

GEI Consultants

Remedial Investigation Work Plan

Hunts Point 600 Food Center Drive
NYSDEC BCP Site No. C203104

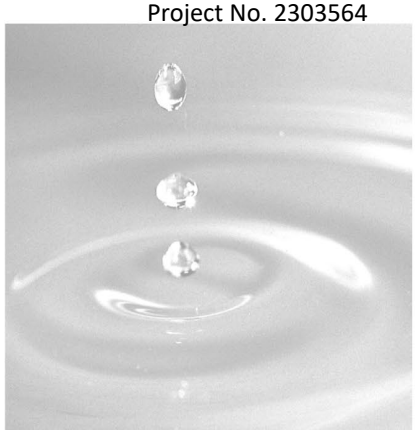
For the Property located at:
600 Food Center Drive, Bronx, New York

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233

On Behalf of:
New York City Economic Development Corporation
1 Liberty Plaza
New York, New York 10006

Submitted by:
GEI Consultants, Inc.
530 7th Avenue, Suite 2007
New York, New York 10018
212.687.8282

February 2026
Project No. 2303564



Stacey Ng, P.G.
Project Manager

Kevin P. McCarty
Senior Project Manager/Environmental Lead

Table of Contents

Certification iii

Acronyms and Abbreviations iv

1. Background and Site Description 7
1.1. Introduction 7
1.2. Objective of the RIWP 7
1.3. Background 7
1.4. Description of Local Hydrogeological Conditions 9
1.5. Previous Report Findings 10
1.6. Project Organizational Structure and Responsibility 11

2. Scope of Work 12
2.1. Execution of the RIWP 12
2.2. Mobilization and Site Access 13
2.3. Site Preparation/GPR/Underground Utility Location 13
2.4. Odor and Fugitive Dust Control and Community Air Monitoring 14
2.5. Soil Boring Installation and Sampling 14
2.5.1. Soil Boring Installation 14
2.5.2. Soil Sample Laboratory Analysis 16
2.5.3. Soil Boring Delineation 19
2.5.4. Soil Boring Backfilling 20
2.6. Monitoring Well Installation and Sampling 20
2.7. Indoor Air and Soil Vapor Installation and Sampling 21
2.7.1. Soil Vapor Installation and Sampling 21
2.7.2. Indoor Air and Ambient Air Sampling 22
2.8 Investigation Derived Waste Management 23
2.9 Site Restoration 23
2.10 Survey 23
2.11 Reporting 23

3. Quality Assurance/Quality Control (QA/QC) Protocols 24

4. Health and Safety Protocols 25

5. Data Evaluation and Remedial Investigation Report 26
5.1. Data Evaluation 26
5.2 Geologic/Hydrogeologic and Water Quality Characteristics 26
5.3 Qualitative Human Health Exposure Assessment 27

5.4 Additional Field Investigations 27
5.5 Remedial Investigation Report 28

6. Citizen Participation Activities 29
6.1 Description of Citizen Participation Activities 29
6.1.1 Citizen Participation Plan 29
6.1.2 RIWP 29
6.1.3 Interim Remedial Measures (IRMs) 29
6.1.4 Remedial Investigation Report 29
6.1.5 Remedial Action Work Plan 29
6.1.6 Post Remedial Action 30

7. Schedule 31

8. References 33

Figures

Figure 1. Site Location
Figure 2. Site Layout
Figure 3. Site Layout with Historic MGP Structures
Figure 4. FEMA Flood Zone Map
Figure 5. Proposed Sampling Locations

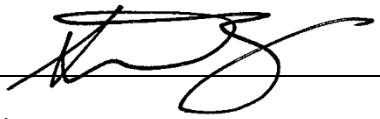
Appendices

Appendix A Key GEI Personnel Resumes
Appendix B Field Sampling Plan (FSP)
Appendix C Quality Assurance Project Plan (QAPP)
Appendix D Health and Safety Plan (HASP) & Community Air Monitoring Plan (CAMP)

SM/SN/KM:ag
B:\Working\NYCEDC\2303564 600 FCD RIWP\RIWP\GEI_600 FCD RIWP_2026-02-13.docx

Certification

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



Signature

2/13/2026

Date

Acronyms and Abbreviations

AA	Alternatives Analysis
ASP	Analytical Services Protocol
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAMP	Community Air Monitoring Plan
CH_4	Methane
Con Edison	Consolidated Edison Company of New York
CO_2	Carbon dioxide
CPP	Citizen Participation Plan
CSM	Conceptual Site Model
DER-10	Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation
DD	Decision Document
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DSNY	New York City Department of Sanitation
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ESA	Environmental Site Assessment
FCD	Food Center Drive
FEMA	Federal Emergency Management Agency
FER	Final Engineering Report
FIRM	Flood Insurance Rate Map
FSP	Field Sampling Plan
ftbgs	Feet Below Ground Surface
GEI	GEI Consultants, Inc.
GPR	Ground Penetrating Radar
H_2S	Hydrogen Sulfide
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCN	Hydrogen Cyanide
HDR	Henningson, Durham & Richardson Architecture and Engineering, P.C.
He	Helium
HPFDC	Hunts Point Food Distribution Center
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid

MDL	Method Detection Limit
MGP	Manufactured Gas Plant
ml/min	milliliter per minute
MTS	Marine Transfer Station
NAPL	Non-Aqueous Phase Liquid
NTU	nephelometric turbidity units
NYCDEP	New York City Department of Environmental Protection
NYCEDC	New York City Economic Development Corporation
NYCRR	6 New York Codes, Rules, and Regulations
NYCSBS	New York City Small Business Services
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2	Oxygen
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PBS	Petroleum Bulk Storage
PCBs	Polychlorinated Biphenyls
PFAS	Per- and Polyfluoroalkyl Substances
PID	Photoionization Detector
PM-10	Respirable Particulates
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
RAWP	Remedial Action Work Plan
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RR ROW	Railroad Right-of-Way
SCGs	Standards, Criteria, and Guidance
SCOs	Soil Cleanup Objectives
SCWP	Site Characterization Work Plan
SHSO	Site Health and Safety Officer
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TOGS	Technical & Operational Guidance Series
TPH	Total Petroleum Hydrocarbons
USCS	Unified Soil Classification System

US EPA	United Stated Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VCA	Voluntary Cleanup Agreement
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds

1. Background and Site Description

1.1. Introduction

GEI Consultants, Inc. (GEI) has prepared this Remedial Investigation Work Plan (RIWP) on behalf of the New York City Economic Development Corporation (NYCEDC) for the property located at 600 Food Center Drive (FCD) in the borough of the Bronx, New York (Site). The Site is located to the east of FCD and immediately north of Farragut Street, along the Bronx River. The Site is included within a larger tax lot containing multiple parcels of land and properties, identified as New York City Tax Map Block 2781, Lot 500. The Site is operated by NYCEDC on behalf of the New York City Department of Small Business Services (NYCSBS). The Site was accepted into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) as Site No. C203104 on November 20, 2017, with NYCEDC, i.e., the Applicant, participating in the BCP as a Volunteer pursuant to a Brownfield Cleanup Agreement (BCA).

No subsurface investigation has been performed within the Site; however, several investigations and remedies have been completed at neighboring properties that are also currently enrolled in the BCP. The entire Hunts Point peninsula is known to have previously been owned and operated by Consolidated Edison Company of New York, Inc. (Con Edison) as a Manufactured Gas Plant (MGP).

A United States Geological Survey (USGS) Topographic Map is included as Figure 1. A Site plan showing the 600 FCD site property boundaries is included as Figure 2.

1.2. Objective of the RIWP

The objective of this RIWP is to obtain valid data to evaluate and define the nature, extent, and degree of impacts onsite, as well as to inform the Qualitative Human Heal Exposure Assessment (QHHEA) both onsite and offsite. The data generated during the field investigation will be used to determine what risks, if any, that the onsite impacts present to public health, ecological resources, biota, and the environment, consistent with DER-10. Additionally, the RIWP has been designed to provide data needed to perform a remedial Alternatives Analysis (AA) for the Site and recommend remedial actions for the Site, which will be presented within a Remedial Action Work Plan (RAWP).

As required by NYSDEC and New York State Department of Health (NYSDOH) under the 6 New York Codes, Rules, and Regulations (NYCRR) Part 375, an investigation will be performed to assist in the development of a QHHEA to support the future RAWP and Decision Document (DD), satisfying requirements of the BCP. This investigation will include the collection of soil, groundwater, and soil vapor samples, and will evaluate potential impacts to biota (no offsite sampling within the river is proposed).

1.3. Background

The Site is located in a commercial and industrial area of Hunts Point in the borough of the Bronx, known as the Hunts Point Food Distribution Center (HPFDC). The Site (BCP Site No. C203104) is an approximate 9.6-acre lot that is relatively level and currently developed. The Site is bounded to the north by the

Anheuser-Busch distribution facility (former Voluntary Cleanup Program [VCP] Parcel C; VCP Site No. V00412), to the east by the Bronx River, to the west by the Railroad Right-of-Way parcel (RR ROW; BCP Site No. C203102), FCD (former VCP Perimeter Site; VCP Site No. V00641), and the Hunts Point Cooperative Market (355 FCD; BCP Site No. C203099), and to the south by Farragut Street and the Hunts Point Landing park (included within the RR ROW BCP site) immediately followed by the New York City Department of Sanitation (DSNY) Marine Transfer Station (MTS), and Fulton Fish Market Cooperative (former VCP Parcel B; VCP Site No. V00436).

The Site was developed with a distribution warehouse in the early 1970s, and the warehouse facility remains on the Site, currently leased from NYCSBS by Sultana Distribution Services, Inc. (Sultana). The Site is improved with one building, surrounded by asphalt and reinforced concrete slabs for loading docks, a northern grassy area abutting the RR ROW BCP Site and FCD, as well as a bulkhead and riprap along the eastern perimeter bounding the Bronx River. Within the grassy southwestern portion of the 600 FCD BCP site, adjacent to Farragut Street, a small circular area of land is omitted from the 600 FCD BCA and subsequent investigation and remedial action. This area is occupied by the New York City Department of Environmental Protection (NYCDEP) and is used as a wastewater pump/lift station. The entire property is surrounded by a chain-link fence, with one guarded entrance in the western corner of the property along FCD. A map showing the Site property boundaries is included as Figure 2.

Historically, 600 FCD was part of the former Con Edison MGP which operated from approximately 1926 until the early 1960s. Gas operations included a coke/oven gas plant, a carbureted water gas plant, a light oil plant, and a liquid petroleum production area. In total, approximately 46 buildings or structures existed within the former MGP facility that were actively involved in gas production. The facility ceased production in the early 1960s and was demolished in or around 1966. The MGP facility covered the entire Hunts Point peninsula to the south of the current Hunts Point Produce Market and east of Halleck Street, with an area of approximately 182 acres of land.

Reviews of historical aerial photographs indicate that, prior to the construction of the MGP facility in 1925, the 600 FCD parcel was primarily undeveloped marsh land, with the eastern shoreline being reinforced with a bulkhead as early as 1911. A review of the Con Edison's historic maps, which were prepared during the operation of the MGP facility, indicate the Site and immediate neighboring parcels were used for coal storage and a structure labeled "saltwater pump" was located in the southeastern corner of the 600 FCD property. The structures associated with the former MGP facility are illustrated in Figure 3. Portions of the MGP facility began to be taken out of service in the 1950s, with the majority of structures being demolished by 1966. A relieving platform along the Bronx River within the former VCP Parcel C Operable Unit One and Two (OU-1 and OU-2) and 600 FCD sites was partially demolished and removed. This relieving platform consisted of an approximately 2-foot-thick, 50- to 60-foot-wide concrete deck, supported by wooden piles, and a concrete bulkhead wall (approximately 10 to 12 feet high), with the upland area behind the bulkhead wall and above the concrete deck containing approximately 10 feet of fill material.

The former bulkhead (relieving platform, cofferdams, and piers) that existed along the shoreline of the former VCP Parcel B, former VCP Parcel C, and 600 FCD was rehabilitated during the remediation of former VCP Parcel B (Fulton Fish Market Cooperative) and Parcel C (Anheuser-Busch distribution facility) in 2007 to 2009 (HDR, 2010a & 2010b). The 600 FCD bulkhead rehabilitation consisted of the demolition

of the southern portion of the existing, dilapidated relieving platform and associated foundation within the parcel, formation of a new toe and slope covered with geotextile fabric, and bedding stone and armor stone laid atop, and the installation of a partially buried concrete jersey barrier wall to act as the curbline between the riprap slope and 600 FCD parking lot. The northern portion of the relieving platform within 600 FCD was maintained, with the parking surface being repaved during the rehabilitation effort. The bulkhead rehabilitation effort that was performed across these sites was documented in the Final Engineering Reports (FERs) for former VCP Parcel B (VCP Site No. V00436) as well as former VCP Parcel C (VCP Site No. V00412), prepared by Henningson, Durham, and Richardson Architecture and Engineering P.C. (HDR) in January and October 2010, respectively (HDR, 2010a & 2010b).

NYCSBS assumed ownership of the Site through multiple deed transactions between 1966 and 1972. The property was developed with the current building and pavement by 1974 and has been leased and used as a distribution warehouse thereafter. The area is currently zoned M3-1 (manufacturing); M3 zoning districts are designated for areas with heavy industries that generate noise, traffic, or pollutants. Typical uses include power plants, solid waste transfer facilities and recycling plants, and fuel supply depots (City Planning Commission, 2024).

On August 15, 2002, Con Edison entered into Voluntary Cleanup Agreement (VCA) Index No. D2-0003-02-08 (the "MGP Agreement") with NYSDEC to conduct investigations and, if necessary, remediation, at 45 of its 51 MGP properties located throughout Manhattan, the Bronx, western Queens, and Westchester counties, New York. One of these MGP-impacted properties is the Con Edison Hunts Point MGP property, which was entered into the NYSDEC VCP as Site No. V00554. The 600 FCD parcel was included within the former VCP Site No. V00554 as OU-4. A Site Characterization Work Plan (SCWP) was prepared for the former VCP Hunts Point MGP OU-4 site by Parsons in September 2011 but the Work Plan was never initiated. The VCP was then terminated by NYSDEC, and the Site was required to be enrolled in the NYSDEC BCP. Following discussions and negotiations between the City and Con Edison, NYCEDC applied to and enrolled in the BCP for the remaining Hunts Point MGP parcels (including 600 FCD) that were not remediated and closed under the VCP. The 600 FCD site was accepted into the NYSDEC BCP as Site No. C203104 in November 2017. Therefore, this RIWP has been prepared to be compliant with the current NYSDEC BCP and allow investigation of the Site.

1.4. Description of Local Hydrogeological Conditions

Prior to the construction of the Con Edison MGP in 1925, the Hunts Point peninsula was an estuarine tidal marsh, with small tributaries flowing into the Bronx and East Rivers. Following review of historic aerial imagery from the 1920s, the former shoreline appeared to be in a similar position as it is today, with a historic bulkhead observed to span from the current southern boundary of 600 FCD to the northern boundary of the former VCP Parcel C. Much of the Hunts Point peninsula is comprised of filled land, with in-filling activities having been conducted prior to the construction of the MGP facility, as well as after its demolition. Information available from prior investigations conducted on adjacent properties, supported by historic aerial photography, illustrates the historic effort to infill the former estuary behind the historic bulkhead, raise the grade, and allow development. Prior to the closure and demolition of the MGP facility, the bulkhead was improved along the eastern portion of the peninsula, utilizing sand and gravel generated from historic dredging activities in the Bronx and/or East River channels as well as other

sources (observed in historic images to have been imported via barge). The history of filling, development, and operations has been assembled from historic aerial photographs and, more recently, from data collected from neighboring site investigations and development. Prior to more recent investigations, there is no known record describing actual design, construction, demolition, and filling activities within Hunts Point.

The Site contains a significant layer of fill material overlaying native soils, as indicated in historic NYSDEC files. The Site is believed to contain an approximate 10- to 15-foot-thick layer of fill material, consisting of a mixture of sand, gravel, construction and demolition material (brick, concrete, stone, wood, etc.), coal and coal ash, slag, and cinders. Based upon documentation from investigations conducted on the adjoining former VCP Parcel C, a site which was also used for coal storage for the duration of MGP operations, a shallow layer of coal with varying thickness may exist and span across 600 FCD. The fill material is underlain by a confining, native clay layer which is believed to be the surface of the former tidal wetland and shallow embayment. The entire eastern Site boundary along the shoreline, where the relieving platform and rehabilitated bulkhead exists, is completely filled with imported material. Much of Hunts Point is similarly filled and is typically underlain by a moderately consistent clay layer immediately beneath the fill.

According to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel (Panel 0111, Map #3604970111F, dated 04/18/2018), the majority of the Site is located within Zone AE, also known as the 100-year floodplain (Figure 4).

Wetlands on or near the Site were evaluated by reviewing the National Wetlands Inventory and NYSDEC-regulated wetlands. There are no wetlands on or adjacent to the Site.

The nearest surface water bodies are the Bronx and East Rivers, located immediately adjacent to the eastern perimeter of Site. Groundwater has previously been encountered between 2 and 5 feet below ground surface (ftbgs) in adjacent properties, which is reasonably consistent with other areas within the Hunts Point peninsula. Groundwater within the Site may vary due in part to the remaining platform and concrete deck. Based on the data collected during investigations on adjacent properties, groundwater at the Site is expected to generally flow southeast towards the confluence of the Bronx and East Rivers, except where there are localized groundwater influences (e.g., platform, utilities, tunnels, building foundations, sumps) and/or temporal variations (i.e., tides, pumping cycles). A significant concrete structure (relieving platform) exists onsite at and below the level of the river (depending on the tidal cycle) and is a significant barrier to the flow of groundwater. It is a solid concrete deck approximately 2 feet thick, connected to a vertical wall that is located over the river.

1.5. Previous Report Findings

No site-wide subsurface investigations have been performed within the 600 FCD property. A Phase I Environmental Site Assessment (ESA) was conducted for the Site in 2005 by HDR which identified five underground storage tanks (USTs) which had been previously closed and removed. Of the storage tanks identified, two 2,000-gallon gasoline USTs, one 4,000-gallon gasoline UST, one 4,000-gallon diesel UST and one 6,000-gallon fuel oil UST were previously located along the eastern boundary of Site (NYSDEC Petroleum Bulk Storage [PBS] Site No. 2-600687). No petroleum release/spill was reported from the resulting closure, and it could be assumed that the closure was completed without incident. No closure

report was identified that would have included sampling of the sidewalls and tank grave(s). During the Phase I ESA inspection, significant repair work was noted within the eastern portion of site, as well as three monitoring wells which had been installed around the perimeter of one of the former USTs (HDR, 2007). It has not been determined if additional tanks or lines remain in the subsurface and/or if any residual impacts are present from the former tanks. No sampling data has been identified to provide detail on conditions at the time of the closure.

1.6. Project Organizational Structure and Responsibility

GEI will coordinate with NYSDEC, Sultana, and NYCEDC to conduct the RIWP. GEI, as the remedial engineer, will be responsible for project management, subcontractor oversight, RIWP compliance, determination of corrective measures when needed, monitoring for health and safety, implementation of the Community Air Monitoring Plan (CAMP), collection of analytical samples, and maintenance of Site sampling and meteorological logs. GEI will also serve as the Site Health and Safety Officer (SHSO).

The drilling subcontractor, under the supervision of GEI, will be responsible for all drilling activities to include, but not limited to, compliance with all applicable Occupational Safety and Health Administration (OSHA) regulations, personnel health and safety, installation of soil borings, soil vapor points, and groundwater monitoring wells associated with the RIWP, and any other specified tasks outlined in this RIWP.

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

Name	Phone/Email Address
Kyle Forster, P.E. NYSDEC Division of Environmental Remediation Project Manager	518-402-8644 kyle.forster@dec.ny.gov
Aaron Keegan NYSDOH Project Manager	518-402-7860 beei@health.ny.gov
Rasheed Lucas, Vice President NYCEDC, Remedial Party	212-312-3752 rlucas@edc.nyc
Gary Rozmus, P.E. GEI, In-House Consultant	631-760-9300 grozmus@geiconsultants.com
Kevin McCarty, Qualified Environmental Professional GEI, Program Manager/Senior Project Manager	212-845-9965 kmccarty@geiconsultants.com
Stacey Ng, Qualified Environmental Professional GEI, Project Manager	212-671-1592 sng@geiconsultants.com
Jaimie Wargo GEI, Quality Assurance Officer	860-368-5300 jwargo@geiconsultants.com
Drilling Subcontractor	TBD

Resumes of key GEI personnel for this project are included in Appendix A.

2. Scope of Work

A number of other sites in the HPFDC that were also part of the former MGP facility have been investigated and fully remediated under both the NYSDEC BCP as well as the former VCP. This RIWP uses this previously acquired data, information, and experience in order to present an RIWP that is comprehensive and focused on identifying impacts across the Site and collecting data that will be used to present remedial recommendations. Data from other investigations is not being included in this RIWP but is being used as a comparison as this BCP parcel is part of the larger original facility. This RIWP is not providing assumptions for remedial options, as that is premature. The RIWP does, however, use the largely documented history of successful and approved investigations and remedies to support the hypothesis and Conceptual Site Model (CSM). All remedial recommendations will be provided following this effort in the RAWP and will take into account current Site conditions as well as future proposed uses of the Site. All future uses are expected to meet the category of commercial land use.

All field work will be performed in accordance with the Field Sampling Plan (FSP) methods included in Appendix B. Analytical sampling will be performed in accordance with the Quality Assurance Project Plan (QAPP) included in Appendix C. A CAMP will be implemented during field activities and is included in the Health and Safety Plan (HASP) in Appendix D. The locations of proposed sampling points for the RIWP are depicted in Figure 5**.**

The RIWP scope of work includes the following general tasks:

- Mobilization and Site Access
- Site Preparation/Ground Penetrating Radar (GPR)/Underground Utility Location
- Odor and Fugitive Dust Control and Community Air Monitoring
- Soil Boring Installation and Sampling
- Monitoring Well Installation and Sampling
- Soil Vapor Point Installation and Sampling
- Material Handling
- Site Restoration
- Survey
- Reporting

2.1. Execution of the RIWP

Site work is anticipated to be performed between the hours of 7 am and 5 pm, Monday through Friday. During working hours, the drilling subcontractor will make every effort to minimize potential community impacts. These include, but are not limited to, noise and traffic concerns associated with the execution of the RIWP, as well as efforts to prevent contaminated material from migrating offsite.

2.2. Mobilization and Site Access

Access to the Site is provided by NYCEDC.

As per OSHA, the drilling subcontractor will prepare, submit, and will be responsible for complying with their own Site-specific HASP. GEI will perform all work under their own HASP, included in Appendix D, and will confirm that the drilling subcontractor's HASP does not conflict with GEI's HASP. All work will be performed in accordance with OSHA, state, and industry safety standards. All onsite personnel performing intrusive activities that have the potential to come in contact with impacted materials will have the requisite 1910.120 OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training as well as Site-specific training prior to intrusive activities. All personnel performing work associated with this RIWP will be required to have both general and Site-specific training. The general training includes all applicable OSHA and state-required training, such as 40-hour HAZWOPER and the 8-hour refresher training. Site-specific training will include a review of potential Site hazards, required personal protective equipment (PPE), and Site warning and evacuation procedures. Supervisory personnel will also have supervisory training.

