of the major criteria for selecting protective material is the concentration of the chemical(s) in air, liquid, and/or solid state. Airborne and liquid chemical concentrations should be compared to the OSHA standards and/or American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute for Occupational Safety and Health (NIOSH) guidelines to determine the level of skin or other absorptive surface (e.g., eyes) protection needed. While these standards are not designed specifically for skin exposed directly to the liquid, they may provide skin designations indicative of chemicals known to have significant skin or dermal absorption effects. For example, airborne levels of PCB on-site may be low because it is not very volatile, so the inhalation hazard may be minimal; however, PCB-containing liquid coming in direct contact with the skin may cause overexposure. Thus, PCB has been assigned a skin designation in both the OSHA and ACGIH exposure limit tables.

3.3.3 Physical State

The characteristics of a chemical may range from nontoxic to extremely toxic depending on its physical state. Inorganic lead in soil would not be considered toxic to site personnel, unless it became airborne, since it is generally not absorbed through the intact skin. Organic lead in a liquid could be readily absorbed. Soil is frequently contaminated with hazardous materials. Concentrations will vary from a few parts per million to nearly one hundred percent. The degree of hazard is dependent on the type of soil and concentration of the chemical. Generally speaking, "dry" soils do not cause a hazard to site personnel if they take minimal precautions such as wearing some type of lightweight gloves.

3.3.4 Length of Exposure

The length of time a material is exposed to a chemical increases the probability of breakthrough. Determinations of actual breakthrough times for short-term exposures indicate that several different materials can be used which would be considered inadequate under long-term exposures. It should be kept in mind that during testing, a pure (100% composition) liquid is usually placed in direct contact with the material producing a worst-case situation.

3.3.5 Abrasion

When selecting protective clothing, the job the employee is engaged in must be taken into consideration. Persons moving drums or performing other manual tasks may require added protection for their hands, lower chest and thighs. The use of leather gloves and a heavy apron over the other normal protective clothing will help prevent damage to the normal PPE and thus reduce worker exposures.

3.3.6 Dexterity

Although protection from skin and inhalation hazards is the primary concern when selecting PPE, the ability to perform the assigned task must be maintained. For example, personnel cannot be expected to perform work that requires fine dexterity if they must wear a thick glove. Therefore, the PPE selection process must consider the task being performed and provide PPE alternatives or techniques that allow dexterity to be maintained while still protecting the worker (e.g., wearing tight latex gloves over more bulky hand protection to increase dexterity).

3.3.7 Ability to Decontaminate

If disposable clothing cannot be used, the ability to decontaminate the materials selected must be taken into consideration. Once a chemical contacts the material, it must be cleaned before it can be reused. If the chemical has completely permeated the material, it is unlikely that the clothing can be adequately decontaminated and the material should be discarded.

3.3.8 Climactic Conditions

The human body works best with few restraints from clothing. Protective clothing adds a burden by adding weight and restricting movement as well as preventing the natural cooling process. In severe situations, a modified work program must be used.

Some materials act differently when they are very hot and very cold. For example, PVC becomes almost brittle in very cold temperatures. If there are any questions about the stability of the protective materials under different conditions, the manufacturer should be contacted.

3.3.9 Work Load

Like climactic conditions, the type of work activity may affect work duration and the ability or personnel to perform certain tasks. Similarly, the amount of protective materials a person wears will affect their ability to perform certain tasks. For example, a person in a total encapsulating suit, even at 72 °F, cannot work for more than a short period of time without requiring a break.

The work schedule should be adjusted to maintain the health of the employees. Special consideration should be given to the selection of clothing that both protects and adds the least burden when personnel are required to perform strenuous tasks. Excessive bodily stress frequently represents the most significant hazard encountered during field work.