The drilling subcontractor will apply for and obtain all necessary federal, state, and local permits associated with the RIWP. These permits may include, but are not limited to, traffic routing, road opening, construction/zoning, etc. No investigation work is proposed beyond the site limits/adjacent roadways (e.g., FCD and Farragut Street).

In accordance with NYS Code Rule 753, the contractor performing intrusive work will be responsible for contacting New York One Call Center (811) to request that all public utilities near the Site be located and marked. GEI will confirm the mark-out has been performed prior to drilling. GEI will also provide a subcontractor to perform a private utility mark-out within the Site boundaries to clear all proposed boring locations prior to drilling. Additional clearance efforts will be made in areas where historic USTs were identified, which were denoted as removed.

The drilling subcontractor will mobilize all necessary labor, equipment, supplies, and materials to complete the RIWP. Lay down areas for equipment, supplies and materials, the appropriate exclusion zone(s) and support area(s) will be identified to conduct the planned activities safely and effectively. All equipment will be decontaminated prior to arrival on the project site and will also be decontaminated prior to leaving the project site.

2.3. Site Preparation/GPR/Underground Utility Location

Site preparation activities necessary to support the work include the establishment of work zones, support facilities, decontamination facilities, and the installation of temporary security measures around work areas, which will be performed prior to executing the RI. The work area may change daily based on the locations of the sampling points.

As part of the Site Preparation effort, GEI will mobilize Ground Penetrating Radar Systems, LLC (GPRS) to perform GPR in the area of the test borings in order to identify on-site underground utilities. GPR is generally helpful in identifying larger underground utilities up to 5 to 6 ftbgs, depending on the conductivity of underlying fill. There are limitations where the surface is covered with concrete or where

metallic obstructions (e.g., fence, gates, steel sheeting, railroad tracks, etc.) exist, which may interfere with signals and can make imaging difficult. Existing site maps and utility drawings that are supplied to GEI will also be reviewed as well, but these can be inaccurate due to replacement work for emergency repairs that is rarely followed by the submission of as-built drawings. Hunts Point, and more specifically 600 FCD, was developed in the early 1970s and historic site information indicated that there were multiple USTs that existed on the Site and were reported to be removed. GEI will look over the entire area where USTs are reported to have been present to attempt to determine if any piping and/or fill and vent lines still remain.

The proposed boring plan will be used while performing GPR, and a 25 to 30-foot area around each boring location will be scanned to accommodate delineation, if necessary. In addition, GPR will be utilized to visualize the bottom of the relieving platform, which was constructed of concrete.

2.4. Odor and Fugitive Dust Control and Community Air Monitoring

In accordance with NYSDEC and NYSDOH requirements, a CAMP will be implemented at the Site during all ground intrusive activities. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., offsite receptors, including residences and businesses, and onsite workers not involved with Site RIWP activities), and from potential airborne contaminant releases as a direct result of intrusive RIWP activities. During all ground-disturbing activities, community air monitoring will be performed for Volatile Organic Compounds (VOCs), Hydrogen Sulfide (H_2S), Hydrogen Cyanide (HCN), and respirable particulates (PM-10) at upwind and downwind locations at the Site perimeter via temporary CAMP stations. Air monitoring procedures and action levels are further detailed as an appendix to the HASP (Appendix D). Field reports including CAMP data will be submitted to NYSDEC/NYSDOH on a weekly basis, at a minimum, while ground-intrusive activities are taking place on the Site. Notification of action level exceedances and any corrective measures taken will be reported to NYSDEC/NYSDOH within 24 hours.

In reviewing neighboring properties to identify areas of off-site environmental concern that could potentially be adversely impacted by 600 FCD, potential sensitive receptors within ½-mile of the Site include Hunts Point Landing community park (within RR ROW BCP boundaries), which bounds 600 FCD to the south. Additionally, the confluence of the Bronx and East Rivers bounds the 600 FCD BCP site to the east. No other sensitive receptors including hospitals, residential areas, schools, day cares, public facilities, and/or waterbodies were identified within ½-mile from Site.

2.5. Soil Boring Installation and Sampling

2.5.1. Soil Boring Installation

An estimated 78 soil borings (excluding delineation borings) will be advanced onsite to document impacts and collect samples specific to the preparation of remedial recommendations. Proposed soil boring locations are depicted in Figure 5. Eleven of the onsite soil borings are proposed to be converted to groundwater monitoring wells and are placed around the parcel to gather data on groundwater elevation, direction of movement, as well as groundwater quality data. Boring locations are subject to

change based on accessibility, utility clearance, and conditions encountered during the Site inspection and field activities.

Additional soil borings (e.g., delineation borings) may be added during the course of the field investigation in order to refine the limits (vertical and horizontal) of impacts and/or MGP-related waste that are identified. Any additional proposed soil borings will be discussed with NYSDEC for approval prior to performing work outside of the approved RIWP. Movement of existing proposed borings will be documented in the daily NYSDEC field reports as a deviation and the explanation for moving the boring will be included. The procedure for presenting recommendations for additional soil borings will begin following this initial RI. The protocols are outlined in this document and are intended to allow a rapid submittal, review, and approval for continuation of the remedial assessment process.

Prior to the advancement of soil borings, all locations will be cleared for utilities and subsurface infrastructure via private utility locating and GPR, as described in Section 2.2 and Section 2.3. This procedure is intended to cover underground utilities not listed or identified in the public utility mark-out. The GPR survey is not expected to detect small non-metallic utilities, small, buried wires, Polyvinyl Chloride (PVC) piping, or piping buried in debris or fill material that contains a greater percentage of non-soil components such as brick, concrete, timbers wood, etc. The soil boring locations will not be pre-cleared via hand or air-knife, as this removes the shallow soil/fill from inspection and will not allow for a determination regarding the presence of impacts and/or MGP-related waste in the upper unsaturated zone.

Soil borings will be advanced to native sediments (e.g., meadow mat [peat], clay, sand and silt, or glacial till) which have historically been encountered in HPFDC between approximately 15 to 20 ftbgs, or to a depth determined in the field to be sufficient for gathering subsurface data. This determination will include penetrating through surface fill material, advancing beyond the surface of the water table, and encountering native sediments. If the native sediments are encountered and found to contain no visible impacts, olfactory odors, staining, sheen, or discoloration, this will be an example indicator which allows the boring to be terminated. In the event that impacts or MGP-related waste (coal tar or purifier waste) are identified during the advancement of soil borings, soil samples will be collected in accordance with Sections 2.5.2 and 2.5.3 below.

Soil samples (cores) will be collected and logged continuously from ground surface to the bottom of the borings (native sediments) utilizing a track-mounted compact roto-sonic drill rig or Geoprobe® direct push rig. Soils retrieved from each boring will be visually classified and logged using the Unified Soil Classification System (USCS), in accordance with the FSP (Appendix B), for soil type, relative grain size distribution, texture, moisture content, and visible evidence of staining or impacts. Each sample will also be screened for the presence of VOCs with a Photoionization Detector (PID). If visually or olfactory impacted materials are observed at the bottom of the boring, the boring will be continued until non-impacted soils are observed or the limit of the drilling equipment is reached. Logs detailing soil type and composition, the presence of visual impacts, relative VOC concentration (as recorded on the PID), and any additional pertinent characteristics will be prepared for each boring location and included in the Remedial Investigation Report (RIR). Soil samples (cores) will be collected using disposable acetate liners for the Geoprobe® direct push rig or liners for the roto-sonic drill rig. Key items of note will be the presence or absence of impacts or MGP waste (coal tar-impacted fill or purifier bed material), the depth

interval impacts are present in, depth to groundwater, and the presence of impacts and/or MGP waste below the groundwater table.

Nine of the 78 total borings will be installed in a tight spacing in the southwest corner of the Site. These borings are specifically targeted to gather specific information and data for NYCEDC to advance projects which include Federal funding that will expire prior to the ability to prepare and implement a remedy. The effort will identify a path for a proposed electric conduit that will connect to an emergency generator (to be installed in the adjacent RR ROW BCP site). Gathering this information during the RI process will offer an opportunity to prioritize evaluation of the data in this area for a submittal to be made to NYSDEC that would allow this critical flood protection and resiliency work to be completed. The installation of these borings will also provide information in the RIR regarding the presence or absence of impacts that would trigger a remedial action. Two samples are proposed to be collected from each of the nine resiliency borings; one sample will be collected across the 0 to 5-foot interval to assess if material can be backfilled during installation/construction of the electrical conduit, and a second sample will be collected near the terminus of the boring in saturated native material. A third sample will be collected if impacts are encountered.

Along the eastern boundary, a portion of the relieving platform remains which was previously used to store vast quantities of coal. The relieving platform includes an approximately 430-foot-long and 50-foot-wide area consisting of paved driving surface, underlain by fill material and a 2-foot-thick concrete slab supported by wooden piles down to approximately 10 feet below surface grade. Soil boring installation in this area will include boring advancement through and sampling of the fill material, situated above the 2-foot-thick slab. One soil sample will be collected across the unsaturated zone (the saturated zone is predominantly tidally-influenced river water and not groundwater). The river is located directly beneath the platform; therefore, no drilling or sampling is proposed beyond the depth of the supporting slab.

2.5.2. Soil Sample Laboratory Analysis

Approximately 145 soil samples (not inclusive of Quality Assurance/Quality Control [QA/QC] samples) are proposed to be collected for laboratory analysis from each of the 78 initial (non-delineation) borings (alternating between one and three samples per boring) installed across the Site, provided there is ample recovery to fill all sample containers and based on the sampling strategy presented below. Sample intervals targeted for lab analysis will be dependent on the overall conditions encountered in each boring. In the event that waste is identified in a boring slated for one sample, which would require an additional sample to be collected, the procedures outlined below will be used to guide data collection. This initial investigation phase has a fixed number of samples, and it may be necessary to adjust a sample from one of the borings slated for three samples in order to meet the requirements to collect a sample from each boring at the terminus (in the saturated zone) if a boring also contains impacts.

The following procedures will be utilized during boring installation to determine sampling intervals:

Borings with Three Samples Proposed

For boring locations not containing impacts and/or MGP-related waste where three soil samples are to be collected, the samples will be collected for laboratory analysis based on the criteria below:

1. One sample will be collected in the upper half of the unsaturated zone.
2. One sample will be collected in the lower half of the unsaturated zone. If there is insufficient unimpacted material above the water table to collect two separate samples (less than 3 feet), only one sample of the unsaturated zone will be collected.
3. One sample will be collected at the boring terminus within native material (organic layer or native sand) in the saturated zone.

In the presence of impacts and/or MGP-related waste (coal tar and/or purifier waste) within the boring, samples will be collected for laboratory analysis based on the following criteria:

1. One sample will be collected in the upper or lower half of the unsaturated zone depending on where the impacted interval is located.
2. One sample will be collected in the impacted interval (based on greatest visual and/or olfactory impacts).
    a. If waste is identified above the water table, this will count as one of the samples in the unsaturated zone (depending on depth).
    b. If waste is identified below the water table, one of unsaturated zone samples will be eliminated.
3. One sample will be collected approximately two feet below the impacted interval (for separation purposes to ensure a clean sample) in the saturated native material. The priority is to sample native, un-impacted material. If refusal is encountered less than 2 feet below the impacts but native, un-impacted material is still present, the sample will be collected just above the refusal.

Borings with One Sample Proposed

4. For boring locations not containing impacts and/or MGP-related waste, the sample will be collected from native material within the saturated zone.
5. If the boring contains impacts and/or MGP-related waste:
    a. One sample will be collected from the zone with visual impacts (e.g., coal tar or purifier waste). If no visual impacts are identified, the sample will be collected from the zone with the highest PID reading.
    b. A second sample will be collected from within the native material in the saturated zone approximately 2 feet below the impacted interval (for separation purposes to ensure a clean sample). This sample will be re-allocated from a non-impacted/non-MGP-waste grid containing a boring with three proposed samples (the three-sample boring will only have two samples collected). The re-allocated sample will be from one of the unsaturated zone

samples. If this procedure is required, GEI will notify NYSDEC of which grid sample will be re-allocated.

Soil samples will be collected in laboratory-supplied containers and properly transported to a NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratory under standard chain-of-custody procedures and analyzed for the following:

- Target Compound List (TCL) VOCs by United States Environmental Protection Agency (US EPA) Method 8260D
- TCL Semi-Volatile Organic Compounds (SVOCs) by US EPA Method 8270E
- Target Analyte List (TAL) Metals by US EPA Method 6020B/7471B
- Trivalent Chromium and Hexavalent Chromium by US EPA Method 7196A
- Polychlorinated Biphenyls (PCBs) by US EPA Method 8082A
- Pesticides by US EPA Method 8081B
- Total Cyanide by US EPA Method 9012B
- 1,4-Dioxane by US EPA Method 8270E SIM
- Per- and Polyfluoroalkyl Substances (PFAS) by US EPA Method 1633A

Borings containing MGP waste (specifically coal tar) may have laboratory issues with dilution. GEI will discuss with the laboratory when the samples are received to determine if the laboratory believes that dilution may be required and if that will negatively impact the ability to meet the PFAS method detection limits (MDLs) per the April 2023 *Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS)* Guidance. If the laboratory indicates that dilution is required and as a result, MDLs will not be able to be met, GEI will cancel the PFAS analysis for the sample and notify NYSDEC.

QA/QC samples will be collected in accordance with the QAPP (Appendix C). Data will be provided in an electronic data package that is in general accordance with NYSDEC Analytical Services Protocol (ASP) Category B data deliverable requirements and submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. A Data Usability Summary Report (DUSR) will be prepared by a third-party data validator for all soil samples collected.

As required by NYSDEC and NYSDOH under the Part 375 BCP, an investigation will be performed to assist in the development of a QHHEA to support the future RAWP and DD, satisfying requirements of the BCP. This investigation will include the collection of soil, groundwater, and soil vapor samples for analysis. As part of the investigation for the QHHEA, two of the soil borings will be advanced at downgradient/perimeter locations to evaluate and document potential impacts extending to surrounding areas from on-site contamination (Figure 5). It should be noted that the downgradient boundary of 600 FCD is the East River and the adjacent Farragut Street and Hunts Point Landing Park, which are included within the RR ROW BCP Site (Site No. C203102) and will require its own investigation and remedial recommendation. Downgradient boring locations will be collected in accordance with the criteria above. Additional soil samples may be collected based on field observations. A permanent groundwater monitoring well will be installed within each downgradient QHHEA boring to allow for the

collection of a groundwater sample. Soil vapor points will also be installed adjacent to/within a 5-foot radius of the monitoring well. Groundwater and soil vapor sampling methodology is further detailed in Sections 2.6 and 2.7.

2.5.3. Soil Boring Delineation

Based on subsurface conditions encountered during the initial round of proposed borings and where impacted materials are discovered, delineation will take place in the manner described in this section. Delineation borings will be installed in order to visually delineate horizontal and vertical extents of MGP waste or other areas that appear heavily impacted. These borings will extend in four general compass directions from the source area in order to surround the original location. Distances from the initial boring may vary, but in general, step-out distances will be approximately 5 to 10 feet in all directions, depending on the conditions encountered (e.g., severity or thickness of impacts). In the event that impacts are identified in one or more of the delineation borings, an additional ring of borings will be installed outward of each boring found to contain impacts and the process will be repeated. Once a delineation boring in each direction is found to be free of impacts, soil samples will be collected for laboratory analysis, as described in Section 2.5.2, from each non-impacted boring at a depth that best corresponds with the impacted interval identified in the original impacted boring.

There is no reasonable way to determine the total number of samples that will be collected during all facets of this remedial investigation (RI) as subsurface conditions are unknown, and delineation efforts can add a large number of borings that were not originally anticipated. All additional samples collected for laboratory analysis as part of delineation efforts will be tested for the full list of parameters listed in Section 2.5.2.

The procedure for installing additional delineation borings will be as follows:

- After the initial RI borings, monitoring wells, and soil vapor points have been installed, GEI will rapidly evaluate the subsurface information collected from the drilling and sampling. This is expected to be in advance of laboratory data reporting and will function to provide the visual delineation of waste that has already been identified and sampled during the RI. This additional information gathered during the delineation is primarily focused on the physical limits (horizontal and vertical) of the waste present, as opposed to the collection and analysis of a large quantity of additional samples.
- A figure will be provided to NYSDEC illustrating the initial boring locations where impacts were encountered, accompanied by draft boring logs. Those borings will be presented to NYSDEC in order to allow delineation efforts to begin as rapidly as possible. Each impacted boring will then be surrounded by four additional borings located, approximately 5 to 10 feet from the initial boring.
- Once delineation efforts begin, each impacted boring will be surrounded with a minimum of four borings. Each consecutive ring will include additional borings only in the directions which were impacted. Should borings within the initial ring be found to be non-impacted, a sample will then be collected from the interval which best correlates to the initial waste interval encountered. The sample will be submitted for the full list of parameters included in Section 2.5.2. This will generate four additional samples for each impacted boring location.

2.5.4. Soil Boring Backfilling

Borings will either be grouted or backfilled with a combination of Morie No. 2 sand, and bentonite chips (as needed). Borings in asphalt or concrete will be repaired and patched at the surface in kind to help prevent settlement. Drilling equipment used to collect samples will be decontaminated between each boring location, in accordance with procedures specified in the FSP (Appendix B). All drill cuttings, impacted material, and investigation-derived waste (IDW), will be containerized in 55-gallon steel drums for future characterization and disposal. Further material handling procedures are discussed in Section 2.8.

2.6. Monitoring Well Installation and Sampling

The RIWP proposes the installation of 11 permanent, flush-mounted monitoring wells to be installed on the Site to assess shallow groundwater quality. Two of the monitoring wells will be installed at the downgradient QHHEA locations. The monitoring wells will be constructed with 2-inch inner diameter, threaded, flush-joint, PVC casing and approximately 10 feet of 0.02-inch slot screen. The annulus around the screens will be backfilled with silica sand having appropriate size for the subsurface conditions (e.g., Morie No. 2). The screens will be placed across the approximate water table to allow for the monitoring of Light Non-Aqueous Phase Liquid (LNAPL), if present. If MGP-related impacts (coal tar and/or purifier waste) are present, the well will be installed to provide data that will support the remedial design.

No additional on-site soil borings are anticipated to be converted into groundwater monitoring wells during the RI/MGP waste investigation/delineation unless specific conditions are identified with respect to groundwater (e.g., Non-Aqueous Phase Liquid [NAPL] or Dense Non-Aqueous Phase Liquid [DNAPL]) are identified in the boring during drilling. The proposed monitoring well locations are shown in Figure 5 and will be used to evaluate the potential migration of on-site impacts to surrounding properties and to assess the groundwater conditions behind the existing bulkhead.

After a minimum of 24 hours, the monitoring wells will be developed until the well is reasonably free of sediment and the turbidity is measured to be less than 50 nephelometric turbidity units [NTU], if possible. If the turbidity cannot be meaningfully reduced to below 50 NTU after one to two hours of development time, a minimum of 10 well volumes will be removed. The level of effort, however, is dependent upon the nature of the soils at each location. Monitoring well installation, construction, development, decontamination, and IDW handling procedures are specified in the FSP (Appendix B). Water generated during development and sample purging will be containerized in 55-gallon drums for future characterization and disposal. Prior to the collection of groundwater samples, GEI will conduct a synoptic gauging event of the installed monitoring wells and this data will be used to generate a groundwater contour map, which will be included in the RIR.

One groundwater sample will be collected from each of the monitoring wells (not inclusive of QA/QC samples) and a period of at least one week will be allowed between development and sampling. Prior to sampling, the headspace within each well will be measured with a PID. An oil/water level interface probe will be used to measure the depths to the water table and thickness of any free product in the wells. The monitoring wells will be purged using low-flow purging techniques to remove a minimum of three times

the volume of standing water in the well to allow for collection of a representative sample. Groundwater samples will then be collected using dedicated sampling equipment (e.g., bailer or pump tubing). Field parameter readings will be monitored during sampling including pH, oxidation reduction potential (ORP), specific conductance, and dissolved oxygen (DO). These groundwater samples will be analyzed for the following:

- TCL VOCs by US EPA Method 8260D
- TCL SVOCs by US EPA Method 8270E
- TAL Metals by US EPA Method 6020B/7470A
- Trivalent Chromium and Hexavalent Chromium by US EPA Method 7196A
- PCBs by US EPA Method 8082A
- Pesticides by US EPA Method 8081B
- Total Cyanide by US EPA Method 9012B
- 1,4-Dioxane by US EPA Method 8270E SIM
- PFAS by US EPA Method 1633A

QA/QC samples will be collected according to the QAPP (Appendix C). Additional lab analyses may be included based on field observations, with prior NYSDEC approval. Groundwater samples will be properly transported to a NYSDOH ELAP-certified laboratory under standard chain of custody procedures. Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared by a third-party data validator for all groundwater samples collected.

2.7. Indoor Air and Soil Vapor Installation and Sampling

2.7.1. Soil Vapor Installation and Sampling

A soil vapor analysis will be performed in the vicinity of the groundwater monitoring wells, along the outside perimeter of the Sultana warehouse, as well as at the downgradient/site perimeter locations to characterize the potential for soil vapor intrusion into the building and offsite. A total of nine soil vapor points are proposed to be installed immediately adjacent to and around the perimeter of the Sultana warehouse as well as at an upgradient location near the eastern waterfront. Two of the nine soil vapor samples will be collected at downgradient locations as part of the QHHEA. Six interior sub-slab sample locations are also proposed within the warehouse building, which will be co-located with indoor air samples, as further discussed in Section 2.7.2. The proposed sampling locations are shown in Figure 5.

Outdoor permanent soil vapor points will not be installed in locations where impacts or MGP-related waste (coal tar and/or purifier waste) are identified since those areas will be targeted for remediation, making the data unrepresentative of post-remedial conditions. If impacts are encountered in the concurrent soil borings of the proposed soil vapor point locations, the vapor point will be installed in the nearest boring not containing impacts or MGP-related waste (coal tar and/or purifier waste). If the nearest well is installed at a boring location containing impacts or MGP-related waste, the soil vapor data

will be compared to the nearest unimpacted well. Each soil vapor probe will be installed in the unsaturated zone approximately 2 ftbgs and using a stainless-steel screen that is fitted to dedicated $^{1}/_{8}$-nch Teflon tubing secured with stainless steel fittings and caps to the ground surface. Following tubing installation, porous, inert backfill material will be used to backfill the hole and create a sampling zone approximately 1 to 1.5 feet in length. The top 6 inches will be sealed with a bentonite slurry to prevent ambient air from entering the area around the probe.

Prior to purging and sample collection, a multi-gas meter will be used to measure the concentration of oxygen (O_2), carbon dioxide (CO_2), and methane (CH_4) in each probe, to assess the subsurface chemistry (e.g., redox state). Additionally, the sampling point will be screened for VOCs via PID.

As required by the NYSDOH, a helium (He) tracer will be used as part of the sampling process, and all testing procedures will follow the *Final Guidance for Evaluating Soil Vapor in the State of New York (2006) with updates (SVI Guidance)*. If greater than 10% He is detected during the screening process, this will indicate excessive leakage and will require the point to be resealed or reinstalled after which tracer gas testing will be performed. Prior to sample collection, the He vapor will be screened using a field meter and the measurement recorded at each soil vapor sampling location.