3.4 Types of Protective Materials

1. Cellulose or Paper
2. Natural and Synthetic Fibers
    a. Tyvek™
    b. Nomex™
3. Elastomers
    a. Polyethylene
    b. Saran
    c. Polyvinyl Chloride (PVC)
    d. Neoprene
    e. Butyl Rubber
    f. Viton

3.5 Protection Levels

3.5.1 Level A Protection

Level A protection (a fully encapsulated suit) is used when skin hazards exist or when there is no known data that positively rule out skin and other absorption hazards. Since Level A protection is extremely physiologically and psychologically stressful, the decision to use this protection must be carefully considered. At no time will Level A work be performed without the consent of the OM. The following conditions suggest a need for Level A protection:

- confined facilities where probability of skin contact is high;
- sites containing known skin hazards;
- sites with no established history to rule out skin and other absorption hazards;
- atmosphere immediately dangerous to life and health (IDLH) through the skin absorption route;
- site exhibiting signs of acute mammalian toxicity (e.g., dead animals, illnesses associated with past entry into site by humans);

- sites at which sealed drums of unknown materials must be opened;
- total atmospheric readings on the Photoionization Detector (PID), Flame Ionization Detector (FID), and similar instruments indicate 500 to 1,000 ppm of unidentified substances; and
- extremely hazardous substances (e.g., cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens and infectious substances) are known or suspected to be present and skin contact is possible.

The following items constitute Level A protection:

- open circuit, pressure-demand self-contained breathing apparatus (SCBA);
- totally encapsulated suit;
- gloves, inner (surgical type);
- gloves, outer;
- chemical protective;
- boots, chemical protective, steel toe and shank;
- radiation detector (if applicable); and
- communications.

3.5.2 Level B Protection

Level B protection is utilized when the highest level of respiratory protection is needed but hazardous material exposure to the few unprotected areas of the body is unlikely.

The following conditions suggest a need for Level B protection:

- the type and atmospheric concentration of toxic substances have been identified and they require the highest level of respiratory protection;
- IDLH atmospheres where the substance or concentration in the air does not present a severe skin hazard;
- the type and concentrations of toxic substances do not meet the selection criteria permitting the use of air purifying respirators; and
- it is highly unlikely that the work being done will generate high concentrations of vapors, gases or particulates, or splashes of materials that will affect the skin of personnel.

Personal protective equipment for Level B includes:

- open circuit, pressure-demand SCBA;
- chemical protective clothing:
- overalls and long-sleeve jacket; or
- coveralls;
- gloves, inner (surgical type); gloves, outer, chemical protective;
- boots, chemical protective, steel toe and shank; and
- communications optional.

3.5.3 Level C Protection

Level C protection is utilized when both skin and respiratory hazards are well defined and the criteria for the use of negative pressure respirators have been fulfilled (i.e., known contaminants and contaminant concentrations, acceptable oxygen levels, approved filter/cartridge available, known cartridge service life, etc.). Level C protection may require carrying an emergency escape respirator during certain initial entry and site reconnaissance situations, or when applicable thereafter.

Personal protective equipment for Level C typically includes:

- full facepiece air-purifying respirator;
- emergency escape respirator (optional);
- chemical protective clothing:
    - overalls and long-sleeved jacket; or
    - coveralls;
- gloves, inner (surgical type);
- gloves, outer, chemical protective; and
- boots, chemical protective, steel toe and shank.

3.5.4 Level D Protection

Level D is the basic work uniform. Personal protective equipment for Level D includes:

- coveralls;
- safety boots/shoes;
- eye protection;
- hand protection;
- reflective traffic safety vest (mandatory for traffic areas or railyard);
- hard hat (with face shield is optional); and
- emergency escape respirator is optional.

3.5.5 Level E Protection

Level E protection is used when radioactivity above 10 mr/hr is detected at the site. Personal protective equipment for Level E includes:

- coveralls;
- air purifying respirator;
- time limits on exposure;
- appropriate dermal protection for the type of radiation present; and
- radiation dosage monitoring.

3.5.6 Additional Considerations

Field work will contain a variety of situations due to chemicals in various concentrations and combinations. These situations may be partially ameliorated by following the work practices listed below:

1. Some sort of foot protection is needed on a site. If the ground to be worked on is contaminated with liquid and it is necessary to walk in the chemicals, some sort of protective "booties" can be worn over the boots. This cuts down on decontamination requirements. They are designed with soles to help prevent them from slipping around. If non-liquids are to be encountered, a Tyvek™ bootie could be used. If the ground contains any sharp objects, the advantage of booties is questionable. Boots should be worn with either cotton or wool socks to help absorb the perspiration.
2. If the site situation requires the use of hard hats, chin straps should be used if a person will be stooping over where his/her hat may fall off. Respirator straps should not be placed over the hard hats. This will affect the fit of the respirator.

   Some types of protective materials conduct heat and cold readily. In cold conditions, natural material clothing should be worn under the protective clothing. Protective clothing should be removed prior to allowing a person "to get warm". Applying heat, such as a space heater, to the outside of the protective clothing may drive the contaminants through. In hot weather, under clothing will absorb sweat. It is recommended that workers use all cotton undergarments.
3. Body protection should be worn and taped to prevent anything from running into the top of the boot. Gloves should be worn and taped to prevent substances from entering the top of the glove. Duct tape is preferred, but masking tape can be used. When aprons are used, they should be taped across the back for added protection. However, this should be done in such a way that the person has mobility.
4. Atmospheric conditions such as precipitation, temperature, wind direction, wind velocity, and pressure determine the behavior of contaminants in air or the potential for volatile material getting into the air. These parameters should be considered in determining the need for and the level of protection.
5. A program must be established for periodic monitoring of the air during site operations. Without an air monitoring program, any changes would go undetected and might jeopardize response personnel. Monitoring can be done with various types of air pumps and filtering devices followed by analysis of the filtration media; personnel dosimeters; and periodic walk-throughs by personnel carrying real-time survey instruments.
6. For operations in the exclusion zone, different levels of protection may be selected, and various types of chemical-resistant clothing may be worn. This selection should be based on the job function, reason for being in the area, and the potential for skin contact with, or inhalation of, the chemicals present.
7. Escape masks must be readily available when levels of respiratory protection do not include a SCBA and the possibility of an IDLH atmosphere exists. Their use can be made on a case-by-case basis. Escape masks could be strategically located at the site in areas that have higher possibilities of vapors, gases or particulates.

APPENDIX E

Subsurface Utility Clearance Management Program

SUBSURFACE UTILITY CLEARANCE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/19**
REVISION NUMBER	**:**	**2**

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APPENDICES

Appendix A – Definitions
Appendix B – Example of Completed One Call
Appendix C – Roux Subsurface Utility Clearance Checklist
Appendix D – Utility Verification/Site Walkthrough Record

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following program for completing proper utility mark-outs and for conducting subsurface clearance activities. This establishes a method to ensure, to the greatest extent possible, that utilities have been identified and contact and/or damage to underground utilities and other subsurface structures will be avoided.

2. SCOPE AND APPLICABILITY

The Subsurface Utility Clearance Management Program applies to all Roux employees, its contractors and subcontractors. Employees are expected to follow this program for all intrusive work involving Roux or other personnel (e.g., contractors/subcontractors) working for Roux unless the client’s requirements are more stringent. Deviation from the program regardless of the specific work activity or work location must be pre-approved based on client’s site knowledge, site experience and client’s willingness for the use of this program. Any and all exceptions shall be documented and pre-approved by the Project Principal and the Office Manager.

3. PROCEDURES

3.1 Before Intrusive Activities

During the project kick-off meeting for intrusive activities the PM will review the Roux Subsurface Utility Clearance Checklist and Utility Verification (Appendix C) / Site Walkthrough Record (Appendix D) and the below bullet points with the project field team:

(Please note that these are intended as general reminders only and should not be solely relied upon.)