Upon confirmation that the seal is secure, a pump will be used to purge the vapors in the probe and tubing of three volumes. Following this procedure, the soil vapor samples will be collected in clean, batch-certified, 1-liter SUMMA™ canisters at flow rates no greater than 200 milliliters per minute (ml/min) and analyzed for the full VOC analyte list via US EPA Method TO-15, including Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and naphthalene. Sample collection will be performed over the course of approximately 2 hours.

QA/QC samples will be collected in accordance with the QAPP (Appendix C). Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared for all soil vapor samples collected.

2.7.2. Indoor Air and Ambient Air Sampling

In addition to the six interior sub-slab vapor locations, six indoor air samples are proposed to be co-located and collected within the warehouse as per the *Final Guidance for Evaluating Soil Vapor in the State of New York (2006) with updates (SVI Guidance)*. All indoor air and interior sub-slab vapor samples will be collected during the heating season.

The indoor air samples will be collected in clean, batch-certified, 6-liter canisters at flow rates no greater than 200 ml/min and analyzed for the full VOC analyte list via US EPA Method TO-15, including BTEX and naphthalene. Sample collection will be performed over the course of approximately 8 hours and collected simultaneously with an ambient air sample outside of the building.

QA/QC samples will be collected in accordance with the QAPP (Appendix C). Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared for all indoor air and ambient air samples collected.

2.8 Investigation Derived Waste Management

All drill cuttings (impacted and non-impacted) will be containerized in 55-gallon steel drums. During well development and sampling, all purged groundwater will also be containerized.

Laboratory data from samples will be used to generally characterize material but sampling for disposal will be required. Removal of drums is expected to take place during the RAWP process or during remediation efforts. This will require drums to remain on-site for a long period of time. The Site is secure; therefore, vandalism is not a significant concern. All drums will be staged together in a secure location approved by NYCEDC.

2.9 Site Restoration

The proposed locations of soil borings are primarily located in areas of asphalt or driving surface. All investigation locations in paved areas will be patched with concrete or asphalt following backfilling with non-impacted drill cuttings and/or an inert material (e.g., sand, grout).

2.10 Survey

Following completion of the RIWP activities, a survey of all soil boring, permanent monitoring wells, and permanent soil vapor locations will be prepared. The elevation of each completed element will be determined to ±0.01 foot. All locations will be provided in the New York State Plane Coordinate System.

2.11 Reporting

Reporting is discussed in Section 5.

3. Quality Assurance/Quality Control (QA/QC) Protocols

QA/QC protocols are included in QAPP in Appendix C.

4. Health and Safety Protocols

Health and safety protocols are detailed in the HASP, which is included in Appendix D.

5. Data Evaluation and Remedial Investigation Report

Soil and groundwater sample results will be compared to NYCRR Part 375 Commercial Use Soil Cleanup Objectives (SCOs) and the New York State Technical and Operational Guidance Series (TOGS) Ambient Water Quality Standards (AWQS) and Guidance Values for Class GA, respectively. In addition to utilizing NYCRR Part 375 Commercial SCOs, soil data will also be compared to Part 375 Protection of Groundwater SCOs for contaminants that are contravening groundwater standards. Soil vapor data will be compared to the guidance values set forth in the *Final Guidance for Evaluating Soil Vapor in the State of New York (2006) with updates (SVI Guidance)*.

5.1. Data Evaluation

The purpose of the analytical data evaluation is to determine and delineate the nature and extent of onsite soil and groundwater impacts, assess the potential for soil vapor intrusion into the Sultana warehouse, and to assure that data obtained during the implementation of the RIWP are adequate in quantity and quality, and applicable to project objectives. Additionally, data will be evaluated to assess the potential for offsite migration of on-site contamination. In order to make this determination, the data will be reviewed for the quality of data coverage, compatibility of data collection methods, and completeness, with respect to meeting project objectives.

To facilitate the interpretation of data generated during the RI activities, the data will be tabulated in data summary tables. Figures showing sampling locations with the corresponding analytical results will be prepared to enhance the overall understanding of Site conditions with regards to the magnitude, location, and flow and transport of contamination.

5.2 Geologic/Hydrogeologic and Water Quality Characteristics

Geologic and hydrogeologic characterization will incorporate the results of subsurface investigation and sampling efforts, groundwater sampling and monitoring activities, as well as general hydrogeologic and hydraulic features of the Site. The characterization will set forth conclusions regarding the direction, gradients, and potential fluctuations or anomalies of shallow groundwater in the immediate vicinity of the Site. Shallow material within the entire Hunts Point peninsula has been found to contain large amounts of non-native fill that includes construction and demolition debris, coal and coal ash, cinders, and slag within sand and gravel, of which the shallow groundwater encounters and flows within. Following completion of the activities under the BCP, the Site will have a deed restriction filed to restrict the use of groundwater, as the quality of the shallow groundwater is not able to be treated for potable use. New York City is served by a public water supply fed by regulated New York State reservoirs, removed from and unaffected by onsite contamination. Shallow groundwater along the East River also has a saline component that would be exacerbated in the event that significant groundwater was withdrawn from the ground via dewatering for treatment. Sampling of the groundwater will be conducted in order to further document existing conditions and to assess the presence of NAPL or DNAPL that would require attention.

5.3 Qualitative Human Health Exposure Assessment

The purpose of the QHHEA is to document how people may be exposed to site contaminants and to identify and characterize the potentially exposed current population under the current and future use of the Site. The exposure assessment must evaluate the five elements associated with exposure pathways and describe how each of these elements pertains to the site being evaluated. The exposure pathway elements that must be addressed include:

1. A description of the contaminant source(s) including the location of the contaminant release to the environment (any waste disposal area or point of discharge) or if the original source is unknown, the contaminated environmental medium (soil, indoor or outdoor air, biota, water) at the point of exposure.
2. An explanation of the contaminant release and transport mechanisms to the exposed population.
3. Identification of all potential exposure point(s) where actual or potential human contact with a contaminated medium may occur.
4. Description(s) of the route(s) of exposure (i.e., ingestion, inhalation, dermal absorption).
5. A characterization of the receptor populations who may be exposed to contaminants at a point of exposure.

In addition to human exposure, the QHHEA will also address the potential for fish and wildlife impacts from Site contaminants and the potential for onsite contamination to impact adjacent parcels. Since the Site is bounded by a combination of closed VCP sites and by water along the eastern perimeter, which is also downgradient of Site, borings for the QHHEA will be advanced at the most downgradient areas along the Site perimeter. Sampling is currently not proposed to be conducted within the adjacent river, or within sites that have already been remediated and closed under the BCP and/or the former VCP, any BCP sites undergoing their own investigation and remediation, or any sites remediated under the BCP and pending final closure.

5.4 Additional Field Investigations

Additional field investigations may be required as the data is developed during the implementation of the site investigation. Conditions that would warrant additional investigation include data gaps, further delineation of groundwater or soil contamination, exterior sample results that may warrant an interior investigation within the building (if feasible), or additional data necessary to evaluate or determine the effectiveness of a potential remedial alternative technology.

If additional investigation is required beyond the delineation presented in this document, a Preliminary Design Investigation (PDI) scope will be prepared and submitted to the NYSDEC for review and approval for implementation. PDI scopes may not require samples being collected for laboratory analysis as they may fill non-analytical data gaps. In the event samples may be necessary, they are not intended to be full deliverable data packages with DUSRs but would be to support engineering assessments and evaluation or to provide clarity on physical conditions such as groundwater availability to assess various remedial options. This scope does not address or discuss any of those potential options as it is inappropriate at

this time. PDI scopes may be performed at any time in order to address issues that relate to remedial decision making and they do not require submittal and approval of RIR and RAWP.

In addition, NYSDEC has presented modifications to NYCRR Part 375, and those changes may be finalized following the completion of investigation efforts at the Site. If modifications are finalized, which include requirements for additional data collection, those will be evaluated during the preparation of the RAWP.

5.5 Remedial Investigation Report

The results of the investigation effort, along with supporting documentation, will be provided to the NYSDEC in the form of a RIR. The RIR will contain a description of the source or deposit of waste material, as well as characterizations of the geologic, hydrogeologic, soil, soil vapor, and water quality. Laboratory deliverables will consist of a data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements. Additionally, DUSRs will be prepared by a third-party data validator for all soil, groundwater, soil vapor, and indoor air samples collected. All data generated as part of the RI will be submitted to NYSDEC in the appropriate EDD format.

Based on the findings of the RI, a list of remedial action objectives will be developed with the requirement of the selected remedial measures to be protective of human health and the environment under the proposed future use scenario. The Site SCOs will be based on published standards, criteria, and guidance (SCGs) and other NYSDEC and NYSDOH accepted values for a commercial property based on the current and future use of the Site.

6. Citizen Participation Activities

GEI prepared a Citizen Participation Plan (CPP) for the Site following receipt of the local community notification list from NYSDEC. The CPP includes:

- Establishment of a Community Information Repository at the local library and local community board.
- Ability to participate in public meetings that the NYSDEC and NYCEDC deem necessary to apprize the community of the current or proposed activities.
- Dissemination of approved fact sheets to the Site Contact List.

A description of the plan is presented below.

6.1 Description of Citizen Participation Activities

This section describes the specific citizen participation activities that are to be conducted during the implementation of the RIWP.

6.1.1 Citizen Participation Plan

The CPP was approved by NYSDEC on November 6, 2024. The CPP and previously prepared documents, such as the BCP application, Consent Order, and NYSDEC approvals, have been filed in the project repositories.

6.1.2 RIWP

The final RIWP will be placed on file in the document repository and will be released for a 30-day public comment period via a Fact Sheet.

6.1.3 Interim Remedial Measures (IRMs)

If an IRM is to be implemented, the public will be involved as part of the Citizen Participation process.

6.1.4 Remedial Investigation Report

The draft RIR will be placed in the information repositories and the public will be notified of this with the fact sheet that describes the RI results.

6.1.5 Remedial Action Work Plan

A draft RAWP will be prepared which details the proposed remedial action plan. Upon submittal of the draft RAWP, a NYSDEC fact sheet will be distributed announcing a 45-day public comment period. A public comment meeting led by NYSDEC pertaining to the proposed remedial action (if requested by the community or at discretion of the NYSDEC project manager) will be held within the 45-day public

comment period. Following the public comment period, NYSDEC will issue a DD, at which time the RAWP will be finalized and placed in the project repositories.

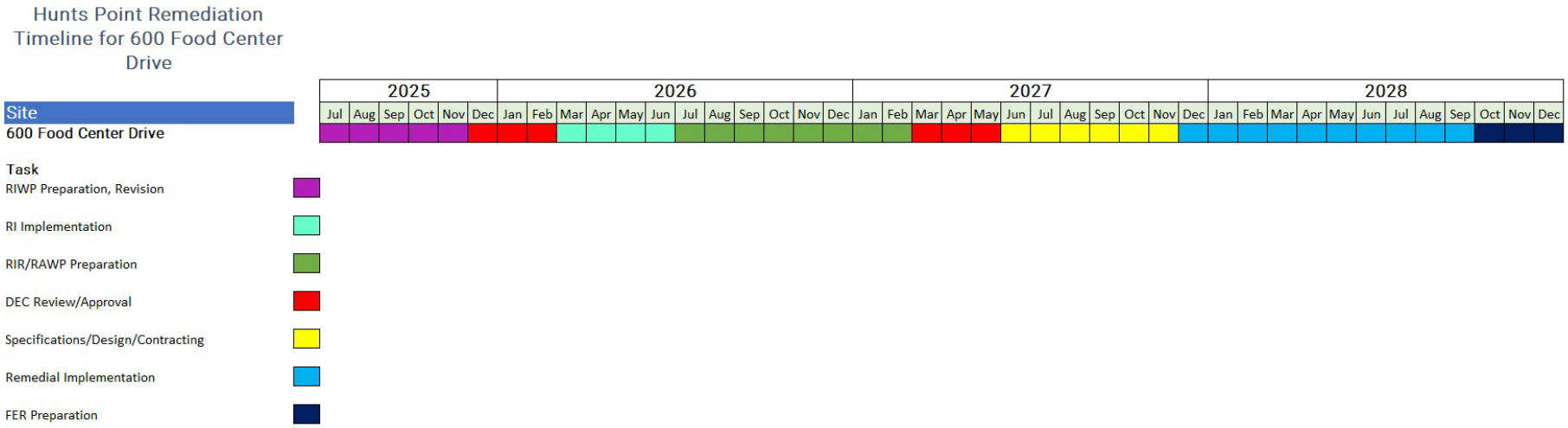
6.1.6 Post Remedial Action

Following completion of the remedial action, or actions, two Fact Sheets will be prepared. The first will summarize the FER, and the second will announce the issuance of the Certificate of Completion (COC).

7. Schedule

The project schedule for implementation of the RIWP activities is presented below. The schedule may be affected by regulatory review time periods, contractor response timeframes, periods of time necessary to negotiate access agreements with property owners, community issues, permit review and approval timeframes, or other unknown factors. Additionally, if the scope of the proposed RIWP changes as a result of negotiating access or regulatory review, then revisions to the work plan, specifications, change orders with subcontractors and/or the schedule presented herein may be necessary. Every effort, however, will be made to keep the project on the anticipated schedule.

The field investigation present within this RIWP will be implemented within six months of the formal approval of the Draft RIWP. Once the RIWP has been formally accepted and the public comment period has concluded, GEI will begin the procurement process for subcontractors. The schedule will include approval from stakeholders, tenants, NYCEDC, and Con Edison. The schedule for subsequent milestones is illustrated below.


Hunts Point Remediation Timeline for 600 Food Center Drive
2025
2026
2027
2028
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Site
600 Food Center Drive
Task
RIWP Preparation, Revision
RI Implementation
RIR/RAWP Preparation
DEC Review/Approval
Specifications/Design/Contracting
Remedial Implementation
FER Preparation

8. References

City Planning Commission (2025). Article I General Provisions. Zoning Resolution. New York: Department of City Planning, August.

FEMA (2025). Federal Emergency Management Area Flood Maps. Washington: United States Department of Homeland Security, October.

HDR (2005). "Phase I Environmental Site Assessment 600 Food Center Drive Bronx, New York," prepared for New York City Economic Development Corporation, October.

HDR (2010a). "Hunts Point Food Distribution Center Redevelopment Plan Engineering Report Parcel B, Bronx, NY Final," prepared for New York City Economic Development Corporation, January.

HDR (2010b). "Hunts Point Food Distribution Center Final Engineering Report Parcels C OU-1 & OU-2, Bronx, NY Final," prepared for New York City Economic Development Corporation, October.

NYSDEC (2010). Appendix 2B: Guidance For Data Deliverables and Development of Data Usability Summary Report (DUSR). New York: Department of Environmental Conservation, May.

NYSDEC (2021). Citizen Participation Handbook for Remedial Programs. DER-23. New York: Department of Environmental Conservation, Division of Environmental Remediation, January.

NYSDEC (2010). DER Technical Guidance for Site Investigation and Remediation. DER-10. New York: Department of Environmental Conservation, Division of Environmental Remediation, May.

NYSDEC (1998). Division of Water Technical and Operational Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values and Effluent Limitations. New York: Department of Environmental Conservation, June.

NYSDEC (2023). Environmental Remediation Programs. 6 NYCRR Part 375. New York: Department of Environmental Conservation, Division of Environmental Remediation, February.

NYSDEC (2023). Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs. New York: Department of Environmental Conservation, April.

NYSDEC (2010). Soil Cleanup Guidance. Commissioner's Policy (CP) 51. New York: Department of Environmental Conservation, October.

NYSDOH (2006). Final Guidance for Evaluating Soil Vapor in the State of New York with updates (SVI Guidance). New York: Bureau of Environmental Exposure Investigation, October.

Figures

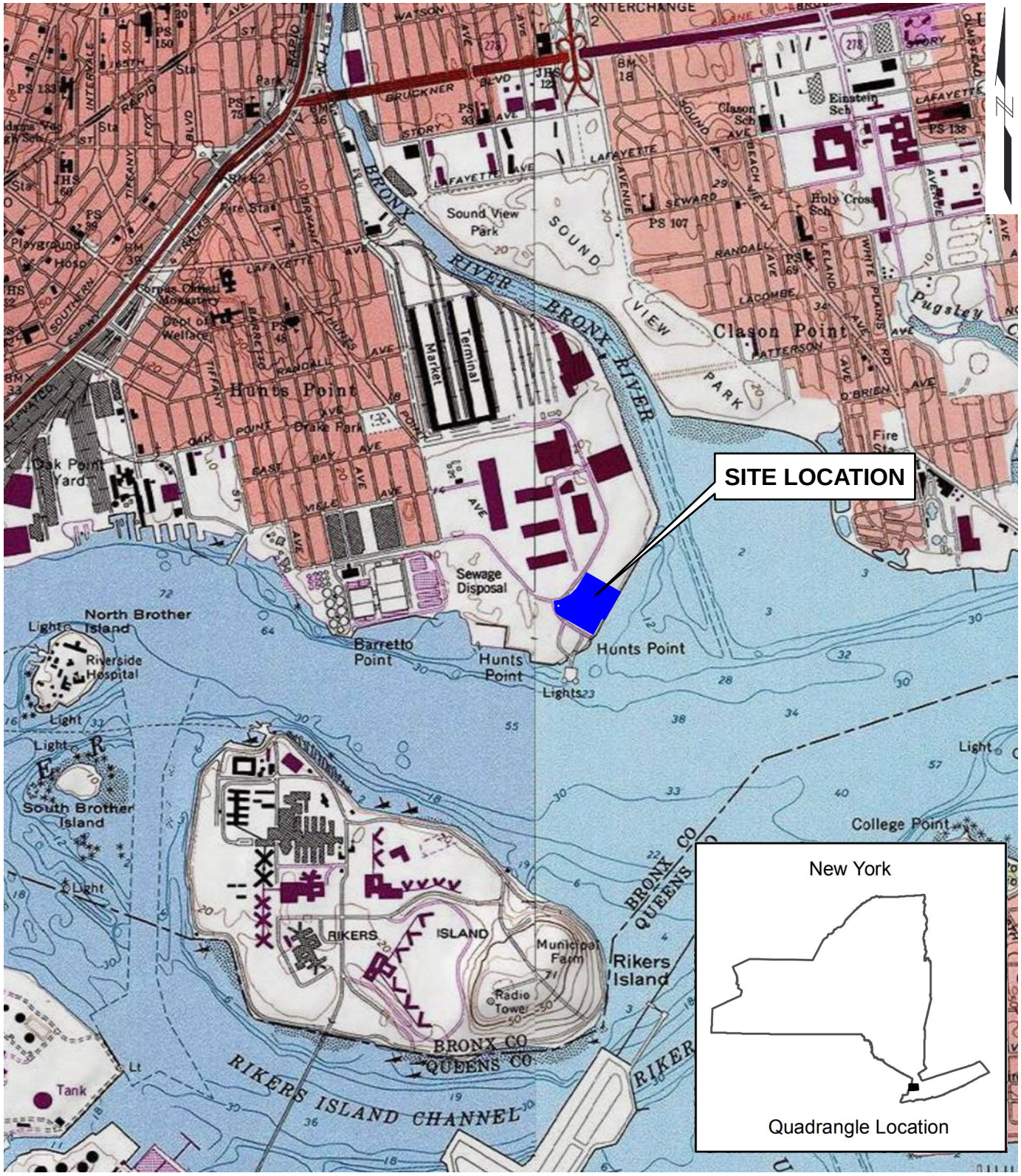
Figure 1. Site Location

Figure 2. Site Layout

Figure 3. Site Layout with Historic MGP Structures

Figure 4. FEMA Flood Zone Map

Figure 5. Proposed Sampling Locations



SOURCE:
1. USGS 7.5' TOPOGRAPHIC QUADRANGELS
CENTRAL PARK, NY; FLUSHING, NY

0 970 1,940
SCALE: 1:24,000

Remedial Investigation Work Plan 600 Food Center Drive (BCP No. C203104) Bronx, New York	GEI	SITE LOCATION
New York City Economic Development Corporation (NYCEDC) New York, New York	Project 2303564	February 2026 Fig. 1

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx



SOURCE:
1. ESRI WORLD IMAGERY

0 70 140
SCALE: 1:1,700

Remedial Investigation Work Plan
600 Food Center Drive (BCP No. C203104)
Bronx, New York

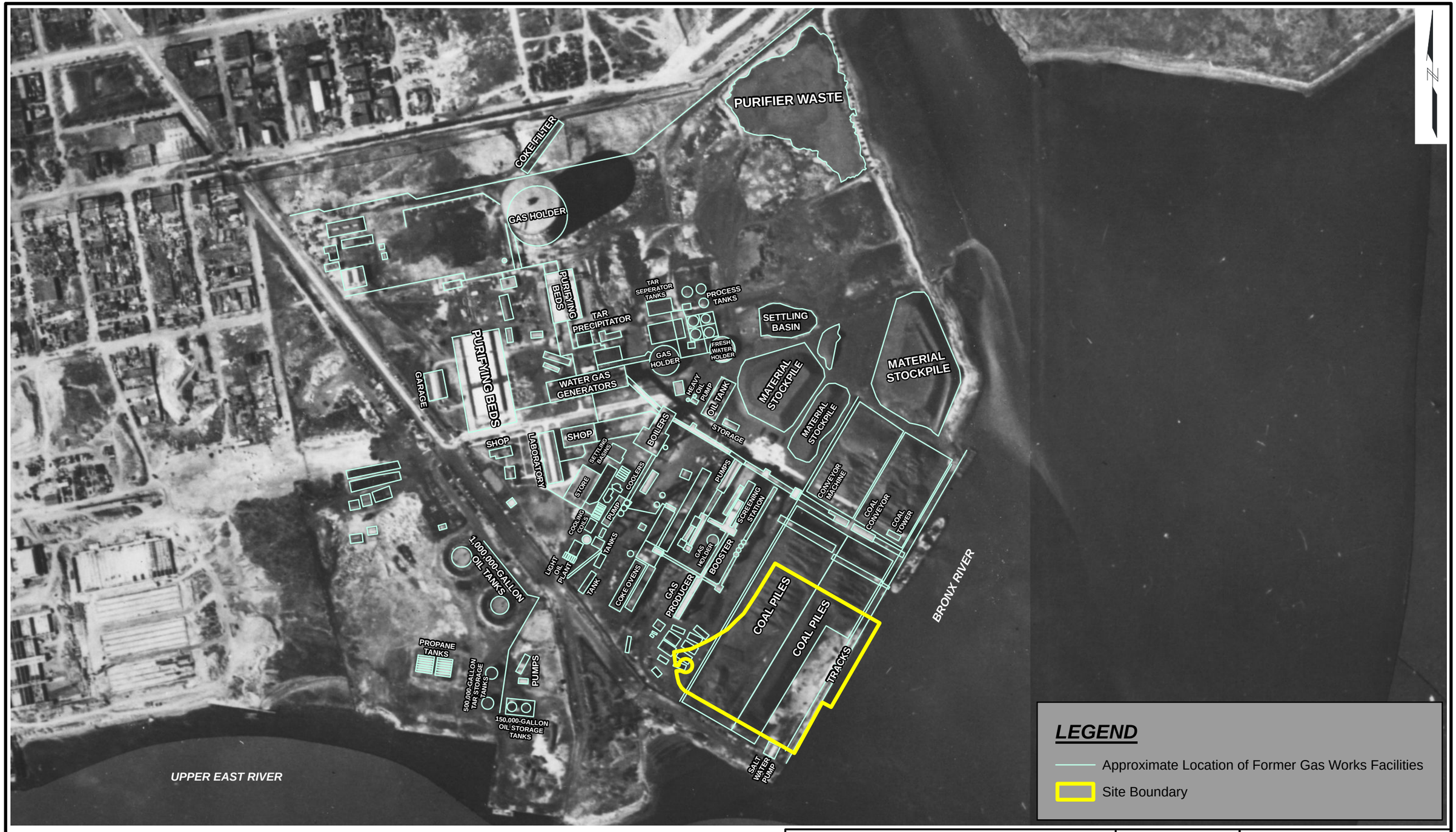
New York City Economic Development Corporation (NYCEDC)
New York, New York

GEI

SITE LAYOUT

Project 2303564 | February 2026 | Fig. 2

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx



LEGEND

- Approximate Location of Former Gas Works Facilities
- Site Boundary

SOURCE:
1. 1951 ORTHO, THE CITY OF NEW YORK

0 360 720

SCALE: 1:4,925

Remedial Investigation Work Plan
600 Food Center Drive (BCP No. C203104)
Bronx, New York

New York City Economic Development Corporation (NYCEDC)
New York, New York

GEI

SITE PLAN WITH HISTORIC MANUFACTURED GAS PLANT STRUCTURES

Project 2303564 | February 2026 | Fig. 3

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx



SOURCE:
1. ESRI WORLD IMAGERY
2. FEMA NATIONAL FLOOD HAZARD LAYER

0 230 460

SCALE: 1:3,150

Remedial Investigation Work Plan
600 Food Center Drive (BCP No. C203104)
Bronx, New York

New York City Economic Development Corporation (NYCEDC)
New York, New York

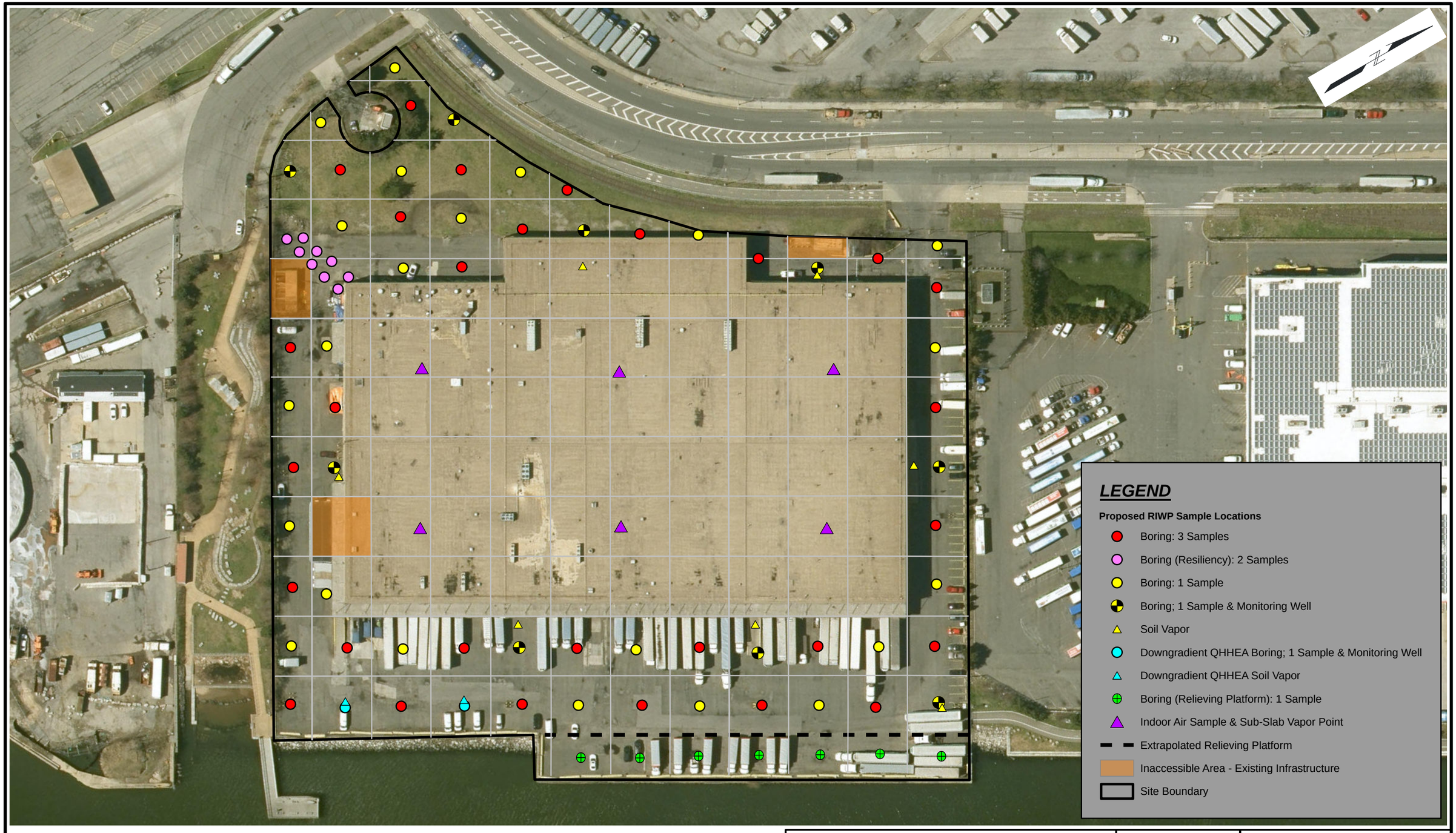
GEI

Project 2303564

FEMA FLOOD ZONE MAP

February 2026 Fig. 4

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx



SOURCE:
1. ESRI WORLD IMAGERY

NOTES:
1. The two soil vapor points adjacent to the building in the eastern portion of Site may be moved outward towards the waterfront if there is a concrete loading dock apron.
2. The seven borings along the eastern relieving platform can only be advanced 8 to 9 feet below ground surface (ftbgs) where the concrete slab is located. No soil sample will be collected from the saturated zone in this area.

0 75 150

SCALE: 1:1,100

Remedial Investigation Work Plan
600 Food Center Drive (BCP No. C203104)
Bronx, New York

New York City Economic Development Corporation (NYCEDC)
New York, New York

GEI

PROPOSED SAMPLING LOCATIONS

Project 2303564 | February 2026 | Fig. 5

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx

Appendix A Key GEI Personnel Resumes

Gary Rozmus, P.E.
Senior Consultant

resume

Gary Rozmus is a recognized leader in the environmental services and Brownfield redevelopment marketplace. His expertise is in Brownfield redevelopment and risk-based closure (including area-wide and site specific planning and redevelopment); site assessment (Phase I, II and II ESAs, soil vapor intrusion and RI/FS); remediation; environmental compliance; regulatory interaction and negotiations; permitting; impact assessments; hazardous materials management; GIS mapping and inventory; hazardous and non-hazardous waste management; litigation support; design, construction and facility decommissioning and demolition environmental services; stormwater and wastewater management; natural resource assessments; landfill closure; emergency incident/derailment consulting response; sustainable environmental design; and real estate transaction and support.

EDUCATION
M.S., Civil Engineering, Polytechnic Institute of New York
B.S., Civil Engineering, Manhattan College

EXPERIENCE IN THE INDUSTRY
45 years

EXPERIENCE WITH GEI
6 years

REGISTRATIONS AND LICENSES
Professional Engineer, NY No. 056744
Professional Engineer, LA No. 0024470
Professional Engineer, TN No. 103375

PROFESSIONAL ASSOCIATIONS
NYC Brownfield Partnership, BOD & Former First President
National Brownfield Assoc., Former Member of NYS Executive team and National Advisory Board
National Brownfield Conference, Speaker and Conference Planning Committee

Brownfield Opportunity Area (BOA) and Brownfield Redevelopment Experience

Gary has managed area-wide Brownfield contracts under nine NYSDOS Brownfield Opportunity Area grant awards. The following projects summarize Gary's BOA experience, as well as other Brownfield and grants-related experience:

City of Mt. Vernon Canal Village Brownfield Opportunity Area (BOA) and Local Waterfront Revitalization Plan (LWRP) Study, Mt. Vernon, NY. Environmental Project Manager for the Canal Village combined BOA and LWRP project to develop a redevelopment plan for the 251-acre waterfront area which includes the industrial area in the southeast corner of the City. This area lays along the eastern edge of the city limits that coincide with the Hutchinson River and its southern boundary with the Bronx, New York City. Because this planning effort has been made possible by two separate grants being combined—New York State's BOA and LWRP programs—there are two separate project boundaries which overlap. The work will serve as a BOA Nomination Report and as a neighborhood master plan for the Canal Village and the Hutchinson River Waterfront. This project included a study of the transportation and pedestrian network; industrial sector and regional relationships; strategic redevelopment sites investigation; public outreach; climate change impacts, habitat restoration, waterfront redevelopment plans, and green infrastructure opportunities; economic and market conditions study; urban design and open space considerations; and priority/catalytic redevelopment site selections.

City of Newburgh Brownfield Opportunity Area (BOA) Project, Newburgh, NY, City of Newburgh. Environmental Task Leader for the study to create a strategy for revitalizing and redeveloping the Census Tract area of the city of Newburgh, New York. This work included analysis of local, regional, and national markets to determine best land use revitalization, inventory and analysis of brownfield sites, existing land use patterns and zoning, transportation systems and infrastructure, and natural resources and environmental features. Tasks included community outreach and participation in the BOA process and the development of a redevelopment master plan.

Sunset Park Brownfield Opportunity Area Study, Brooklyn, NY. Environmental Project Manager for the UPROSE Brownfield Opportunity Area (BOA) project to develop a redevelopment plan for the 694-acre waterfront in Sunset Park Brooklyn NY. This project included a study of the transportation and pedestrian network; industrial sector and regional relationships; strategic redevelopment sites investigation; public outreach; climate change impacts, habitat restoration, and green infrastructure opportunities; economic and market

conditions study; urban design and open space considerations; and priority/catalytic redevelopment site selections.

Bradhurst Brownfield Opportunity Area Study, Harlem, NY. Environmental and Transportation Services Project Manager for the Harlem Congregations for Community Improvement (HCCI) Brownfield Opportunity Area (BOA) project. This involved conducting an analysis of existing conditions in the Bradhurst BOA and creating recommendations employing redevelopment and urban design strategies to facilitate community revitalization and economic growth. The work included an analysis of the community and regional setting, Brownfield and vacant sites, infrastructure, and economic development and market conditions to develop recommendations for the redevelopment of strategic sites in the BOA.

Long Beach Brownfield Opportunity Area Study, Long Beach, NY, City of Long Beach. Project Manager responsible for providing professional planning services for the preparation of the Brownfield Opportunity Area (BOA) Pre-Nomination study for the revitalization of the Bayfront area consistent with New York State Department of State and New York State Department of Environmental Conservation requirements. The project area was along Reynolds Channel on the southern shore of Long Island that is programmed for mixed-use redevelopment, including mid-rise residential development and a waterfront promenade.

Brownfields Opportunity Area Nomination Study, Huntington, NY. Project Manager responsible for the preparation of a two-phase Brownfields Opportunity Area Nomination study for the revitalization of the Huntington Station area. Two BOA grants were obtained by the Town for the work. The first phase of the study identified four strategic subareas for redevelopment. The second phase of the work included evaluating alternative redevelopment scenarios involving two of the strategic subareas and identifying conceptual plans for the redevelopment of one of the principal catalytic sites in the BOA. This included providing assistance in securing the Part II BOA Grant.

Greater Jamaica Brownfield Opportunity Area Study, Jamaica NY. Project Manager. Evaluated the potential for redevelopment of several former industrial parcels located adjacent to the Long Island Railroad Station and the recently developed MTA JFK Airlink terminal. The project focused on developing strategic land use and policy strategies to support public-private partnerships for the development of a transit-oriented development in the city blocks adjacent to the station. The proposed development includes a series of mixed-use mid-rise buildings and a hotel. Services included Site Reuse Planning, Infrastructure Analysis, Environmental Assessments and traffic impacts analysis. This BOA has received a Step 3 Implementation grant.

Newtown Creek Brownfield Opportunity Area, Brooklyn, NY, Greenpoint Manufacturing and Design Center. Project Manager coordinating following tasks: planning, developing a public engagement strategy, attending meetings, analyzing existing conditions of the study area, developing conceptual design guidelines, completing an economic analysis, developing a geographic information system (GIS) database, and preparing project recommendations and a Nomination plan document.

Brownfield Redevelopment, Babylon, NY, Town of Babylon. Senior Project Manager and Principal-in-Charge responsible for conducting Phase I and Phase II assessments and end-use planning and for providing other engineering services related to the brownfield redevelopment of the Straight Path Area in the Hamlet of Wyandanch. This work was funded under a U.S. Environmental Protection Agency Brownfield Grant.

NY City Brownfield Cleanup Program and SPEED Portal (Searchable Properties Environmental E-Database), New York City Mayor's Office of Environmental Remediation. Environmental Project Manager for the development of a database for the NYC Brownfield sites Voluntary Cleanup Program and the SPEED portal which provides land use and environmental data for the entire City with the goal to promote the redevelopment of potentially contaminated and under-utilized sites.

Kevin P. McCarty
Senior Environmental Practice Lead

resume

Kevin McCarty is a principal geologist in GEI's New York City office. His experience includes environmental construction management, design, permitting and implementation during construction, specifically within NYC. He has more than 30 years of experience working on a wide variety of sites that have involved regulatory programs and New York State Department of Environmental Conservation (NYSDEC) oversight. These sites have included multiple divisions within NYSDEC and have covered nearly every region within New York State.

Mr. McCarty also specializes in solid waste management in construction projects. His knowledge covers material generated from both upland locations and excavations, demolition of existing structures, and material removed from underwater excavation or dredging. Mr. McCarty has over 20 years of environmental construction management experience on above- and below-ground projects. He has historically managed the environmental construction management aspects for the New York City Department of Environmental Protection (NYCDEP) Bureau of Engineering Design and Construction Combined Sewer Overflow Program.

EDUCATION
B.A., Geology/Earth Science, Western Connecticut State University

EXPERIENCE IN THE INDUSTRY
36 years

EXPERIENCE WITH GEI
6 years

PROJECT EXPERIENCE

Hunts Point Comprehensive Brownfield Cleanup Program/Redevelopment, Bronx, NY. Senior Project Manager in charge of moving 8 Sites from the Voluntary Cleanup Program and creating new applications to the BCP. Negotiating a multi-year comprehensive agreement with Con Ed and implementing all facets of investigation, design and remedial actions in order to satisfy the State Program requirements. Included in this are remedial efforts never attempted in the United States following the most sustainable and protective criteria for facilities and infrastructure and incorporating multiple new developments and resiliency into the entire complex effort. The overall area incorporates over 200 acres of City-owned property, multiple tenant leased spaces and open space for completing the Hunts Point Vision Plan. The effort requires multi-stakeholder negotiations, review of documentation from a wide variety of consultants, negotiation with City and State agencies for each phase and reporting to the local community board regularly on the progress. Project work requires meeting all City procurement requirements, minority and women-owned business criteria as well as completing all work within specified budgets. Mr. McCarty has been fully responsible for every aspect of this endeavor working with everyone involved, from the GEI team to the City and State.

Environmental Hazardous Investigation Contract, New York City Economic Development Corporation (NYCEDC), New York, NY. Served as program manager for NYCEDC environmental hazardous investigation contracts since 1998. Managed the brownfield

redevelopment and Regulatory aspects of this contract under an agreement with NYCEDC. Responsible for coordination and management of projects including investigations for redevelopment on various types of property owned by NYC. The work relies heavily on coordination with city and state agencies for review and approval of documents that are related and required for various programs including Voluntary Cleanup Program and Brownfields Program. Also responsible for thirteen Voluntary Cleanup Agreements between NYC and the State of New York that involved a former manufactured gas plant site.

NYCDEP Specifications Rewrite, Omnibus BUD, New York, NY. Contracted by NYCDEP to assist in a multi-year rewrite of all DEP materials management specifications and Standard Operating Procedures and create a large-scale, Department-wide program that will incorporate reduced disposal and increased reuse of construction material on DEP projects. During this effort, NYSDEC has asked for assistance and coordination in the rewriting of the State Solid Waste Regulations for the first time in a quarter century. The second revisions are currently underway.

Yankee Stadium Pocket Parks Project, New York City Economic Development Corporation (NYCEDC), New York, NY. Yankee Stadium Pocket Parks project included two new replacement parks that were slated to be constructed as part of the much larger Yankee Stadium rebuild. The parks included a skateboard park and children's playground. Following design and contract award, NYCEDC and New York City Department of Parks and Recreation (NYCDPR) realized both sites had petroleum spills that needed to be addressed. The effort required a rapid investigation and determination of the issues as well as a proactive plan that could be presented to NYSDEC for rapid approval. In addition, the design would need to work around the existing park design in order to keep those contracts from being modified. Team building within the City and State were required in addition to providing all documentation necessary for a multiple City Agency approval and implementation of the remedy.

Anheuser Busch/Greenway Remediation and Redevelopment Project, New York City Economic Development Corporation (NYCEDC), New York, NY. The Anheuser Busch/Greenway remediation and redevelopment project involved the classification and reuse of over 43,000 cubic yards of material generated on adjacent construction projects to raise the development site out of the 100-year floodplain. The approval required a significant coordination effort with NYSDEC Divisions of Environmental Remediation and Solid Waste. The project created a document used by NYSDEC for other similar reuse efforts in New York. The project was completed saving NYC over $6 million in disposal of material and the developer over $.5 Million in purchasing new fill. The project was awarded the 2010 Diamond Award for environmental projects in New York State and was a National Finalist.

Ferry Point Park Final Engineering Report and Sub-Slab Vapor Extraction System, Bronx, NY. Project Manager responsible for coordinating the entire drafting of an engineering report for the Ferry Point Park golf course in order to gain closure from NYSDEC in time for the lease opening of the facility. This work was all performed by other firms who, for various reasons, refused to assist DPR in writing this document. It is unprecedented that a firm would be able to accept this level of responsibility for work performed by others, but Mr. McCarty was able to review all documentation and prepare the report within the budget and deadline to satisfy NYSDEC Materials Management engineers. In addition, at the final point in time, a sub-slab system that was never installed needed to be evaluated, designed, installed and tested for operation, all within a several-day period. Mr. McCarty, along with engineering staff and trusted contractors, was able to create drawings, control systems, perform design evaluations on a completed building and install and connect a fully operational system in less than a week in order to again satisfy the DPR lease with the golf course operations.

Development of Fulton Fish Market, New York. Evaluated most efficient method of beneficial reuse for excavated material taken from an area historically used to dispose of coal tar. Final selection was incineration in a NYSDEC-permitted waste-to-energy facility where the material would be used for fuel. In the end, a total of 7.6 megawatts of electricity was generated and placed into the local electrical grid as well as a significant amount of

steam energy that was supplied via underground piping to local industrial facilities. The electrical generation equivalent was enough to supply 10,000 homes with power for 3.5 months.

Hurricane Sandy Flood Cleanup in New York City Financial District, New York. Managed pumping and dewatering operations following the flooding of the lower section of Manhattan. Coordinated numerous contractors with pumping capacity to clear 53 million gallons of flooded office and parking garage space that contained water and ruptured fuel oil tank contents. Effort included NYCDEP and NYSDEC permits, insurance company coordination, and building health and safety coordination for the overall effort.

Voluntary Cleanup Agreements at a Former Manufactured Gas Plant, New York. Coordinated with city and state agencies for review and approval of documents related to 13 voluntary cleanup agreements for a former manufactured gas plant site between New York City and the State of New York under Voluntary Cleanup and Brownfields programs.

PROFESSIONAL AFFILIATIONS

Board of Directors for the New York City Partnership of Brownfield Practitioners, Charter Member

Board of Directors for New Partners for Community Revitalization (NPCR), Member

Downstate Soil Reuse Committee, Member

Board of Directors, Center for Creative Land Recycling

Stacey Ng, P.G.
Geologist and Project Manager

resume

Stacey Ng is a geologist in GEI's New York City office with ten years of experience in the environmental consulting industry throughout New York City and New Jersey. Ms. Ng possesses a strong field background, specializing in remedial and construction oversight, materials management, beneficial reuse and directing remedial investigations. She also specializes in the remediation of former Manufactured Gas Plant (MGP) sites and supports various New York State Brownfield Cleanup Program (NYS BCP) projects.

PROJECT EXPERIENCE

Beneficial Use – NYC Department of Environmental Protection Water Tunnel Shafts, Queens and Brooklyn, NY. Provided environmental support for the beneficial reuse of over 25,000 cubic yards of clean fill generated from the construction of two water tunnel shafts. GEI managed the field sampling efforts for in-situ and ex-situ material classification, assisted in the preparation of reuse facility submittals for transport approval, and provided excavation and export oversight. The clean fill was able to be accepted and transported to multiple recycling facilities, used as landfill capping material, and supported operations at NYC's Clean Soil Bank (CSB) .

Remedial Design and Implementation - Hunts Point Former MGP Site (Site D), New York City Economic Development Corporation, Bronx, NY. Assistant Project Manager for a remedial project with oversight work valued at $1.86 million. GEI performed the bench test treatability study and created the remedial design. Ms. Ng was responsible for coordinating all field operations for GEI, supervising both GEI staff and subconsultant staff in community air monitoring operations; monitoring of in-situ stabilization (ISS) mixing; quality control (QC) testing of the monolith; and oversight of the general workings of a complex environmental site. She assisted with weekly reporting to State oversight agencies and acted as a liaison among multiple stakeholders: GEI's project manager and design team, the Client, the Owner's Construction Manager and the Contractor.

Remedial Investigation and Design – Hunts Point Former MGP Site (400 Food Center Drive), New York City Economic Development Corporation, Bronx, NY. Project Geologist for an ISS remedy at a 19-acre site impacted by historic MGP-related waste material within an active food distribution warehouse. This project is currently underway with initial design and a Remedial Action Work Plan.

Remedial Design and Implementation – Hunts Point Former MGP Site (Site AOU-2), New York City Economic Development Corporation, Bronx, NY. Assistant Project Manager for remediation of purifier waste and coal tar deposits at a 3.2-acre site impacted by historic MGP operations. Remedial implementation occurred from January through August 2018. Ms. Ng coordinated all GEI field operations; she directed drilling and laboratory subcontractors,

EDUCATION
B.A., Geosciences, Hamilton College

EXPERIENCE IN THE INDUSTRY
10 years

EXPERIENCE WITH GEI
6 years

REGISTRATIONS/LICENSES
Professional Geologist, NY
No. 001272

TRAINING/ CERTICATIONS
30-Hour OSHA Construction Safety and Health Training
10-Hour OSHA Construction Safety and Health Training
40-Hour OSHA HAZWOPER Training
8-Hour Supervisor OSHA HAZWOPER
First Aid and CPR/AED
Qualified Erosion and Sediment Control Inspector
LIRR Roadway Worker Protection Training

GEI Consultants

implemented a Community Air Monitoring Plan (CAMP), and monitored Contractor operations to ensure alignment with engineering specifications and NYS regulations.