- Ensure the Mark-out / Stake-out Request Information Sheet (or one-call report) is complete and accurate for the site including address and cross streets and review for missing utilities. (Note: utility mark-out organizations do not have contracts with all utilities and it is often necessary to contact certain utilities separately such as the local water and sewer authorities).
- Have written confirmation prior to mobilizing to the site that the firm or Roux personnel performing the intrusive activity has correctly completed the mark-out notification process including requesting mark-outs, waiting for mark-outs to be applied to ground surfaces at the site, and receiving written confirmation of findings (via fax or email) from utility operators for all known or suspected utilities in the proposed area of intrusive activity, and provided utility owner written confirmation to Roux personnel for review and project files documentation.
- Do not begin any intrusive activity until all utilities mark-out has been completed (i.e., did all utilities mark-out the site?) and any unresolved mark-out issues are finalized. Perform a site walk to review the existing utilities and determine if said utilities have been located by the utility locators.

  (Note: The Tolerance Zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside edge of any subsurface structure.)
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or other soft digging techniques) for the first 5-ft below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-Clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternative approaches will need to be pre-approved by the OM.

- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the "moat" technique (i.e., soft digging around the perimeter). In these cases, dig in small lifts (<12" for first 5 feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes performed to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.
- In addition, the following activities should be conducted:
  - Review the work scope to be performed with the site owner/tenant to determine if it may impact any utilities;
  - Attempt to procure any utility maps or historic drawings of subsurface conditions of the site;
  - **Determine the need for utility owner companies to be contacted or to have their representatives on site**;
  - Where mark-outs terminate at the property boundary, consider the use of private utility locating / GPR / geophysical-type services which may be helpful in locating utilities. Use of private utility locating firms, however, does not eliminate the legal requirement for the Excavator firm to submit a request for Public Utility Mark-outs. Also, the information provided by the service may be inaccurate and unable to locate subsurface utilities and structures in urban areas, landfills, urban fill areas and below reinforced slabs, etc. They should not be relied upon as the only means of performing utility clearance;
  - Documented description of the dig site which is included in the projects Health and Safety Plan (HASP) and one call report will be maintained in the field and distributed amongst Roux personnel its contractors and subcontractors; and
  - Documentation of the actual placement of mark outs in the field shall be collected using dated pictures, videos and/or sketches with distance from markings to fixed objects. All documentation shall be maintained within the project file.

3.2 During Intrusive Activities

The PM, field team lead or personnel performing oversight is to:

- Ensure the mark-out remains valid. (In certain states there are limits regarding the duration of time after the mark-out was applied to the ground surface work can be started or interrupted.) Additionally, the mark-outs must be maintained, documented, and in many cases refreshed periodically to be considered valid, this will be accomplished through calls to the one call center.
- Ensure intrusive activities are only performed within the safe boundaries of the mark-out as detailed in the One-Call Report.
- Halt all work if intrusive activities have resulted in discovery of an unmarked utility. Roux personnel shall notify the facility owner/operator and the one call center. All incidents such as this will be reported as per Roux Incident Investigation and Reporting Management Program.
- Halt all work if intrusive activities must take place outside of the safe boundaries of a mark-out and only proceed after new mark-outs are performed.
- Halt the intrusive activities and immediately consult with the PP if an unmarked utility is encountered.
- Completing any subsurface utility clearance incident reports that are necessary.

- If a utility cannot be found as marked Roux personnel shall notify the facility owner/operator directly or through the one call center. Following notification, the excavation may continue, unless otherwise specified in state law.
- Contractors/subcontractors must contact the one-call center to refresh the ticket when the excavation continues past the life of the ticket. Ticket life shall be dictated by state law however at a maximum ticket life shall not exceed 20 working days.

3.3 Stop Work Authority

Each Roux employee has Stop Work Authority which he or she will execute upon determination of any imminent safety hazard, emergency situation, or other potentially dangerous situation, such as hazardous weather conditions. This Stop Work Authority includes subsurface clearance issues such as the adequacy of a mark-out or identification during intrusive operations of an unexpected underground utility. Authorization to proceed with work will be issued by the PM/PP after such action is reviewed and resolved. The PM will initiate and execute all management notifications and contact with emergency facilities and personnel when this action is appropriate.

Appendix A - Definitions

Intrusive Work Activities	All activities such as digging or scraping the surface, including but not limited to, excavation, test pitting or trenching, soil vapor sampling or the installation of soil borings, soil vapor monitoring points and wells, or monitoring wells, and drilling within the basement slab of a recently demolished building.
Mark-out / Stake Out	The process of contracting with a competent and qualified company to confirm the presence or absence of underground utilities and structures. This process will clearly mark-out and delineate utilities that are identified so that intrusive work activities can be performed without causing disturbance or damage to the subsurface utilities and structures. After utility mark-outs are completed the soft digging will be completed prior to intrusive work.
Tolerance Zone	Defined as two feet on either side of the designated centerline of an identified utility, plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct backs and other non-cylindrical utilities) of that utility and two feet from the outside edge of any subsurface structure.
Structure	For the purpose of this program a structure is defined as any underground feature that may a present potential source(s) of energy such as, but not limited to, utility vaults, bunkers, piping, electrical boxes, wires, conduits, culverts, utility lines, underground tanks and ducts.
Soft Digging	The safest way to remove material from unknown obstructions or services is by using tools such as a vactor or air knife, non-mechanical tools, or hand tools. The methods are clean and non-evasive and used for uncovering and exposing buried services, excavating and for providing a quick method of soil removal from sensitive areas.
Verification	Exploratory test-hole dug with hand tools within the Tolerance Zone to expose and verify the location, type, size, direction-of-run and depth of a utility or subsurface structure. Vacuum excavation (soft dig) methods can further facilitate exposure of a subsurface utility and accurately provide its location and identification prior to intrusive work approaching the Tolerance Zone.

Appendix B - Example of Completed One Call Report

Example Completed One-Call Report

New York 811

Send To: C_EMAIL Seq No: 744

Ticket No: 133451007 ROUTINE

Start Date: 12/16/13 Time: 7:00 AM Lead Time: 20

State: NY County: QUEENS Place: QUEENS
Dig Street: 46TH AVE Address:
Nearest Intersecting Street: VERNON BLVD
Second Intersecting Street: 11TH ST

Type of Work: SOIL BORINGS
Type of Equipment: GEOPROBE
Work Being Done For: ROUX

In Street: X On Sidewalk: X Private Property: Other:
On Property Location if Private: Front: Rear: Side:

Location of Work: MARK THE ENTIRE NORTH SIDE OF THE STREET AND SIDEWALK OF:
46TH AVE BETWEEN VERNON BLVD AND 11TH STREET

Remarks:

Nad: Lat: Lon: Zone:
ExCoord NW Lat: 40.7475399 Lon: -73.9534811 SE Lat: 40.7457406 Lon: -73.9493680

Company : ZEBRA ENVIROMENTAL Best Time: 6AM-5PM
Contact Name: DAVID VINES Phone: (516)596-6300
Field Contact: DAVID VINES Phone: (516)596-6300
Caller Address: 30 N PROSPECT AVE Fax Phone: (516)596-4422
LYNBROOK, NY 11563
Email Address: david@zebraenv.com

Additional Operators Notified:

ATTNY01	AT&T CORPORATION	(903)753-3145
CEQ	CONSOLIDATED EDISON CO. OF N.Y	(800)778-9140
MCINY01	MCI	(800)289-3427
PANYNJ01	PORT AUTHORITY OF NY & NJ	(201)595-4841
VZQ	VERIZON COMMUNICATIONS	(516)297-1602

Link to Map for C_EMAIL: http://ny.itic.occinc.com/XGMZ-DF2-L23-YAY

Original Call Date: 12/11/13 Time: 1:15 PM Op: webusr
IMPORTANT NOTE: YOU MUST CONTACT ANY OTHER UTILITIES DIRECTLY