PREVIOUS PROJECT EXPERIENCE

Former Manufactured Gas Plant, New York State Voluntary Cleanup Program (NYS VCP) Site E OU-3, Bronx, NY. Provided construction oversight for excavation and demolition activities as part of the remediation and redevelopment of a 15-acre food distribution facility. Implemented the site-specific CAMP and performed daily stormwater pollution prevention plan (SWPPP) inspections. Inspected all excavated material for visual and olfactory evidence of MGP impacts associated with the former gas plant. Documented the importation and exportation of regulated material to and from site and ensured that such materials were handled appropriately and within the scope of New York State Department of Environmental Conservation (NYSDEC) approvals. Supervised dewatering of impacted and non-impacted groundwater from Site, confirming that the methods of dewatering were controlled and that the treatment system was operating properly prior to any discharges.

Springfield Gardens Beneficial Use Determination, NYCEDC, Queens, NY. Provided excavation and transport oversight of approximately 42,000 cubic yards of material produced from the expansion and improvement of a tidal wetlands project in Springfield Gardens, NY. Material was approved by NYSDEC for beneficial reuse as surcharge and fill material for a roadway extension project. Monitored and inspected all loads of material to ensure that only acceptable material was transported for reuse. Coordinated and managed all manifest documentation associated with material removal, tracking, and placement. Assisted with the preparation of petitions and reports to submit to NYSDEC to gain permission for the beneficial use activities and provide final documentation of the completed effort.

Metals Recycling Facility Petroleum Spill Closure, Queens, NY. Performed monthly inspections of monitoring wells and a belt-skimmer product recovery system that were installed as part of an interim remedial measure. Oversaw excavation and directed the separation of non-impacted and petroleum-impacted material in preparation for the installation of a stormwater retention basin. Classified and managed proper handling of all material and performed waste characterization sampling to meet disposal facility requirements. Ensured spill area was remediated in accordance with NYSDEC cleanup standards and regulations and collected confirmatory soil and groundwater end-point samples to successfully obtain spill closure.

Former Manufactured Gas Plant, Remedial Investigation for NYS VCP Site A OU-2, Bronx, NY. Reviewed previous investigations and developed a supplemental remedial investigation to confirm and further delineate the extent of coal tar and purifier waste material across site. Directed the drilling of soil borings and installation of groundwater monitoring wells. Collected and analyzed sample data and organized remedial supporting documents to assist in the preparation of the bid package and implementation of the remedial action.

LNAPL Monitoring and Remediation at Car Rental Facility, Newark, NJ. Implemented the interim remedial measure for impacted groundwater from former gasoline and diesel releases. Conducted monthly to bi-monthly gauging events in accordance with the NJDEP Remediation Program. Monitored product levels and maintained product absorbent socks and/or coordinated vacuum-enhanced fluid recovery (VEFR) events as needed. Prepared the annual light non-aqueous phase liquid (LNAPL) interim remedial measures report for submittal to NJDEP.

In-Situ Chemical Oxidation (ISCO) Treatment for Groundwater Remediation at Numerous Sites, NY. Directed the execution of ISCO groundwater treatments at various locations in Queens, Brooklyn, and Staten Island, New York. Performed routine groundwater monitoring and sampling following all injection events to determine the effectiveness of the treatments.

Investigation and Remediation of Tank Systems at Numerous Sites, NY. Performed soil investigations and routine groundwater monitoring and remedial activities at sites containing aboveground and underground storage tanks. Tank systems included gasoline and diesel motor fuel, waste oil, and hydraulic oil at many City agencies including fire departments, police precincts, hospitals, parks, DOS garages, and DEP and DOT sites.

Jaimie L. Wargo
Senior Data Coordinator/Project Professional

resume

Jaimie Wargo is the Manager and Lead of an in-house service team managing analytical and survey data flowing through the East Region for QC and regulatory comparison.

Prior to joining GEI, Ms. Wargo worked 5.5 years as a Database Technician for a company providing food distribution software maintaining inventory; customer; vendor; accounts receivable; accounts payable and purchasing data. Her responsibilities included providing technical support to over 150 clients via phone, fax, email and remote access, installing new software and maintaining program updates on clients' server and troubleshooting and reporting program bugs. She also conducted in house and onsite training sessions for her clients.

EDUCATION
A.A., General Studies, Manchester Community College

EXPERIENCE IN THE INDUSTRY
22 years

EXPERIENCE WITH GEI
17 years

EXPERIENCE

As Coordinator of the Data Management team Jaimie schedules and coordinate daily deliverables, working with Project Managers and staff to identify the project needs and providing day to day technical support to our team and project staff. She works as a laboratory liaison setting up lab deliverable formats and deliverable needs and facilitate supply chain and tracking processes to ensure timely project delivery. This includes database setup and tracking, sample verification, troubleshooting data errors, database input, creating custom reports and invoice review. Ms. Wargo has also worked with multiple state agencies to provide analytical data in their required specified format.

As an EQuIS Data Specialist managing analytical, geotechnical, and survey data. Ms. Wargo has 20 years of experience managing data and over 17 years of experience using EarthSoft EQuIS, Microsoft Access and some familiarity with SQL Server Database. Responsible for loading data using EQuIS Electronic Data Processor program as well creating MS Access tools to work with historical data loading and troubleshooting. Ms. Wargo maintains and update quality control checks and data tracking logs. She has worked extensively with management of soils, ground water, vapor intrusion – including community response - and sediment data and familiar with coordinate conversions, stratigraphy, and boring log data.

Ms. Wargo also is a main point of contact and data lead for our web based DIVR data visualization portal and help desk team. She works closely with the data engineer and programming team. She has participated in conducting on-line training and creation of training documentation.

Data Management projects include but not limited to:

- Various sites Valero Energy Corporation, U.S., and Canada
- Various sites Premcor Former Refineries, U.S., Midwest and adjacent to a major U.S. River

- Various sites ExxonMobil, US
- Kalamazoo River Superfund Remediation, NCR Corporation, MI
- UGI Utilities, Inc. COA, Various Sites, NJ
- 320 New Road, Monmouth Junction, NJ
- Georgia Power Company, Plant McIntosh Landfill3, Landfill4, AshPond sites, Effingham County, GA
- Con Edison, Consolidated Edison Company of NY, Various Sites, NY
- National Fuel Gas, Various Sites, Upstate NY.
- New York State Electric and Gas (NYSEG), Various Sites, NY
- Henderson Remediation, Titanium Metals Corporation, Henderson, NV.
- Erie Street Former Manufactured Gas Plant, AGL Resources, Inc., Elizabeth, NJ.
- Orange & Rockland, Suffern MGP Site, Suffern, NY
- NiSource, Various Sites, Indiana.
- Columbia Gas of Virginia/NiSource Ap - Crawford Bay Dredging-former Portsmouth Virginia MGP, Columbia Gas of VA, Inc. /NiSource AP, Portsmouth, VA.
- Alpha Metals, Cookson Electronics, Jersey City, NJ
- Downing Square Environmental, Arlington, MA
- National Grid Former Manufactured Gas Plants- Various Sites, Long Island, NY.
- Gowanus Canal Superfund Site, National Grid, Brooklyn, NY.
- Rhode Island Department of Transportation, Providence, RI,
- Former Lite Control Facility, Hanson MA
- Ithaca First Street Former MGP Remedial Investigation and Workplan, New York State Electric & Gas Corp, Ithaca, NY.
- Stewardship Permit, MacDermid, Inc., Waterbury, CT.
- Sea Isle City RASR & RAW Remedial Design, FirstEnergy Corporation, Sea Isle City, NJ.

COMPUTER SKILLS

- EarthSoft EQuIS Chemistry
- Microsoft Access; Excel; Power Point; Word; SSMS 18; Outlook
- Adobe Acrobat
- PC Anywhere, Terminal Services, gotomeeting, VPN, TEAMS, etc.

Savanna Marino, G.I.T.
Staff Professional

resume

Savanna Marino, G.I.T. is a staff professional in GEI's New York City office with six years of environmental consulting experience throughout the New York metropolitan area. Ms. Marino regularly performs site remediation and construction oversight, waste and material management and disposal, remedial systems implementation, performance monitoring and compliance, GIS mapping, and Phase I & II Environmental Site Assessments. Her responsibilities include performing and managing field investigations and remedial activities at various sites, with a concentration on the remediation of former Manufactured Gas Plant (MGP) sites, including New York State Brownfield Cleanup Program (BCP) and New York City Voluntary Cleanup Program (VCP) projects.

PROJECT EXPERIENCE

Remedial Investigation and Design – Hunts Point Former MGP Site (355 Food Center Drive), New York City Economic Development Corporation, Bronx, NY. Field Manager for the supplemental investigation and remedial action of a 50-acre, active food distribution facility impacted by former MGP-operations. Ms. Marino managed the remedial investigation to confirm and delineate the extent of purifier material and coal tar across the site, including drilling, laboratory, and field subcontractors, implementing the Community Air Monitoring Plan (CAMP), the installation of 172 site-wide borings, groundwater sampling, and field documentation. She prepared the Supplemental Remedial Investigation Report (SRIR). This project is currently underway with initial design and a Remedial Action Work Plan.

Environmental Engineering Services and Post-Closure Monitoring and Maintenance Operations - Former Landfill (Ferry Point Park), New York City Department of Parks and Recreation – Bronx, NY. Field Manager for the monitoring and maintenance of a 210-acre former landfill. Ms. Marino is responsible for coordinating field operations for GEI and subconsultant staff, including the groundwater sampling, piezometer monitoring, post-closure settlement plate monitoring, landfill gas monitoring, monitoring and inspection of sub-slab depressurization system (SSDS) infrastructure, cover system inspections, and the maintenance of the remote methane detection system. She prepares the monthly, quarterly, and annual reporting associated with monitoring and maintenance efforts, as well as securing and retaining applicable local and state permits. This project is currently ongoing.

Beneficial Reuse - New York City Clean Soil Bank (CSB), New York City Office of Environmental Remediation, Brooklyn, NY. Field Manager of the New York City Office of Environmental Remediation's Clean Soil Bank (CSB) facility dedicated to the recycling of clean, native soil generated from construction sites across the city.

EDUCATION
M.S., Applied Environmental Geoscience, Queens College
B.S., Geology, Temple University

EXPERIENCE IN THE INDUSTRY
6 years

EXPERIENCE WITH GEI
3 years

REGISTRATIONS AND LICENSES
Geologist-In-Training, NY No. 000060

TRAINING AND CERTIFICATIONS
30-Hour OSHA Construction Safety and Health Training
10-Hour OSHA Construction Safety and Health Training
40-Hour OSHA HAZWOPER Training
First Aid and CPR/AED
NYSDEC-Certified Erosion, Sediment and Stormwater Inspector (CESSWI)
Roadway Worker Protection Training – LIRR Contractor Safety Training

PROFESSIONAL AFFILIATIONS
New York City Brownfield Partnership (NYCBP) – Minority and Women-owned Business Enterprise (MWBE) Committee
Brownfield Coalition of the Northeast (BCONE) – Member

GEI Consultants

GEI manages the field operations for the CSB, as well as supports the New York City Office of Environmental Remediation in the review and approval of material. Operations include management of the facility's Stormwater Pollution Prevention Plan (SWPPP) - performing weekly inspections and maintaining stormwater controls, on-site coordination of clean soil deliveries – management of all manifest documentation; monitoring and inspection of all loads of fill to ensure only acceptable material is imported; oversight of the integration and organization of inbound soil into onsite stockpiles as well as the exportation of stockpiled soil to end-users; oversight of material screening; oversight of the production and subsequent sampling of topsoil blends. Ms. Marino has authored presentations on the Clean Soil Bank for various environmental conferences, including the 2023 National Brownfields Training Conference in Detroit, Michigan and the 2023 Excess Soils Symposium in Toronto, Canada. This project was the recipient of the American Council of Engineering Companies of New York (ACEC New York) Engineering Excellence Award – Gold for Category A: Studies, Research and Consulting Engineering Services in 2024. This project is ongoing.

Geotechnical Investigation - Mary Cali Dalton Recreation Center, New York City Department of Design and Construction, Staten Island, NY. Site Engineer preforming drilling oversight and soil logging/sampling for classification as part of the geotechnical site investigation for proposed development of the property. Ms. Marino oversaw the installation of geotechnical borings via mud rotary and hollow stem auger, performed the collection and logging of soil samples retrieved from unconsolidated deposits, and performed rising and falling head tests to measure the permeability of soils.

Beneficial Use - Water Tunnel Shafts, New York City Department of Environmental Protection, Queens, NY. Project Geologist providing support and oversight for the material classification, disposal, and beneficial reuse of more than 40,000 cubic yards of soil/fill to be generated from the construction of two water tunnel shafts. Material classification included in-situ and ex-situ sampling, preparation of data packages for disposal and reuse facility approval, oversight of material excavation and transportation as well as coordination and management of documentation associated with material tracking. Beneficial reuse of native, clean material included facilities such as the New York City Clean Soil Bank, as well as sites including a former landfill closure effort.

Remedial Implementation - Hunts Point Former MGP Site (Site AOU-2), New York City Economic Development Corporation, Bronx, NY. Project Geologist supporting the remediation of purifier waste and coal tar deposits at a 3.2-acre site impacted by historic MGP operations. Ms. Marino performed contractor oversight and directed final site grading and capping activities, including; oversight and direction of beneficial-use material importation, with final elevation being confirmed utilizing a global navigation satellite system (GNSS) receiver to meet New York State Department of Environmental Conservation (NYSDEC) design requirements; drafting and implementation of the Site-specific CAMP; preparation of daily progress reports for submittal to NYSDEC. Field data was incorporated into the Final Engineering Report (FER), currently being prepared. Ms. Marino aided in cartographic map production for the FER, processing geologic, hydrogeologic, analytical, and surveying data collected and utilizing ArcGIS Pro and AutoCAD to develop maps depicting groundwater, soil, soil vapor, and ambient air quality and conditions, final cover thickness, and multi-media contaminant concentrations - vertical and horizontal waste extent(s) to produce as-built drawings, topographic maps, groundwater contour figures, and cross-section figures.

PREVIOUS PROJECT EXPERIENCE

LaGuardia Airfield Reconfiguration Project, Queens, NY. Performed construction and environmental compliance oversight at an operational airport. Prepared environmental compliance plans, permits, inspections, and reports for waste characterization, spill prevention, air quality (NYSDEC Air State Facility permit), New York State Pollutant Discharge Elimination System (SPDES) permit, and SWPPP. Completed dewatering treatment system design modifications, as well as monitored, maintained, and ensured compliance of the system(s) with the project and facility SPDES permits. Developed and implemented work and sampling plans, including the

collection, interpretation, and reporting of multimedia data. Oversaw underground storage tank (UST) removal and reporting.

Former Manufactured Gas Plant - New York State Brownfield Cleanup Program (BCP), Bronx, NY. Provided oversight for construction activities within an active distribution facility. Implemented the site-specific CAMP. Inspected and sampled excavated materials, monitored dewatering activities, and documented the exportation of impacted soils off site in adherence with local, state and federal regulations.

John F. Kennedy Airport Bulk Fuel Farm Tanks No. 1 & 2, Queens, NY. Monitored construction activities to ensure environmental compliance. Performed SWPPP inspections and reporting. Monitored and sampled dewatering treatment system in compliance with facility SPDES permit. Gauged, sampled, and monitored wells and non-aqueous phase liquids (NAPLs). Prepared Sewer Discharge Permits and conducted wastewater sampling and daily flow monitoring.

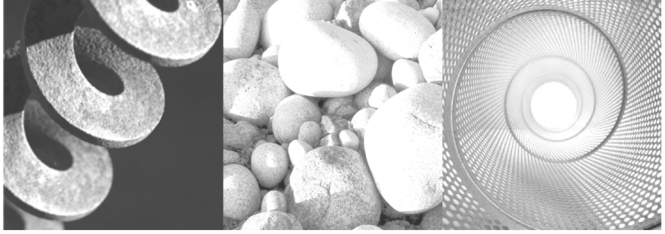
John F. Kennedy Airport Improvement Works Project, Queens, NY. Oversaw construction activities associated with civil improvements in active airfield. Ensured activities did not impact existing, active utilities or airport operations. Documented the exportation of impacted materials off site in compliance with applicable regulations.

LaGuardia Airport Jet Fuel Transmission System Project, Queens, NY. Developed the SWPPP and Environmental Management Plan (EMP) for the proposed utility installation within an active airport. Worked with regulatory agencies to ensure plans encompassed necessary guidelines for anticipated work and complied with local, state and federal regulations. Prepared the project SPDES permit application, including the collection, interpretation, and reporting of groundwater data.

Wastewater Treatment Plant, Mahwah, NJ. Monitored facility's wastewater effluent and performed wastewater sampling to ensure compliance with the facility's National Pollutant Discharge Elimination System (NPDES) permit. Analyzed, compiled and formatted data to distribute to regulatory agencies on behalf of the facility.

Former Textile Mill - New York State Voluntary Cleanup Program (VCP), Brooklyn, NY. Performed groundwater sampling and air monitoring to evaluate the performance of the installed remediation technology at a Voluntary Cleanup Program (VCP) site. Analyzed and compared laboratory data and configured information into an electronic data deliverable (EDD) for submission to the applicable governing agency.

Appendix B Field Sampling Plan (FSP)



Field Sampling Plan

Hunts Point 600 Food Center Drive
NYSDEC BCP Site No. C203104

For the Property located at:
600 Food Center Drive, Bronx, New York

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233

On Behalf of:
New York City Economic Development Corporation
1 Liberty Plaza
New York, New York 10006

Submitted by:
GEI Consultants, Inc.
530 7th Avenue, Suite 2007
New York, NY 10018
212.687.8282

February 2026
Project No. 2303564



Stacey Ng, P.G
Project Manager

Kevin P. McCarty
Senior Project Manager/Environmental Lead

Table of Contents

1. Introduction 1
1.1. Introduction 1
1.2. Site Location 1
1.3. Sampling Objective 2
1.4. Field Activities 2
1.4.1. Soil 2
1.4.2. Groundwater 6
1.4.3. Soil Vapor and Sub-Slab Vapor 7
1.4.4. Indoor Air 8

2. Sampling for Emerging Contaminants (EC's)

3. Pre-Mobilization Activities

4. Air Monitoring (AR)

5. Field Documentation (FD)

6. Drilling Methods (DM)

7. Sample Collection and Field Screening (SC)

8. Solid Matrix Sampling (SM)

9. Groundwater (GW)

10. Soil Gas Sampling (SG)

11. Quality Control – Quality Assurance (QA)

SM\SN\KM
B:\Working\NYCEDC\2303564 600 FCD RIWP\RIWP\Appendix B - FSP\600 FCD FSP_FINAL_20260213.docx

Acronyms and Abbreviations

ASP	Analytical Services Protocol
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAMP	Community Air Monitoring Plan
CH_4	Methane
CO_2	Carbon dioxide
COC	Chain of Custody
DER	Division of Environmental Remediation
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DSNY	New York City Department of Sanitation
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
FCD	Food Center Drive
FSP	Field Sampling Plan
ftbgs	Feet Below Ground Surface
GEI	GEI Consultants, Inc.
GPR	Ground Penetrating Radar
H_2S	Hydrogen Sulfide
HASP	Health and Safety Plan
HCN	Hydrogen Cyanide
He	Helium
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
ml/min	milliliter per minute
MTS	Marine Transfer Station
NAPL	Non-Aqueous Phase Liquid
NTU	nephelometric turbidity units
NYCEDC	New York City Economic Development Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2	Oxygen
ORP	Oxidation Reduction Potential
PCBs	Polychlorinated Biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
PID	Photoionization Detector

PM-10	Respirable Particulates
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Human Health Exposure Assessment
RAWP	Remedial Action Work Plan
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RR ROW	Railroad Right-of-Way
SOP	Standard Operating Procedure
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
US DOT	United States Department of Transportation
US EPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds

1. Introduction

1.1. Introduction

This document serves as a Field Sampling Plan (FSP) for the types of environmental sampling activities that may be utilized during implementation of the Remedial Investigation (RI) at 600 Food Center Drive (FCD), Bronx, NY (the Site). The primary intent of this document is to promote accuracy and consistency for field and office support operations.

This FSP encompasses a broad range of activities to improve the planning, implementation, and documentation of field and pertinent office operations. All methodologies presented in this document may not be applicable to site-specific situations. In the event of differences between the FSP and any site-specific work plan or a Quality Assurance Project Plan (QAPP), the provisions of the site-specific plan will prevail.

This document is organized according to the chronological sequence of typical workflow proceeding from project setup to field activities and then to data collection.

The document contains two types of guidance:

General Guidance Procedures – Documents intended to be informative and not prescriptive. The documents are designed to provide necessary background information to adequately understand associated field processes.

Standard Operating Procedures (SOPs) – Documents intended to provide the necessary procedures and notes to successfully implement the operation.

This FSP incorporates requirements including, but not limited to, New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation dated May 3, 2010, any applicable local, state, or federal requirements, and client requirements. Each SOP is current as of the effective date indicated in the header and will be updated as necessary.

This document has been provided to all staff performing field tasks for the client.

1.2. Site Location

The Site is located in a commercial and industrial area of the Hunts Point section of the borough of the Bronx, New York. The Site (Brownfield Cleanup Program [BCP] Site No. C203104) is an approximate 9.6-acre lot contained within a portion of a larger tax lot containing multiple parcels of land and properties, identified as New York City Tax Map Block 2781, Lot 500. The Site is relatively level and currently developed with a distribution warehouse; the Site is zoned M3-1 (manufacturing). The Site is bounded to the north by the Anheuser-Busch distribution facility (former Voluntary Cleanup Program [VCP] Parcel C; VCP Site No. V00412), to the east by the Bronx River, to the west by Railroad Right-of-Way (RR ROW; BCP Site No. C203102), Food Center Drive (former VCP Perimeter Site; VCP Site No. V00641), and the

Hunts Point Cooperative Market (355 Food Center Drive; BCP Site No. 203099), and to the south by Farragut Street and the Hunts Point Landing park (included within the Railroad Right-of-Way BCP site) immediately followed by the New York City Department of Sanitation (DSNY) Marine Transfer Station (MTS).

1.3. Sampling Objective

The objective of this Remedial Investigation Work Plan (RIWP) is to obtain data to evaluate and define the nature, extent, and degree of impacts onsite, satisfying requirements of the BCP. This RI effort will investigate Site media (soil, groundwater, and soil vapor) and collect samples for laboratory analysis to fully understand impacts, sources of impacts, as well as the horizontal and vertical extent of contaminants.

Other components of this RI will include investigation and sampling as part of a downgradient Qualitative Human Health Exposure Analysis (QHHEA), which will be used to determine what risks, if any, that the onsite impacts present to public health, ecological resources, and to the environment. As part of the QHHEA, two soil borings and concurrent permanent groundwater wells and soil vapor points will be installed. The borings for the QHHEA will be advanced at downgradient portions of the eastern Site perimeter, adjacent to the Bronx River waterfront (rather than fully offsite).

1.4. Field Activities

1.4.1. Soil

An estimated 78 soil borings (not including delineation borings) will be advanced using the Geoprobe® direct push method or roto-sonic drilling to native sediments typically located depths ranging from approximately 15 to 20 feet below ground surface (ftbgs) depending on observed soil conditions in the field as determined by GEI Consultants, Inc. (GEI) Field Personnel. Two of these soil borings will be advanced at downgradient locations and installed concurrently with permanent groundwater wells and temporary soil vapor points. Boring locations are subject to change based on accessibility, utility clearance, and conditions encountered during the Site inspection and field activities. Additional soil borings (e.g., delineation borings) may also be added during the course of the field investigation based on subsurface conditions encountered. If additional soil borings are deemed necessary based on the subsurface conditions encountered during the field investigation, the proposed locations will be presented to NYSDEC for approval prior to installation.