Appendix C - Roux Subsurface Utility Clearance Checklist

Roux Subsurface Utility Clearance Checklist ***Date of Revision – 12/3/14***

Work site set-up and work execution

ACTIVITY	Yes	No	N/A	COMMENTS INCLUDING JUSTIFICATION IF RESPONSE IS NO OR NOT APPLICABLE
Daily site safety meeting conducted, SPSAs performed, JSAs reviewed, appropriate work permits obtained.				
HASP is available and reviewed by site workers / visitors.				
Subsurface Utility Clearance Procedure has been reviewed with all site workers.				
Work area secured; traffic control established as needed. Emergency shut-off switch located. Fire extinguishers / other safety equipment available as needed.				
Utility mark-outs (public / private) clear and visible. Provide Excavator's Stake-Out Reference Number / Request Date / Time.				
Tolerance zone work identified.				
Work execution plan reviewed and adhered to (ground disturbance methods, clearance depths, any special utility protection requirements, or any other execution requirements; especially for Tolerance Zone work).				
Verbal endorsement received from Roux PM for any required field deviations to work execution plan.				

Key reminders for execution:

The Subsurface Utility Clearance Protocol should be referenced to determine all requirements while executing subsurface work. The bullet points below are intended as general reminders only and should not be solely relied upon.

- Tolerance zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside of any subsurface structure.
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or vacuum excavation) must be performed for the first five feet below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternate approaches will need to be pre-approved by the OM.
- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the "moat" technique (i.e., soft

digging around the perimeter). In these cases, dig in small lifts (<12” for first five feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.

Appendix D - Utility Verification/Site Walkthrough Record

Employee Name:____

Date: ____

Instructions: For each utility suspected at the job site, indicate location on the job site, approximate burial depth, and means of detecting the utility. Leave blank if that utility is not believed to be present.

Utility	Description of Utility Location Identified Onsite	Approx. Depth (bls)	Method / Instrumentation used to determine Utility Location	Utility Owner Response (Date/Time)	Mark Out Indicates (Clear / Conflict)
Electrical Lines					
Gas Lines					
Pipelines					
Steam Lines					
Water Lines					
Sanitary and Stormwater Sewer lines					
Pressured Air-Lines					
Tank Vent Lines					
Fiber Optic Lines					
Underground Storage Tanks					
Phone Lines/ Other					

* bls - below land surface

Site Sketch Showing Utilities:

Color Code

- ELECTRIC
- Gas-oil Steam
- Communications CATV
- WATER
- Reclaimed Water
- SEWER
- Temp. Survey Markings
- Proposed Excavation

Other Comments / Findings:

Completed by: ______________________________

Signature: ______________________________ Date: ____________

APPENDIX F

Heavy Equipment Exclusion Zone Policy

HEAVY EQUIPMENT EXCLUSION ZONE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/2019**
REVISION NUMBER	**:**	**1**

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1. PURPOSE

The purpose of the Exclusion Zone Management Program is to establish the minimum clearance distance that must be maintained between workers and heavy equipment while equipment is in operation (i.e., engaged or moving). The intent is to have no personnel or equipment entering the Exclusion Zone while the equipment is in operation or moving to ensure that Roux and Subcontractor employees are not unnecessarily exposed to the hazards of the equipment.

2. SCOPE AND APPLICABILITY

This Management Program applies to all Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) employees and their subcontractors who are performing field work and are potentially exposed to heavy equipment. For the purpose of this program, heavy equipment includes, but is not necessarily limited to: excavation equipment, drill rigs, vacuum trucks, forklifts, lull telehandlers, man lifts, bobcats, delivery trucks, etc.

3. PROCEDURES

As specified in the following sections of this Program, an Exclusion Zones must be established and maintained during activities involving the movement/operation of heavy equipment. The Exclusion Zone requirements apply to all personnel on the site but are primarily focused on those personnel who are required to be working in the vicinity of the equipment. The exclusion zone is in effect when heavy equipment is moving or engaged (ex. movement of an arm or bucket of an excavator, rotation of an auger, lifting of a load with a forklift, raising/lowering of a man lift, etc.).