In accordance with NYSDEC and New York State Department of Health (NYSDOH) requirements, a Community Air Monitoring Plan (CAMP) will be implemented at the Site during all ground intrusive activities. During all ground-disturbing activities, community air monitoring well be performed for Volatile Organic Compounds (VOCs), Hydrogen Sulfide (H_2S), Hydrogen Cyanide (HCN), and respirable particulates (PM-10) at upwind and downwind locations at the Site perimeter via temporary CAMP stations. Air monitoring procedures and action levels are further detailed as an appendix to the HASP (Appendix D of the RIWP).

Prior to the advancement of soil borings, all locations will be cleared for utilities and subsurface infrastructure via private line and utility locating services, and Ground Penetrating Radar (GPR). This will cover investigative areas within the Site that are not included as part of the State One-Call (811) public mark-outs.

Soil samples (cores) will be collected and logged continuously from ground surface to the bottom of the borings (native sediments) utilizing a track-mounted compact roto-sonic drill rig or Geoprobe® direct push rig. Soil samples retrieved from each boring will be visually classified and logged using the Unified Soil Classification System (USCS) for soil type, relative grain size distribution, texture, moisture content, and visible evidence of staining or impacts. Each sample will also be screened for the presence of VOCs with a Photoionization Detector (PID). If visually or olfactory impacted materials are observed at the bottom of the boring, the boring will be continued until un-impacted soils are observed or the limit of the drilling equipment is reached. Logs detailing soil type and composition, the presence of visual impacts, VOC concentration, and any additional pertinent characteristics will be prepared for each boring location and included in the Remedial Investigation Report (RIR). Soil samples will be collected using disposable acetate liners for the Geoprobe® direct push rig or liners for the roto-sonic drill rig. Key items of note will be the presence or absence of impacts and/or Manufactured Gas Plant (MGP) waste (coal tar-impacted fill or purifier bed material), the depth interval impacts are present in, depth to groundwater, and the presence of impacts and/or MGP waste below the groundwater table. Borings will either be grouted or backfilled with a combination of Morie No. 2 sand, and bentonite chips (as needed). Borings in asphalt or concrete will be repaired and patched at the surface in kind to help prevent settlement.

Nine of the 78 total borings will be installed in the southwest corner of the Site. These borings are specifically targeted to gather specific information and data for NYCEDC to advance projects which include Federal funding that will expire prior to the ability to prepare and implement a remedy. The effort will identify a path for a proposed electric conduit that will connect to an emergency generator (to be installed in the adjacent RR ROW BCP site). Two samples are proposed to be collected from each of the nine resiliency borings; one sample will be collected across the 0-5-foot interval to assess if material can be backfilled during installation/construction of the electrical conduit, and a second sample will be collected near the terminus of the boring in saturated native material. A third sample will be collected if impacts are encountered.

Along the eastern boundary, a portion of the relieving platform remains which was previously used to store vast quantities of coal. The relieving platform includes an approximately 430-foot-long and 50-foot-wide area consisting of paved driving surface, underlain by fill material and a 2-foot-thick concrete slab supported by wooden piles down to approximately 10 feet below surface grade. Soil boring installation in this area will include boring advancement through and sampling of the fill material, situated above the 2-foot-thick slab. One soil sample will be collected across the unsaturated zone (the saturated zone is predominantly tidally-influenced river water and not groundwater). The river is located directly beneath the platform; therefore, no drilling or sampling is proposed beyond the depth of the supporting slab.

Approximately 145 soil samples (not inclusive of Quality Assurance/Quality Control [QA/QC] samples) are proposed to be collected for laboratory analysis from the 78 initial (non-delineation) borings

(alternating between one and three samples per boring) installed across the Site, provided there is ample recovery to fill all sample containers and based on the sampling strategy presented below. Sample intervals targeted for lab analysis will be dependent on the overall conditions encountered in each boring.

In the event that waste is identified in a boring slated for one sample, which would require an additional sample to be collected, the procedures outlined below will be used to guide data collection. This initial investigation phase has a fixed number of samples, and it may be necessary to adjust a sample from one of the borings slated for three samples in order to meet the requirements to collect a sample from each boring at the terminus (in the saturated zone) if a boring also contains impacts.

The following procedures will be utilized during boring installation to determine sampling intervals:

Borings with three samples proposed

For boring locations not containing impacts and/or MGP-related waste where three soil samples are to be collected, the samples will be collected for laboratory analysis based on the criteria below:

1. One sample will be collected in the upper half of the unsaturated zone.
2. One sample will be collected in the lower half of the unsaturated zone. If there is insufficient unimpacted material above the water table to collect two separate samples (less than 3 feet), only one sample of the unsaturated zone will be collected.
3. One sample will be collected at the boring terminus within native material (organic layer or native sand) in the saturated zone.

In the presence of impacts and/or MGP-related waste (coal tar and/or purifier waste) within the boring, samples will be collected for laboratory analysis based on the following criteria:

1. One sample will be collected in the upper or lower half of the unsaturated zone depending on where the impacted interval is located.
2. One sample will be collected in the impacted interval (based on greatest visual and/or olfactory impacts).
    a. If waste is identified above the water table, this will count as one of the samples in the unsaturated zone (depending on depth).
    b. If waste is identified below the water table, one of unsaturated zone samples will be eliminated.
3. One sample will be collected approximately two feet below the impacted interval (for separation purposes to ensure a clean sample) in the saturated native material. The priority is to sample native, un-impacted material. If refusal is encountered less than two feet below the impacts but native, un-impacted material is still present, the sample will be collected just above the refusal.

Borings with one sample proposed

1. For boring locations not containing impacts and/or MGP-related waste, the sample will be collected from native material within the saturated zone.
2. If the boring contains impacts and/or MGP-related waste:

a. One sample will be collected from the zone with visual impacts (e.g., coal tar or purifier waste). If no visual impacts are identified, the sample will be collected from the zone with the highest PID reading.
b. A second sample will be collected from within the native material in the saturated zone approximately two feet below the impacted interval (for separation purposes to ensure a clean sample). This sample will be re-allocated from a non-impacted/non-MGP-waste grid containing a boring with three proposed samples (the three-sample boring will only have two samples collected). The re-allocated sample will be from one of the unsaturated zone samples. If this procedure is required, GEI will notify NYSDEC of which grid sample will be re-allocated.

Soil samples will be properly transported to a NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratory under standard chain-of-custody (COC) procedures and analyzed for the following:

- Target Compound List (TCL) VOCs by United States Environmental Protection Agency (US EPA) Method 8260D;
- TCL Semi-Volatile Organic Compounds (SVOCs) by US EPA Method 8270E;
- Target Analyte List (TAL) Metals by US EPA Method 6020B/7471B;
- Trivalent Chromium and Hexavalent Chromium by US EPA Method 7196A;
- Polychlorinated Biphenyls (PCBs) by US EPA Method 8082A;
- Pesticides by US EPA Method 8081B;
- Total Cyanide by US EPA Method 9012B;
- 1,4-Dioxane by US EPA Method 8270E SIM; and
- Per- and Polyfluoroalkyl Substances (PFAS) by US EPA Method 1633A.

Borings containing MGP waste (specifically coal tar) may have laboratory issues with dilution. GEI will discuss with the laboratory when the samples are received to determine if the laboratory believes that dilution may be required and if that will negatively impact the ability to meet the PFAS method detection limits (MDLs) per the April 2023 *Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS)* Guidance. If the laboratory indicates that dilution is required and as a result, MDLs will not be able to be met, GEI will cancel the PFAS analysis for the sample and notify NYSDEC.

QA/QC samples will be collected according to the QAPP. Additional lab analyses may be included based on field observations. Data will be provided in an electronic data package that is in general accordance with NYSDEC Analytical Services Protocol (ASP) Category B data deliverable requirements and submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. A Data Usability Summary Report (DUSR) will be prepared by a third-party data validator for all soil samples collected.

1.4.2. Groundwater

Eleven permanent, flush-mounted monitoring wells will be advanced at the Site to assess shallow groundwater quality. Two of the monitoring wells will be installed at the downgradient QEA locations. The wells will be installed in the upper shallow fill material and water table. The monitoring wells will be constructed with 2-inch inner diameter, threaded, flush-joint, Polyvinyl Chloride (PVC) casing and approximately 10 feet of 0.02-inch slot screen. The annulus around the screens will be backfilled with silica sand having appropriate size for the subsurface conditions (e.g. Morie No. 2). The screens will be placed across the approximate water table interface to allow for the monitoring of Light Non-Aqueous Phase Liquid (LNAPL), if present. If MGP-related impacts (coal tar and/or purifier waste) are present, the well will be installed to provide data that will support the remedial design.

No additional on-site soil borings are anticipated to be converted into groundwater monitoring wells during the RI/MGP waste investigation/delineation unless specific conditions are identified with respect to groundwater (e.g., Non-Aqueous Phase Liquid [NAPL] or Dense Non-Aqueous Phase Liquid [DNAPL]) are identified in the boring during drilling.

After a minimum of 24 hours, the monitoring wells will be developed until the well is reasonably free of sediment (less than 50 nephelometric turbidity units [NTU], if possible) or until the pH, temperature, and conductivity stabilize. A maximum of one to two hours of development time per well is anticipated. The level of effort, however, is dependent upon the nature of the soils at each location. Water generated during development and sample purging will be containerized in 55-gallon drums for future characterization and disposal. Prior to the collection of groundwater samples, GEI will conduct a synoptic gauging event of the installed monitoring wells and this data will be used to generate a groundwater contour map, which will be included in the RIR.

One groundwater sample will be collected from each of the monitoring wells (not inclusive of QA/QC samples) and a period of at least one week will be allowed between development and sampling. Prior to sampling, the headspace within each well will be measured with a PID. An oil/water level interface probe will be used to measure the depths to the water table and thickness of any free product in the wells. The monitoring wells will be purged using low-flow purging techniques to remove a minimum of three times the volume of standing water in the well to allow for collection of a representative sample. Groundwater samples will then be collected using dedicated sampling equipment (e.g., bailer or pump tubing). Field parameter readings will be monitored during sampling including pH, oxidation reduction potential (ORP), specific conductance, and dissolved oxygen (DO). These groundwater samples will be analyzed for the following:

- TCL VOCs by US EPA Method 8260D;
- TCL SVOCs by US EPA Method 8270E;
- TAL Metals by US EPA Method 6020B/7470A;
- Trivalent Chromium and Hexavalent Chromium by US EPA Method 7196A;
- PCBs by US EPA Method 8082A;
- Pesticides by US EPA Method 8081B;

- Total Cyanide by US EPA Method 9012B;
- 1,4-Dioxane by US EPA Method 8270E SIM; and
- PFAS by US EPA Method 1633A.

QA/QC samples will be collected according to the QAPP. Additional lab analyses may be included based on field observations, with prior NYSDEC approval. Groundwater samples will be properly transported to a NYSDOH ELAP-certified laboratory under standard chain of custody procedures. Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared by a third-party data validator for all groundwater samples collected.

1.4.3. Soil Vapor and Sub-Slab Vapor

A soil vapor analysis will be performed in the vicinity of the groundwater monitoring wells, along the outside perimeter of the Sultana warehouse, as well as at the downgradient/site perimeter locations to characterize the potential for soil vapor intrusion into the building and offsite. A total of nine soil vapor points are proposed to be installed immediately adjacent to and around the perimeter of the Sultana warehouse as well as at an upgradient location near the eastern waterfront. Two of the nine soil vapor samples will be collected at downgradient locations as part of the QHHEA. Six interior sub-slab sample locations are also proposed within the warehouse building, which will be co-located with indoor air samples and collected during the heating season.

Permanent soil vapor points will not be installed in locations where impacts or MGP-related waste (coal tar and/or purifier waste) are identified since those areas will be targeted for remediation, making the data unrepresentative of post-remedial conditions. If impacts are encountered in the concurrent soil borings of the proposed soil vapor point locations, the vapor point will be installed in the nearest boring not containing impacts or MGP-related waste (coal tar and/or purifier waste). If the nearest well is installed at a boring location containing impacts or MGP-related waste, the soil vapor data will be compared to the nearest unimpacted well. Each soil vapor probe will be installed in the unsaturated zone approximately 2 ftbgs and using a stainless-steel screen that is fitted to dedicated 1/8-inch Teflon tubing secured with stainless steel fittings and caps to the ground surface. Following tubing installation, porous, inert backfill material will be used to backfill the hole and create a sampling zone approximately 1 to 1.5 feet in length. The top 6 inches will be sealed with a bentonite slurry to prevent ambient air from entering the area around the probe.

Prior to purging and sample collection, a multi-gas meter will be used to measure the concentration of oxygen (O_2), carbon dioxide (CO_2), and methane (CH_4) in each probe, to assess the subsurface chemistry (e.g., redox state). Additionally, the sampling point will be screened for VOCs via PID.

As required by the NYSDOH, a helium (He) tracer will be used as part of the sampling process, and all testing procedures will follow the *Final Guidance for Evaluating Soil Vapor in the State of New York (2006) with updates (SVI Guidance)*. If greater than 10% He is detected during the screening process, this will indicate excessive leakage and will require the point to be resealed or reinstalled after which tracer gas testing will be performed. Prior to sample collection, the He vapor will be screened using a field meter and the measurement recorded at each soil vapor sampling location.

Upon confirmation that the seal is secure, a pump will be used to purge the vapors in the probe and tubing of three volumes. Following this procedure, the soil vapor samples will be collected in clean, batch-certified, 1-liter SUMMA™ canisters at flow rates no greater than 200 milliliters per minute (ml/min) and analyzed for the full VOC analyte list via US EPA Method TO-15, including Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and naphthalene. Sample collection will be performed over the course of approximately 2 hours.

QA/QC samples will be collected in accordance with the QAPP. Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared for all soil vapor samples collected.

1.4.4. Indoor Air

In addition to six interior sub-slab vapor locations, six indoor air samples are proposed to be co-located and collected within the warehouse as per the *Final Guidance for Evaluating Soil Vapor in the State of New York (2006) with updates (SVI Guidance)*.

The indoor air samples will be collected in clean, batch-certified, 6-liter canisters at flow rates no greater than 200 ml/min and analyzed for the full VOC analyte list via US EPA Method TO-15, including BTEX and naphthalene. Sample collection will be performed over the course of approximately 8 hours and collected simultaneously with an ambient air sample outside of the building.

QA/QC samples will be collected in accordance with the QAPP. Data will be provided in an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements and submitted to NYSDEC in the appropriate EDD format. A DUSR will be prepared for all indoor air and ambient air samples collected.

2. Sampling for Emerging Contaminants (EC's)

- *Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs*, NYSDEC, April 2023

NEW YORK STATE OF OPPORTUNITY.

Department of Environmental Conservation

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

Under NYSDEC's Part 375 Remedial Programs

April 2023



www.dec.ny.gov

Table of Contents

Objective 1
Applicability 1
Field Sampling Procedures 1
Analysis and Reporting 2
Routine Analysis 2
Additional Analysis 2
Data Assessment and Application to Site Cleanup 3
Water Sample Results 3
Soil Sample Results 3
Testing for Imported Soil 4
Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS 5
Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids 6
Appendix C - Sampling Protocols for PFAS in Monitoring Wells 8
Appendix D - Sampling Protocols for PFAS in Surface Water 10
Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells 12
Appendix F - Sampling Protocols for PFAS in Fish 14
Appendix G - PFAS Analyte List 22
Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids 24

ERRATA SHEET for

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

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

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

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

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

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

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

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

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

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

Objective

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

Applicability

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

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

Field Sampling Procedures

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

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

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

Analysis and Reporting

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

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

Routine Analysis

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

Additional Analysis

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

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

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

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

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

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

Data Assessment and Application to Site Cleanup

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

Water Sample Results

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

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

Soil Sample Results

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

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

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

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

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

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

Testing for Imported Soil

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

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

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

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

General Guidelines in Accordance with DER-10

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

Specific Guidelines for PFAS

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

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

General

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

Laboratory Analysis and Containers

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

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

Equipment

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

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

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

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

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

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

Laboratory Analysis and Container

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

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

Equipment

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

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

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

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

Equipment Decontamination

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

Sampling Techniques

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

Appendix D - Sampling Protocols for PFAS in Surface Water

General

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

Laboratory Analysis and Container

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

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

Equipment

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

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

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

- stainless steel cup

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

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

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

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

General

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

Laboratory Analysis and Container

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

Equipment

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

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

Equipment Decontamination

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

Sampling Techniques

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

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

Sample Identification and Logging

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

Quality Assurance/Quality Control

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

Documentation

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

Personal Protection Equipment (PPE)

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

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

Appendix F - Sampling Protocols for PFAS in Fish

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

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

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

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

Version: 8

Previous Version Date: 21 March 2018

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

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

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

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

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

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

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

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

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

   1. Project and Site Name.

   2. DEC Region.

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

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

   5. Preservation Method.

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

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

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

   3. Date collected.

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

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

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

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

D. General data collection recommendations:

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

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

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

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

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

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

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

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

the same information.

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

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

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

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

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

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

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

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

Project and Site Name _____ DEC Region _____

Collections made by (include all crew) _____

Sampling Method: □Electrofishing □Gill netting □Trap netting □Trawling □Seining □Angling □Other _____

Preservation Method: □Freezing □Other _____ Notes (SWFDB survey number): _____

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

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

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, _____, of _____ collected the
(Print Name) (Print Business Address)

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

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

Town of _____, in _____ County.

Item(s) _____

_____

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

_____ _____
Signature Date

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

_____ _____
Signature Date

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

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

NOTICE OF WARRANTY

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

HANDLING INSTRUCTIONS

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

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

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

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

EQUIPMENT LIST

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

Fish measuring board.

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

Individually numbered metal tags for fish.

Manila tags to label bags.

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

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

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

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

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

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

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

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

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

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

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

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

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

CCV recovery <70 or >130%	J flag results

Blanks

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

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

Field Duplicates

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

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

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

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

Matrix Spike/Matrix Spike Duplicate

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

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

Extracted Internal Standards (Isotope Dilution Analytes)

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

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

Signal to Noise Ratio

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

Reporting Limits

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

Peak Integrations

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

3. Pre-Mobilization Activities

- PM-001 Public Utility Markout and Clearance

STANDARD OPERATING PROCEDURE

PM-001 Utility Markout and Clearance

1. Objective

Describe typical utility markout/clearance procedures prior to and during excavation. All markout procedures should be performed in accordance with local and state regulations.

Many states, by law, require that utility companies are notified before excavation begins. Actual procedures and requirements differ by state. City/state government may have additional requirements for utility markout procedures. Check the requirements in the locality before beginning. Also check with the GEI project manager to determine whether it is most appropriate for GEI or the drilling/excavation subcontractor to handle mark out and clearance.

2. Execution

Public Utility Markouts

- The drilling/excavation locations should be marked with white paint, stakes, or flags.
- The contractor should call the appropriate one call communication network for the state the work is being conducted in. Refer to the Reference section in this SOP for contact information. Contractors shall provide all necessary information to the one call system. Sample location maps may be provided to clarify sampling locations. The contractor shall provide GEI with the utility clearance ticket number.
- If necessary, contact the municipalities or other utility owners to mark their water, sewer, or other lines if they do not belong to the one call system. The contractor should keep a record of these calls.
- Utility plans, if available, should be obtained from the property owner or municipal offices.
- Prior to excavation, a visual check should be made that all utilities companies and municipalities have marked their locations. This includes looking for signs that a utility exists, and verifying that the markings agree with a visual check. If they do not, contact the appropriate utility to remark their locations.
- Utilities will generally only markout and clear utilities in roadways or other public property up to the property boundary. Owners of fiber optic cables, natural gas pipelines, and other high hazard utilities will often markout on private property if requested. The contractor should request this. See section on private utility clearance below.
- Public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation should adopt the American Public Works Association (APWA) Uniform Color Code using ANSI standard Z535.1 Safety Colors for temporary marking and utility identification, as follow:

The APWA Uniform Color Code

1. **White** – Proposed Excavation
2. **Pink** – Temporary Survey Markings
3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
4. **Yellow** – Gas, Oil, Steam, Petroleum & Gaseous Material
5. **Orange** – Communications, Alarm or Signal Lines, Cables or Conduit
6. **Blue** – Potable Water
7. **Purple** – Reclaimed Water, Irrigation and Slurry Lines
8. **Green** – Sewers and Drain Lines

However, not all organization do use these colors. Make sure the color scheme is understood.

- The excavator/contractor and consultant begins work on the scheduled work date and time (if all the facility operators have responded) taking care to find and preserve any markings that have been made.
- If markings may be disturbed during work, establish offset marks to create reference points for the underground utilities. Take photographs of the markings before starting work.
- When digging near a buried utility, the excavator/contractor and consultant should be aware of their proximity to the utility and use caution.
- If there is uncertainty about the accuracy of the markings or there are too many utilities in a given location to excavate or drill safely, consideration should be given to hand-digging the first few feet, vacuum excavation, or use of a utility location company as detailed below in Private Utility Markouts.
- Some clients may require hand or vacuum clearance to a minimum depth. Check with the GEI project manager.
- If exposing a utility, the excavator/contractor should provide proper support and protection for the utility to prevent damage. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, the excavator/contractor should provide proper backfill for any utilities that have been exposed.

Private Utility Markouts

- Utility markouts on private property should follow the steps outlined above in public utility markouts with the additions below.
- If work is conducted on private property where public utilities may not provide markouts and the property owner cannot provide accurate utility plans, it is

recommended to use a company to determine the utility locations using one or more of the following technologies:

i. Electro-Magnetic (EM) device: This technology uses an electro-magnetic field in the subsurface to accurately locate metallic lines or non-metallic lines incorporating a metallic trace wire along their surface. The field is created either by direct contact to the pipe or tracewire, or by an induced current via radio waves.
ii. Sewer Sonde: For non-metallic lines where internal access is possible (such as clean-out ports in a sewer), a beacon or 'sonde' that emits a signal to the surface receiver as it is snaked through the pipe provides the same accuracy as the EM detector. If the internal condition of the pipe is desired, a camera can be deployed instead of a simple sonde.
iii. Ground Penetrating Radar (GPR): This technology involves radar waves reflecting to a surface receiver which provides a visual real-time map of the subsurface by which anomalies (such as pipes or tanks) may be detected. It has limitations in clay or wet soils and requires a skilled operator for interpretation. GPR should be considered for high risk utilities (e.g. PVC natural gas lines without trace wire) where line-of-sight project from site entry point to a kiosk or other building is uncertain.

- Utility markout on private property should include clearance for other types of underground structures such as underground storage tanks, septic systems, utility or access tunnels, and in-ground irrigation systems.

3. Limitations

- Markout notification time usually does not include holidays. Make sure holidays are considered and markout time is scheduled accordingly. Do not conduct excavation or drilling prior to the required wait time. Do not mark excavation locations using spray paint if it is raining or snowing enough so that the paint markings will be washed away. Consider using long stakes instead of paint if snow is predicted. Excavations within the tolerance zone should be performed with non-powered hand tools until the marked utility is exposed. The tolerance zone may be determined by the utilities, law or codes.
- When excavating close to an underground utility, it is good practice for the contractor/excavator to have a spotter assist and guide the machine operator.
- Take care not to damage the conduit or protective coating of a utility. If the excavator/contractor damages this, leave the damaged utility exposed and immediately call the utility owner.
- If contact to a gas utility occurs, notify police, fire, and emergency personnel, and evacuate employees and general public. No attempt should be made to tamper with or correct the damaged utility.

4. References

Connecticut
Name: Call-Before-You-Dig (CBYD)
Telephone: 1-800-922-4455
Website: www.cbyd.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

Massachusetts, Maine, New Hampshire, Rhode Island and Vermont
Name: Dig Safe
Telephone: 1-888-DIG-SAFE or 811
Website: www.digsafe.com
Wait time after notification:
MA, ME, NH, and RI: 3 business days (excluding holidays)
VT: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York State
Name: Dig Safely New York
Telephone: 1-800-962-7962
Website: www.digsafelynewyork.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York City/Long Island
Name: New York City One Call Center
Telephone: 1-800-272-4480
Website: www.nycli1calldsi.com
Wait time after notification: 2 to 10 days (excluding holidays)
Expiration of markout: 30 days

New Jersey
Name: New Jersey One Call
Telephone: 1-800-272-1000
Website: www.nj1-call.org
Wait time after notification: 2 business days
Expiration of markout: 45 days

5. Attachment

Attachment A – Standard Utility Color Codes

6. Contact

Brian Conte
Anne Leifer

SOP PM-001

Attachment A – Standard Utility Color Codes

Color Code	Utility Description
Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

4. Air Monitoring (AR)

- AR-001 General Guidance on Work Zone Monitoring Methods
- AR-005 Hydrogen Cyanide Work Zone Air Monitoring Procedures
- AR-006 Air Sampling for Volatile Organic Compounds (VOCs) using Summa Canisters

STANDARD OPERATING PROCEDURES

AR-001 General Guidance on Work Zone Monitoring Methods

1. Objective

Protect human health by measuring air quality at the perimeter of a work area.

2. Execution

Walk-around perimeter and work zone monitoring for Total Volatile Organic Compounds (TVOC), Respirable Particulate matter less than 10 microns (RPM_{10}), and odor will occur along the perimeter of the project site on a regular and as-needed basis. Specific site conditions that will trigger walk-around perimeter or work zone monitoring include:

- visible dust
- odor complaints
- detection of TVOCs and/or RPM_{10} at levels approaching or exceeding action levels
- direction by the site oversight consultant or client

Perimeter air monitoring and work zone monitoring, in the absence of any specific triggering criteria, will be conducted on a regular basis during the normal work day. Particular attention will be given to the direction of any residences or other sensitive receptors.

At the time when a triggering condition is observed, the walk-around perimeter and work zone monitoring will occur continuously until the conditions that triggered the monitoring have subsided. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

TVOC concentrations will be monitored and recorded using a Rae Systems MiniRAE 2000 Portable Ionization Detector (PID) or equivalent. RPM_{10} will be measured and recorded using a MIE personal DataRAM 1200 (PDR-1200) portable real-time aerosol monitor equipped with a PM-10 monitor and Gilian personal air sampling pump. AR-002 Suspended Particulate Matter in Ambient Air using the MIE DataRAM Real-time Aerosol Monitor (Portable) provides guidance on the use of this meter. Odors will be noted based on the n-butanol scale, as adapted from ASTM E544-99.

At each monitoring point, the 15-minute average value of TVOC and RPM_{10}, sample time, and sample location will be collected and recorded. The odor intensity based on the n-butanol scale will be monitored over a 15-minute period and recorded. At each location, air temperature, wind direction, and wind speed may be monitored and recorded using a hand-held wind meter.

Odors as a function of naphthalene concentration will be monitored over a 15-minute period and recorded. To measure naphthalene concentrations, the zNose™ Model 4200 system will be used. The zNose™ is an ultra-fast gas chromatograph (GC) that is capable of analyzing airborne concentrations of VOCs and SVOCs in less than one minute. The zNose™ uses a surface acoustic wave (SAW) detector that changes in vibration frequency as compounds elute from the column and condense onto the surface of the detector.

The zNose™ is a portable instrument and will be positioned downwind of the remedial activities. Up to five samples will be analyzed for naphthalene concentrations over a 15-minute period. The concentrations will be averaged to produce a 15-minute result. The calibration will be checked at the start of the day, at mid-day, and at the end of the day. An air blank will be run every two hours. A blank will also be run if a reading exceeds the calibration range of the instrument.

The zNose™ also has the capability of generating fingerprint images of the chemical constituents in the vapor called VaporPrints™. A VaporPrint™ of an air sample can be collected through a headspace analysis. This VaporPrint™ can be compared to others generated at the perimeter and off-site to see if remedial operations are the source of the odors. VaporPrints™ can allow for identification of odors that may not be affiliated with remedial operations.

To monitor cyanide (as hydrogen cyanide gas), a real-time hand-held meter in conjunction with the Dräger Chip Measuring System (CMS) will be used. Types of continuously monitoring equipment include the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems and are available from rental equipment suppliers. Due to potential interference from sulfur compounds, hydrogen sulfide gas (H_2S) will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real-time meter.

At each location, air temperature, wind direction, and wind speed will be monitored and recorded using a hand-held wind meter.

3. References

New York State Department of Environmental Conservation. 2010. DER-10 / Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206

ASTM E544 - 99(2004) Standard Practices for Referencing Suprathreshold Odor Intensity

4. Attachments

None

5. Contact

Brian Skelly

STANDARD OPERATING PROCEDURE

AR-005 Hydrogen Cyanide Work Zone Air Monitoring Procedures

1. Objective

Describe real-time monitoring of hydrogen cyanide gas during field activities.

2. Equipment

To monitor cyanide (as hydrogen cyanide gas), the GEI field representative should utilize a real time handheld meter in conjunction with the Dräger Chip Measuring System (CMS) during subsurface activities including subsurface excavations, borings and monitoring well installation, materials handling, and groundwater sampling in areas with confirmed or suspected cyanide impacts.

Continuous monitoring equipment includes the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems, and are available from rental equipment suppliers. Due to potential interference from sulfurs, hydrogen sulfide gas (H_2S) should also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real time meter.

3. Calibration

Prior to commencing work on-site, the real-time cyanide meter should be calibrated in accordance with the equipment manufacturer's specifications. If the meter is calibrated in the field, the daily calibration results should be recorded in the field notebook.

4. Execution

Cyanide will be monitored around the perimeter of the work zone on a regular basis. Continuous monitoring should be completed every fifteen minutes if sulfur odor or suspected purifier waste material (former MGP sites only) is encountered. Measurements should be monitored in the breathing zone and should be recorded into the field notebook or on an applicable form. In the event that hydrogen cyanide is detected, the GEI field representative should proceed as follows:

4.1. Action Level: HCN ≤1 ppm for 15-minute average using real time meter

- Run CMS Dräger tube.
- Continue monitoring with real time meter.
- Continue work if CMS Dräger tube for hydrogen cyanide reads <2 ppm.

4.2. Action Level: 1 ppm < HCN < 2ppm for 15-minute average using real time meter.

- Run CMS Dräger using hydrogen cyanide gas chip and confirm <2 ppm concentration.
- Continue monitoring with real time meter.
- Run CMS Dräger tube using sulfur dioxide, hydrogen sulfide phosphine chip to evaluate potential interference.
- Recalibrate the real time meter and continue to monitor the work zone.

4.3. Action Level: HCN 2 ppm on CMS Dräger tube

- Stop work and move (with continuous monitoring meter) at least 25 feet upwind from excavation or until continuous monitoring meter registers <1 ppm.
- Run CMS Dräger hydrogen cyanide chip and re-evaluate activities
- Continue monitoring with real time meter.
- Allow area to ventilate and continue to monitor while returning to the work zone.
- Do not move into an area when readings are >1 ppm without confirming with additional CMS Dräger measurement.
- May resume work if Dräger tube for cyanide reads <2 ppm.

5. Limitations

No air purifying respiratory protection is available for hydrogen cyanide gas.

The American Conference of Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Hydrogen Cyanide is 4.7 ppm.

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

7. Contacts

Brian Skelly
Ryan Hoffman

STANDARD OPERATING PROCEDURE

AR-006 Air Sampling for Volatile Organic Compounds (VOCs) using Summa Canisters

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for volatile organic compounds (VOCs) using Summa canisters. Typically, U.S. EPA Method TO-15 is used for laboratory analysis. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Materials

- Sampling canister
- Flow controller
- Vacuum gauge
- Wrench for removing fittings and assembling the sample train
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Camera and measuring tape
- Weather station data
- PID

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- The laboratory prepares the canister for sampling by cleaning and then evacuating the contents to a vacuum of approximately 29.9 inches of Mercury (in. Hg). Opening the stainless steel bellows valve allows the air sample to enter the canister. When the target volume of sample is collected, close the valve and return the canister to the laboratory.
- A flow controller is used as part of the sample train to control the amount of air allowed to flow into the container over time. Flow controllers are typically set to a flow rate that collects a sample continuously over a 1-hour (hr), 8-hr, or 24-hr interval. The sampling duration needs to be communicated to the laboratory prior to sampling, so that the laboratory can provide the appropriate flow controller.
- Summa canisters are typically used and named after the “Summa” process which describes the electro polishing of the interior surface of the canister to prepare it for sampling.
- The holding time for a standard VOCs list of EPA Method TO-15 is 30 days after sample collection, although some projects may require a shorter hold time.

3.2. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- Sketch the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Record pertinent observations, such as odors and readings from field instrumentation.

3.3. Sample Collection

- Collect samples in a clean Summa canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (e.g. 8-hour, 24-hour, etc.). The flow controller flow rate should not exceed 0.2 liters per minute.
- Verify the initial vacuum of the canister using the vacuum gauge. If the canister vacuum is less than 25 in. Hg, do not use it. The procedure to verify the initial pressure is simple, and a missed step can compromise the validity of the sample media.
    i. Confirm the canister's bellows valve is closed by turning the knob clockwise to tighten.
    ii. Remove the brass cap from the canister inlet.
    iii. Attach the vacuum gauge.
    iv. Open and close the bellows valve quickly (a few seconds).
    v. Read and record the vacuum on the gauge as 'Initial vacuum' on the chain-of-custody (COC).
    vi. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
    vii. Remove the vacuum gauge and replace the brass cap.
- <u>Begin Sampling</u>
    i. Confirm the bellows valve is open by turning the knob counter-clockwise to loosen.
    ii. Remove the brass cap.
    iii. Attach the flow controller.
    iv. Attach a "J"-shaped sampling cane to prevent precipitation from entering the canister.
    v. Place the canister at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.

vi. Record the start date and time on the COC.
vii. Record the identification numbers for the canister and flow controller and the vacuum gage.

- Begin Sampling (with a field duplicate)
  i. Confirm the bellows valve is closed by turning the knob clockwise to loosen on both canisters.
  ii. Remove the brass cap from both canisters.
  iii. Attach a flow controller on both canisters.
  iv. Attached a "T"-shaped sample train designed for field duplicates to both canisters.
  v. Attach a "J"-shaped sampling cane to the common end of the sampling "T" to limit precipitation entering the canisters.
  vi. Place the attached primary and duplicate canisters at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
  vii. Record the start date and time on the COC.
- Monitoring Sample progress
  i. At regular intervals, record the vacuum on the flow controller to confirm that the vacuum is decreasing in the canister. If the vacuum reads 5 in. Hg or less the bellows valve should be closed and the sample interval ended.
  ii. Some residual vacuum is important to maintaining sample integrity. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Evaluate whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- End Sampling
  i. Sampling will end when the time interval (e.g., 8-hr period) is completed, or when the canister vacuum reads 5 in. Hg or less.
  ii. Close the bellow valve by turning the knob clockwise to tighten.
  iii. Remove the "J"-shaped sampling cane.
  iv. Remove the flow controller.
  v. Attach the vacuum gauge.
  vi. Open and close the bellows valve quickly (a few seconds).
  vii. Read and record the vacuum on the gauge as 'Final vacuum' on the chain-of-custody (COC).
  viii. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
  ix. Remove the vacuum gauge and replace the brass cap.
- Sample Transport
  i. Return the canister, flow controller, and sampling cane to the laboratory in the boxes provided.
  ii. Fill out the COC and relinquish samples properly with flow controller and canister numbers on the COC.

iii. Place the COC in the box and retain a copy of the COC for your records.
iv. Tape the box shut.
v. Deliver or ship the samples to the laboratory as soon as practical to adequately meet the holding time of the sample.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: Do not collect a field blank.
- Trip Blank: Do not collect a trip blank. The canister is prepared for sampling by evacuating the contents to a vacuum of, so no air exists for a trip blank to provide meaningful information.

5. References

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS), US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

Guide To Air Sampling & Analysis, Air Toxics, Ltd., Folsom, CA.

6. Contacts

Brian Skelly
Mark C. Ensign

5. Field Documentation (FD)

- FD-001 Field Notebook
- FD-002 Field Observation Report
- FD-003 Sample Management and Chain of Custody
- FD-004 Photo Documentation
- FD-006 Handheld Global Positioning Receiver Operation

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

1. Objective

Describe methods for documentation of field activities.

Documentation of site activities is a crucial part of the field investigation process. The field notebook serves as the record of field activities performed or observed during the project. It provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Attachment A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and "Return Book To:" the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
    - If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    - Date/time/weather.
    - GEI personnel.
    - Purpose of visit/daily objectives.
    - People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
  - Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
  - Time of arrival and departure of individuals.
  - Activities as they occur.

- Additional examples of observations to record may include and are not limited to:
  - Type and quantity of monitoring well construction materials used.
  - Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
  - Ambient air monitoring data.
  - Field equipment calibration information.
  - Locations and descriptions of sampling points.
  - Contractor/Subcontractor progress.
  - Sample media (soil, sediment, groundwater, etc.).
  - Sample collection method.
  - Number and volume of sample(s) collected and sample bottle preservatives used.
  - Sample identification number (s) and date and time of sample collection.
  - Approximate volume of groundwater removed before sampling.
  - Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
  - References for maps and photographs of the sampling site(s).
  - Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
  - Surveying data (including sketches with north arrows).
  - Changes in weather.
  - Rationale for critical field decisions.
  - Recommendations made to the client representative and GEI Project Manager.
  - Site sketch of conditions at the end of the day.
  - Summary of work completed/work remaining.
  - Allow time at the end of the day to complete entries in the notebook.

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

ASFE Daily Field Report for Geotechnical Field Observation, 2nd Edition (2001), ASFE, Inc.

4. Attachments

Attachment A - Example Field Notes

5. Contact

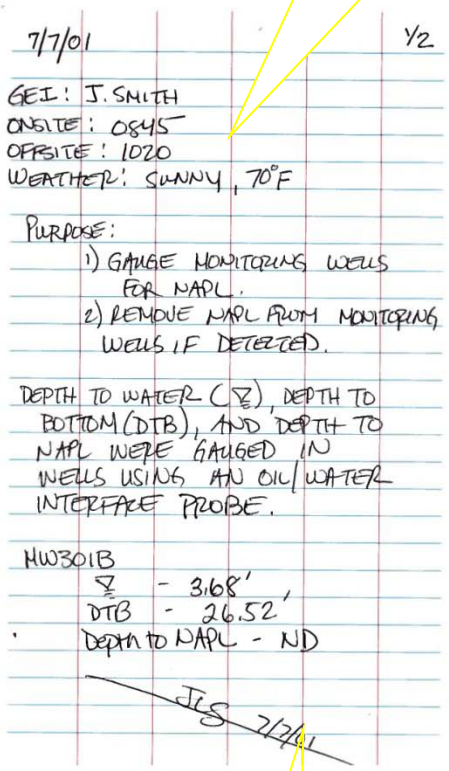
Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes

Start of each day includes:
- **Date**
- **Project Number**
- **People on site**
- **Purpose of Work**
- **Weather Conditions**

Each page is numbered



7/7/01 1/2

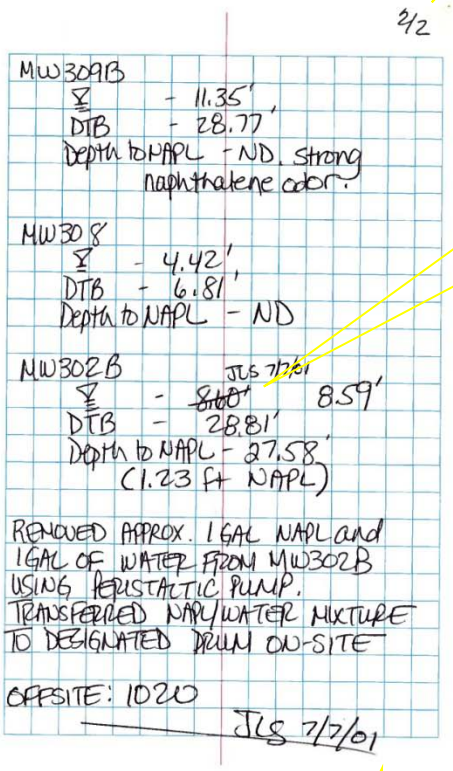
GEI: J. SMITH
ONSITE: 0845
OFFSITE: 1020
WEATHER: SUNNY, 70°F

PURPOSE:
1) GAUGE MONITORING WELLS FOR NAPL.
2) REMOVE NAPL FROM MONITORING WELLS IF DETECTED.

DEPTH TO WATER (▽), DEPTH TO BOTTOM (DTB), AND DEPTH TO NAPL WERE GAUGED IN WELLS USING AN OIL/WATER INTERFACE PROBE.

MW301B
▽ - 3.68'
DTB - 26.52'
Depth to NAPL - ND

JLS 7/7/01



2/2

MW309B
▽ - 11.35'
DTB - 28.77'
Depth to NAPL - ND. Strong naphthalene odor.

MW308
▽ - 4.42'
DTB - 6.81'
Depth to NAPL - ND

MW302B JLS 7/7/01
▽ - ~~8.60'~~ 8.59'
DTB - 28.81'
Depth to NAPL - 27.58'
(1.23 ft NAPL)

REMOVED APPROX. 1 GAL NAPL and 1 GAL OF WATER FROM MW302B USING PERISTALTIC PUMP. TRANSFERRED NAPL/WATER MIXTURE TO DESIGNATED DRUM ON-SITE

OFFSITE: 1020

JLS 7/7/01

Errors are single line crossed out and initialed

Blank Space crossed out and initialed

Bottom of each page signed and dated

GEI Consultants

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

1. Objective

Describe methods to generate a Field Observation Report.

The Field Observation Report is used to record a summary of activities, observations, and decisions made during the day's field work. The daily field observation report serves as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and/or client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report should be prepared by the individual responsible for the field notebook. This report should be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information:
    - A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    - A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    - A summary of deviation(s) from the field plan or objectives.
    - A summary of field decisions made, who made them, and the basis for such decisions.
    - A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    - Recommendations that may result from field observations and actions that may result from implementation of those recommendations.
    - A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

ASFE Daily Field Report for Geotechnical Field Investigations, 2nd Edition (2001), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	1 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

SOP FD-002 - Attachment A – Example Field Observation Report

Time of Arrival: 0700 **Departure: 1440** **Weather: Overcast, Raining, 55^{0}F**

Persons Contacted, Company
Jane Doe, ABC Contracting

GEI Representatives
Bill Smith

Purpose of Site Visit: To observe excavation of soils for new guard booth and sidewalk.

Observations:

1. **Excavation**
   a. Areas for guard booth and sidewalk were laid out by ABC with stakes, string, and spray paint. Locations were between the pavement and wetland area; no excavation occurred in the wetland area.
   b. Staging area for soil stockpile was located to the west of the excavation, along the fenceline; polyethylene sheeting was placed beneath the pile.
   c. HDPE membrane delivered to site; stored in garage area through the inside fence.
   d. ABC crew began hand digging area for sidewalk and guard booth. Sidewalk area measured 22 feet long by 4 feet wide by 4 inches deep. Guard booth area measured 12 feet long by 10 feet wide by 9 inches deep. Utility pole and bollard locations started today.
   e. Rain continued to get worse in the afternoon; ABC covered the entire excavation and soil stockpile with poly sheeting and secured the sheeting with grade stakes.

2. **Subgrade Preparation**
   a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. **Dewatering**
   a. No dewatering occurred today.

4. **Air Monitoring**
   a. During excavation, I monitored the breathing zone of the workers with an organic vapor meter (OVM). No headspace readings were measured in soil samples S-1 through S-8.

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	2 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0



Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith	**Reviewed By:**

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

1. Objective

Describe methods to label sample containers, manage the samples, and prepare Chain of Custody documentation for the samples. Sample transport is also addressed.

2. Project Setup

When setting up a sampling event, inform the recipients of the samples (laboratories) and recipients of laboratory results (data group and project managers). Discuss with the laboratory the sampling media, turnaround times, and reporting limits for appropriate regulatory criteria for the site. Include the data group on correspondence so that turnaround times, data validation, and project deliverable schedules can be tracked successfully.

- Laboratory - Number of samples, analyses needed: bottle orders and holding times, turnaround times needed, reporting limits needed for regulatory criteria.
- Data group - Number of samples, analyses requested, turnaround times and reporting limits requested, data validation needed, regulatory criteria to use for tabulating results, deliverables needed, and project name and number.
- Schedule - Inform the laboratory and Data Group of schedule delays, changes to analyses, and expediting.

3. Sampling Execution

- Review the work plan prior to sampling to determine the following:
  - Sample matrix and sampling method.
  - Required analysis and sample volumes.
  - Sample container type and preservative requirements.
  - Required analysis methods and/or report formats.
  - The turnaround time required by the project.
  - If the data will be sent directly from the laboratory to the data validator, Project Manager, or Data Group.
  - Holding time restrictions for sampling media and analytical methods.
  - Sample naming convention used for this project site.
- Sample labels should be filled out using a waterproof or permanent marker or pen. Required information includes:
  - Sample ID.
  - Date and time (military time) of sample collection.
  - Project number.
  - Sample preservatives.
  - Sampler's initials.
  - Laboratory analytical methods.

- Place the label on the jar or bottle, not on the cap. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material, if needed. See SOP SC-002 for guidance on packaging samples for shipment to the laboratory by way of common carrier. Place samples in a cooler with bagged ice or freezer packs (blue ice) immediately after collection. Add sufficient ice or freezer packs to cool samples to approximately 4°C.
- Complete a chain of custody (COC) for the samples as described below. GEI or laboratory COCs may be used as long as they contain fields for all required sample information as described in Section 2.1.

3.1. Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the

COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.

- If the samples are placed in a designated secure area (e.g. GEI sample fridge), note this location in the "Received by" box on the COC.
- GEI uses both single sheet and triplicate COCs. If using the triplicate COCs (white, yellow, and pink copies), the pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- If you are using the single sheet COC, make a copy of the COC after it has been signed by the lab courier and forward it to the Data Group.
- Prior to sample shipment by common carrier, the COC must be placed inside the cooler in a Ziplock bag or other watertight package.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- If a courier is used to transport samples to the laboratory (lab courier or GEI personnel), the courier signs the COC in the "Received by" box.
- Place a custody seal on the cooler if shipping via common carrier.
- Transport samples to the laboratory as soon as possible. It is preferable to transport the samples directly to the laboratory from the field. Samples brought back to the office for storage prior to submission to the laboratory must be kept cold (4° C).
- Unused sampling containers/media that are sent back to the lab should be included on a separate COC.
- After the samples are sent to the laboratory, the GEI copy of the COC must be forwarded to the Data Group: datagroup@geiconsultants.com.