1. The Exclusion Zone must meet the following minimum requirements:
   - A minimum distance of 10 feet from all heavy equipment and loads being moved by the equipment;
   - Greater than the swing/reach radius of any moving part on the heavy equipment (i.e., for large equipment this may mean an exclusion zone distance larger than 20 feet);
   - Greater than the tip-over distance of the heavy equipment; and
   - Greater than the radius of blind spots.

   > The size of the Exclusion Zone will need to be determined on a task-specific basis considering the size of the heavy equipment in use and the task being performed. Prior to all heavy equipment operations, the Exclusion Zone(s) distance must be specifically identified in the Job Safety Analysis (JSA).

2. The spotter (or another individual) should be assigned responsibility for enforcing the Exclusion Zone. The spotter should be positioned immediately outside of the Exclusion Zone within a clear line of sight of the equipment operator. The spotter must signal the operator to stop work if anyone or anything has the potential to enter or compromise the Exclusion Zone. The operator should stop work if the spotter is not within his/her line of sight. If multiple pieces of equipment are being used, each piece of equipment must have its own Exclusion Zone and spotter. For large excavation and demolition projects the spotter should be in constant radio contact (not cell phone) with the machine driver.
3. If an individual must enter the Exclusion Zone, the designated Spotter must signal the Equipment Operator to stop the equipment. Once the equipment is no longer moving (ex. movement of an arm of an excavator is STOPPED, lifting of a load with a forklift STOPPED, raising/lowering of a man lift is

STOPPED, etc.), the operator must DISENGAGE THE CONTROLS and STOP and SIGNAL BY "SHOWING HIS HANDS". This signal will indicate that it is safe for the personnel to enter the limits of the Exclusion Zone to perform the required activity. The equipment must remain completely stopped/disengaged until all personnel have exited the limits of the Exclusion Zone and the designated Spotter has signaled by "SHOWING HIS HANDS" to the Equipment Operator that it is safe to resume operations.

4. When entering the limits of the Exclusion Zone, personnel must at a minimum:
   - Establish eye contact with the operator and approach the heavy equipment in a manner that is in direct line of sight to the Equipment Operator;
   - Never walk under any suspended loads or raised booms/arms of the heavy equipment; and
   - Identify a travel path that is free of Slip/Trip/Fall hazards.
5. The Exclusion Zone should be delineated using cones with orange snow fence or solid poles between the cones, barrels, tape or other measures. For work in rights-of-way rigid barriers, such as Jersey barriers or temporary chain link fence should be used. For certain types of wide-spread or moving/mobile equipment operations, such delineation may not be practicable around pieces of equipment or individual work areas. In such instances, it is expected that the entire operation will be within a larger secure work area or that additional means will be utilized to ensure security of the work zone.

All subcontractors who provide heavy equipment operations to field projects must implement a program that meets or exceeds the expectations described above as well as any additional requirements that may be required on a client or site-specific basis.

3.1 Exceptions

It is recognized that certain heavy equipment activities may require personnel to work within the limits of the Exclusion Zone as specified in this program. Such activities may include certain excavation clearance tasks, drill crew activities or construction tasks. However, any such activity must be pre-planned with emphasis on limiting the amount and potential exposure of any activity required within the zone. The critical safety steps to mitigate the hazards associated with working within the Exclusion Zone must be defined in the JSA and potentially other project-specific plans (i.e., critical lift plans, etc.), and approved by the Roux Project Principal and client representative, if required, prior to implementation.

4. TRAINING

Many Roux projects have different requirements that are client-specific or site-specific in nature. It is the responsibility of the Project Principal (or Project Manager if delegated this responsibility by the Project Principal) to ensure that the workers assigned to his/her projects are provided orientation and training with respect to these client and/or site-specific requirements.