4. Limitations

- Keep the number of people involved in handling samples to a minimum.
- Where practical, only allow people associated with the project to handle the samples.
- Always document the transfer of samples from one person to another on the COC.
- The COC should always accompany the samples.
- Give samples positive identification at all times that is legible and written with waterproof or permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Where practical, avoid sending samples from more than one site with separate COCs in a single package.

5. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

6. Attachments

Attachment A - Example Chains of Custody
Attachment B - Shipping Info Pics

7. Contact

Brian Skelly
Leslie Lombardo

Chain of Custody Record

Example COC

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client: GEI	Project Manager: Dave Terry	Date: 12-31-07	Chain of Custody Number: 00452
Address: 455 Winding Brook Dr	Telephone Number (Area Code)/Fax Number: 860 368 5300 / 860 368 5307	Lab Number	Page 1 of 1
City: Glastonbury / State: CT / Zip Code: 06033	Site Contact: M. Felter	Lab Contact: Paul Mobart	
Project Name and Location (State): Carroll Gardens NY	Carrier/Waybill Number: FedEx 9383 7603 0879		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis: VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	Special Instructions/ Conditions of Receipt
CGSB-01 (0-2)	12-31-07	1130				X	X						X	X		
CGSB-02 (3-4)	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X	X						X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X	X						X	X		
CGSB-XX (5-6)	12-31-07	0800				X	X						X	X		
CGTB-123107	12-31-07	1400				TB				X			X			
CGGW-01	12-31-07	1430		X			X			X			X	X		
CGSG-01	12-31-07	0700-1500	X												X	CANISTER # 2613 REGULATOR # 779

Per NEW JERSEY: "CLP data package deliverables"

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other See Contract

QC Requirements (Specify): NYS Cat B ASP deliverable send to Lorie Mackinnon

Send EDD to datagroup@geiconsultants.com

1. Relinquished By: Melissa J Felter	Date: 12-31-07	Time: 1600	1. Received By: FedEx Waybill 923117-4432	Date: 12-31-07	Time:
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments: USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

EXAMPLE COC

Chain-of-Custody Record

Laboratory: Accutest

Laboratory Job # (Lab use only)

GEI Consultants
400 Unicorn Park Dr.
Woburn, MA 01801
PH: 781.721.4000
FX: 781.721.4073

Project Information

Project Name: MWRA - Low Service Storage Tank
Project Location: Stoneham, MA
Project Number: 093400
Project Manager: D. Aghjayan

Send Report to: rseigener@geiconsultants.com
Send EDD to: labdata@geiconsultants.com

MCP PRESUMPTIVE CERTAINTY REQUIRED – YES NO

If Yes, Are MCP Analytical Methods Required? YES NO NA
If Yes, Are Drinking Water Samples Submitted? YES NO NA
If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	Preservative	PCBs	VPH Fractions Only	EPH Fractions Only	SVOCs	VOCs, % Solids**	Conductivity	RCRA 8 Metals*	TPH by GC/FID DRO	Sample Specific Remarks
							None		MeOH	None	None	MeOH	None	None	None	
							Analysis									
	093400-LS6-S5(19'-21')	12/29/2009	9:30	SO	3	JMR			x			x				
	093400-LS6-COMP (FILL)	12/29/2009	9:30	SO	1	JMR		x		x	x		x	x	x	
	093400-LS6-COMP (NATIVE)	12/29/2009	15:00	SO	1	JMR		x		x	x		x	x	x	
	093400-LS8-COMP	12/29/2009	14:00	SO	1	JMR		x		x	x		x	x	x	
	093400-LS9-S4 (8'-8'-5")	12/30/2009	14:30	SO	3	JMR			x			x				
	093400-LS9-COMP	12/30/2009	15:00	SO	1	JMR		x		x	x		x	x	x	

Sample Handling

Samples Field Filtered
YES NO NA

Sampled Shipped With Ice
YES NO

MCP Level Needed: GEI requires the most stringent Method 1 MCP standard be met for all analytes whenever possible.

Relinquished by sampler: (signature)	Date:	Time:	Received by: (signature)
1. Joseph M. Reyes	12/30/09	16:30	1. GEI FRIDGE
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
2. GEI FRIDGE	1/4/10	1310	2. Naomi Stegman
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
3. Naomi Stegman	1/4/10	1310	3. W. R. Odell
Relinquished by: (signature)	Date	Time	Received by: (signature)
4.			4.

Turnaround Time (Business days):

Normal _X_ Other ____
10-Day ____ 7-Day ____
5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you must notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

Please use MA Landfill List

* Please run TCLP analysis for RCRA 8 Metals results that exceed the 20 times rule.

** Please use % solids sample for VOC and VPH analysis of 093400-LS6-COMP (FILL), 093400-LS6-COMP (NATIVE), 093400-LS8-COMP, and 093400-LS9-COMP

Chain-of-Custody Record

Laboratory:

Laboratory Job # (Lab use only)

GEI Consultants

455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
PH: 860.368.5300
FX: 860.368.5307

Project Information

Project Name/Number:

Project Location:

Project Contact:

Phone Number:

Page __ of __

Send Report to:

Send EDD to: datagroup@geiconsultants.com

Preservative

Analysis

Sample Handling

Samples Field Filtered

YES NO NA

Samples Shipped With Ice

YES NO

Deliverables:

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection		Matrix	No. of Bottles	Sampler(s) Initials	Sample Specific Remarks
		Date	Time				

Relinquished by sampler: (signature)	Date:	Time:	Received by: (signature)
1.			1.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
2.			2.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
3.			3.
Relinquished by: (signature)	Date:	Time:	Received by: (signature)
4.			4.

Turnaround Time (Business days):

Normal _____ Other _____

10-Day _____ 7-Day _____

5-Day _____ 3-Day _____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

1. Objective

Describe methods to document and retain photographic records.

Keeping a record of photographs taken is crucial to their validity as a representation of existing conditions.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- Set the camera to record the time and date for each photograph.
- All photographic records, along with the following information, should be recorded in the field notebook (SOP FD-001).
    - If applicable, the compass direction describing the direction the photograph was taken (e.g. looking southeast). This may not apply to photographs of individual samples.
    - Brief description of what the photograph is intended to show.
- The field notebook should note who took the photographs.
- The photographs should be electronically backed up on a computer or other data storage device.
- If photographs will be used in a report, memo, or letter, they should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

3. Limitations

- Some clients and regulatory agencies require photographs of every subsurface soil sample collected. These photographs typically include a “whiteboard” which indicates the site, the boring ID, and the depth of the sample, while logging details are recorded in the field notebook. Under these circumstances, it is not necessary to include compass directions or descriptions.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template
GEI Consultants, Inc.

Project: Project Name

Location: Project Location



Photographer: K. Barber
Date: 10/25/07
Photo No.: 1
Direction: N

Comments:
Entrance of site with tree mulching operations.



Photographer: K.Barber
Date: 10/25/07
Photo No.: 2
Direction: W

Comments:
On-site building built in 1936.

STANDARD OPERATING PROCEDURE

FD-006 Handheld Global Positioning Receiver Operation

1. Objective

Use handheld global positioning system (GPS) receivers to locate sample points and site features with “Mapping-Grade” accuracy.

Use handheld GPS receivers to “stake out” proposed sample point locations within the limits of “Mapping Grade” accuracy.

2. Execution

- Handheld GPS receivers provide a low-cost and user-friendly method for locating sample points and site features with a fair degree of horizontal accuracy.
- In simplistic terms, GPS works by measuring the distance from numerous orbiting satellites to a point on the earth surface. Individual satellites broadcast their real-time location in terms of x,y and z coordinates, and the distance from each satellite is measured as a function of the length of time that a time-stamped signal takes to reach the receiver. Built-in GPS software derives new points by intersecting the distances from known orbital locations – in much the same way that points are located by intersecting tape-measured distances from building corners or other pre-existing site features.
- Late-model handheld GPS receivers utilize a real-time differential correction technique called WAAS (Wide Area Augmentation System). This system was designed to provide greater confidence and reliability in using GPS data for commercial aircraft landing approaches, and the additional correction improves all GPS operations.
- Handheld GPS receivers display navigational information on a variety of standard pages. Although each manufacturer uses slightly different formats, all receivers toggle back and forth between the following visual presentations:
- A “satellite” page displays the relative orbital location of all GPS satellites that are currently being tracked by the receiver. The display may include information on the real-time geometrical strength of the solution: satellite intercepts that cross at right angles provide more accurate solutions than intercepts that cross at acute or obtuse angles.
- A “track” page that displays the travel path of the receiver while it is turned on, along with the relative location of recorded points. Many GPS models have a “track-back” function that will guide the user on the same path back to the starting point
- A “navigation” page that displays instantaneous location and the real-time direction and velocity of travel. Some units provide two pages to display this information in different formats. Most units will report the overall “course

made good" (straight-line bearing and distance from the starting point) at any point.

- A "waypoint" page that allows users to "Go To" a created point or previously recorded point by providing a straight-line bearing and distance to the point. The information is instantaneously updated as the user moves along; some units display a pointing arrow that directs the user to the direction of travel. Be careful of go-to lines that lead through swamps or over cliffs – if you will be travelling in difficult terrain have a paper copy of the USGS quadrangle and a compass on hand for navigation.
- Signal strength degrades significantly next to buildings and underneath tree canopy. Most GPS receivers have an "averaging" function to improve the accuracy of shielded locations. GPS users can also improve precision by locating points three times, at different times of the day. Two of the solutions will generally be closer to each other than to the third and can be averaged for a more reliable fix.
- Most GPS receivers default to latitude and longitude, but data is more accurate and easier to input and when expressed in UTM coordinates to the nearest meter. The handheld GPS setup will have a function somewhere to change to UTM. Most of Connecticut is in UTM Zone 18 but the easternmost parts are in Zone 19.
- Consult "Corpscon" the datum translator available from the National Geodetic Survey website. Corpscon translates instantly from latitude/longitude to UTM coordinates to state plane coordinates and provides tools to identify UTM Zones. Also consult the Trimble, Garmin and Magellan websites for technological improvements and discussion of advanced techniques.

3. Limitations

- Handheld GPS receivers operating in unobstructed locations are currently reckoned to provide 2-5 meter accuracy, meaning that the true location of measured points lie within an "error ellipse" with axes of 2-5 meters centered on the measured location. In other words, even under the best of conditions a real-time GPS solution may be as much as 20 feet off the true horizontal location of a point.
- Due to geodetic restrictions, vertical locations (elevations) have less than half the accuracy of horizontal locations, meaning that even under the best of conditions, a surface elevation displayed on a handheld GPS receiver may be off by more than 50 feet.
- Horizontal and vertical data derived from handheld GPS receivers should never be considered more than relatively accurate, and this level of uncertainty should be identified in any discussion of positional tolerance.

4. References

Trimble Website: .trimble.com
Garmin Website: .garmin.com

Magellan Website: .**magellan**gps.com
National Geodetic Survey: ://www.ngs.noaa.gov/

5. Contact

Doug Bonoff, PLS

6. Drilling Methods (DM)

- DM-001 General Guidance on Determination of Appropriate Drilling Methods
- DM-002 Hollow-Stem Auger
- DM-004 Sonic Drilling
- DM-006 GeoProbe ® Direct Push Boring
- DM-007 Monitoring Well Construction and Installation
- DM-009 Monitoring Well Development
- DM-010 General Guidance on Monitoring Well Abandonment

STANDARD OPERATING PROCEDURES

DM-001 General Guidance on Determination of Appropriate Drilling Methods

1. Objective

There are multiple drilling methods which can be employed based on the type of stratum (e.g. overburden or bedrock) and the end use of borehole. End uses include geotechnical investigation, subsurface soil sampling, and monitoring well installation or a combination thereof.

The following text describes different methods of drilling with considerations for their use to collect groundwater and/or subsurface soil samples. Profiles of subsurface conditions encountered and well installation details must be recorded on logs. Procedures for field documentation are provided in Section 4 - Field Documentation.

2. Hollow-Stem Augers (HSAs)

Borings can be installed in unconsolidated formations using solid-stem or hollow-stem augers (HSAs). The augers are advanced by rotation and the drill cuttings are brought to the surface by travelling up the outside of the auger flights in a screw-like manner. HSAs have the advantage of allowing the well to be installed inside the hollow stem of the auger, which prevents the borehole from collapsing. Upon reaching the planned well depth, the casing and screen are placed inside the HSAs and the flights are individually removed while the annular space around the well is filled with the filter pack and grout, as appropriate. Conversely, solid-stem augers must be completely removed from the borehole before well installation, which can lead to collapse of the borehole. For this reason, solid stem augers are seldom used for installation of monitor wells.

HSAs come in a variety of sizes and allow collection of soil samples utilizing split spoons or Shelby tubes. Samples are collected ahead of the augers for determining soil/sediment type, stratigraphy, depth to the water table, and for collecting soil samples for chemical analysis. During this process, the standard penetration test (SPT, ASTM Method D 1586) can also be performed. The HSA method also has an advantage over mud-rotary drilling techniques in that drilling mud is not used. Drilling mud can contaminate the soil samples and potentially reduce the yield of the wells.

A disadvantage of the method is that HSAs cannot be used to drill into competent bedrock or through large boulders. Also, "heaving or running sands" can be forced up inside the augers as a result of strong vertical groundwater gradients, which can hamper efforts to collect soil samples or complete well installation. Furthermore, the maximum depth achievable using HSAs, which is generally shallower than other methods, is dependent not only on the ability of the rig (e.g., horsepower, rig-torque, weight of augers etc.), but also the lithology of the material drilled.

3. Rotary Drilling

Rotary drilling methods include both direct rotary and reverse-circulation rotary. Direct rotary is more commonly used in environmental investigations, whereas reverse-circulation rotary is used in drilling large-diameter water supply wells. In direct rotary drilling the borehole is advanced by rotating the drill pipe (rods) and bit to produce a cutting action. The cuttings are removed from the borehole by continuous circulation of a drilling fluid. The fluid or "mud" is pumped down the inside of the drill pipe and is circulated back to the surface on the outside of the pipe. The fluid removes the drill cuttings from the borehole and cools and lubricates the bit. Mud used during direct rotary consists of additives (e.g., bentonite), water, or air.

Reverse-circulation rotary drilling is similar to direct rotary except the drill rigs are larger and the flow of the drilling fluid is reversed. The drilling fluid moves upward inside the drill pipes and circulates back to the borehole via settling pits. The drilling fluid returns to the borehole via gravity and moves downward in the annular space between the drill pipe and borehole wall. Drilling fluids for reverse-circulation rotary are generally water and any suspended particles picked up from the surrounding formations.

Mud-rotary methods can be used to drill in both unconsolidated and consolidated (bedrock) formations. In addition, drilling mud stabilizes the borehole and limits the potential for borehole collapse. Disadvantages of using the mud-rotary method include the difficulty in determining the depth to the water table, the potential for drilling mud to impact soil samples and dragging of contamination into deeper zones since the drill cuttings are re-circulated in the borehole. Wells installed using this method typically take longer to develop than wells installed using the HSA or air-rotary methods due to the invasion of mud filtrate into the formation.

In air-rotary drilling, compressed air is directed down the inside of the drill pipe. As in mud-rotary drilling, air removes the cuttings and lubricates the bit. However, since air has no viscosity, it cannot be used to stabilize a borehole therefore, casing must be advanced in unconsolidated formations to keep the borehole open. This is why air rotary methods are best suited for drilling in bedrock formations. The percussion-type air-rotary "hammer" bit provides the best penetration rate when drilling bedrock consisting of crystalline rock. However, when drilling above the water table, an air-rotary bit can grind the soil and bedrock to a fine powder which is blown out of the hole with air and which has the potential to be inhaled. Therefore, drilling above the water table using air-rotary methods requires the addition of potable water to the borehole for dust control. In addition, the air compressor should be of the oil-less variety, or have a filter to prevent any oil from entering the borehole.

A disadvantage of using rotary methods while drilling in unconsolidated formations is the requirement of pulling the drill pipe out of the hole each time a split-spoon soil sample is collected (and the SPT is performed). This adds up to considerable amounts of time when deep wells are being installed or when continuous split-spoon

sampling is being performed. As stated above, split-spoons used to collect soil samples can become contaminated when they are advanced down a mud-filled borehole.

A special type of rotary drilling is bedrock coring, wherein a special core bit and barrel are used to retrieve relatively undisturbed core samples of the bedrock. Coring allows better characterization of bedrock lithology and other features including orientation of fractures and bedding planes, which can control contaminant migration. Core barrels can either be unoriented or oriented. An oriented core is scribed with respect to magnetic north. Although more expensive than collecting an unoriented core, this method gives the true orientation of the features encountered in the core.

Drilling fluids are generally air (air-rotary) or bentonite and/or water (mud-rotary). Water added to a borehole must be of potable quality. The source of the potable water used during the installation (and development) of monitor wells should be documented (e.g., in the Remedial Investigation Report).

Bentonite is high swelling clay with sodium montmorillonite as its primary clay mineral. Bentonite is added to water to increase the viscosity of the drilling fluid so that drill cuttings can be removed from the borehole more effectively. At the same time, the viscosity must be low enough to allow cuttings and coarse-grained particles to settle out once they are circulated out of the hole. Bentonite also adds weight to the drilling fluid, which helps to maintain borehole stability.

4. Sonic Drilling

The method involves driving a core barrel using vibration, rotation, and a downward force to collect soil samples. A sonic drill rig looks and operates very much like a conventional top-drive rotary or auger rig. The main difference is that a sonic drill rig has a specially designed, hydraulically powered drill head or oscillator, which generates adjustable high-frequency vibrational forces. The oscillator uses two eccentric, counter-rotating balance weights or rollers that are timed to direct 100 percent of the vibrational energy at 0 and 180 degrees. There is an air spring system in the drill head that insulates or separates the vibration from the drill rig itself. The sonic head is attached directly to the drill pipe or outer casing, sending the high-frequency vibrations down through the drill pipe to the bit.

A core barrel is advanced using vibration, rotation, and downward force to collect continuous soil cores up to 20 feet in length. The bit at the end of the core barrel contains carbide teeth allowing the core barrel to be advanced through most overburden, soft bedrock, and minor obstructions such as bricks and boulders. Once the core barrel has been advanced, a secondary or "over-ride" casing is advanced down to the same depth as the inner core barrel. The over-ride casing keeps the borehole from collapsing while the inner core barrel is removed. Once the core barrel is removed, the soil core is pushed out of the core barrel through the use of

vibration and either air or water pressure. Soil core diameters are dependent on the size of core barrel used and range from 3 to 12 inches. The use of multiple over-ride casings of increasing diameter allows the borehole to be telescoped down through multiple confining units. The setup used in sonic drilling makes this drilling method amendable to collecting soil cores and installing wells in angled boreholes. With only the bottom of the inner and outer core barrel exposed to the aquifer at any given time, determining the location of the water table can be difficult.

While this drilling method has the capability of drilling through and providing samples of coarse gravels, boulders, and tight clays, these situations will result in slow drilling or advancement of the core barrel. The result is a hotter core barrel and a longer contact time between the core barrel and the encased soil core. The aforementioned conditions will increase the probability that the sonic method will raise the temperature of the soil core and facilitate VOC and SVOC loss.

The ability to quickly install deep borings and wells, while generating a large-diameter continuous soil core, makes this drilling technique invaluable when continuous soil sampling is needed to assess deep or complex geological situations. However, sonic drilling's high cost, relative to other drilling methods, may be prohibitive for small projects or shallow boreholes. The higher cost of the drilling method should be weighed against the cost savings incurred due to its faster drilling rate and high quality of the soil core produced.

5. GeoProbe®-Direct Push

The method involves hydraulically pushing hollow rods into the subsurface for the purpose of collecting soil and/or groundwater samples (e.g., Geoprobe®). The method can be used to collect discrete soil samples or install small-diameter wells used to collect groundwater samples.

Advantages of the direct-push method include the relatively quick collection of groundwater samples and, when used along with a mobile laboratory, collection of data in “real” time. The method allows for collection of multiple samples in a day with the potential for achieving contaminant delineation in one mobilization of the field equipment. The data can also be used to select locations of permanent monitor wells.

Disadvantages of the method include the fact that the data quality achieved is often suitable only for screening purposes. Direct-push methods typically result in very turbid samples since an oversize borehole is not produced and a filter pack is not used. Turbid samples can produce higher metal concentrations in groundwater samples since metals are typically adsorbed onto soil particles. Use of direct-push methods can also cause cross-contamination since contamination from shallow zones may be driven down to deeper zones. Due to the narrow diameter of the direct-push rods, samples are often collected with peristaltic pumps. When samples are collected for volatile organic compounds (VOCs) using peristaltic pumps, some

of the volatiles may be lost due to the pressure drop produced by the suction lift. In such cases, the VOC data must be qualified accordingly. For this reason, use of the peristaltic pump for collecting groundwater samples for VOC analysis is not recommended and approval for its use should first be obtained from the project manager or geologist.

Another disadvantage of using direct-push technology for collecting groundwater samples is the potential to breech confining units. To prevent this, soil sampling using direct-push technology or conventional split-spoon sampling techniques should first be performed to identify the presence, depth and lateral extent of confining units. Pushing through confining units should be avoided if the presence of dense, non-aqueous-phase liquid (DNAPL) or very soluble compounds such as Methyl Tertiary Butyl Ether (MTBE) are suspected or the contaminant plume appears to be diving in the aquifer.

6. Contact

Gary Fuerstenberg

STANDARD OPERATING PROCEDURE

DM-002 Hollow-Stem Auger

1. Objective

Describe standard operating procedures for drilling of overburden soil borings using hollow-stem augers.

2. Execution

- Confirm that the appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned or pressure-washed. Record observations in the field notebook (See SOP FD-001).
- Observe that the augers are vertical when the first section is advanced into the ground.
- Use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification,* for details). Count and record the number of blows per 6-inch increments, confirming blow counts with driller if necessary).
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination,* SOP QA-001) or use another decontaminated split-spoon sampler.
- Ensure that the drillers advance the augers only after they have inserted the auger plug (to prevent soil from entering the augers while advancing to the next sample interval).
- Request that the drillers remove the auger cutting bit/plug and insert the split-spoon sampler into the interior of the augers. Measure the stick-up of the rods attached to the sampler to ensure that the nose of the spoon is in virgin soil below the augers.
- Watch for signs of a soil strata change at depth during drilling (i.e., change in blow counts, change in soil color, soil wetness, soil contamination, bouncing of the drill rig, etc.). If important to the investigation, stop drilling and collect a soil sample.
- If subsurface soil samples are being collected with split-spoon samplers, ensure that the drillers use a 30-inch drop of the 140-pound hammer. The number of blow-counts for each 0.5 foot penetration provides important geotechnical data.
- Repeat until the borehole has been drilled to the desired depth.
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Check with Project Manager and/or the appropriate regulatory personnel before using drill cuttings to backfill the boring.

- If a monitoring well will be installed, refer to SOP DM-007.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. If the boring location will not be surveyed, measure each location from on-site reference points and record the information in the field notebook so that the location can be plotted on site figures.

3. Limitations

- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see SOP DM-008 *Monitoring Well Telescoping Techniques*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of “running sands” or “blow in” to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present. If sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.
- Down-hole drilling equipment should be steam cleaned or pressure-washed between holes unless otherwise directed by the project manager.
- Record when standard operating procedures are deviated from. The drilling inspector should also record any detected odor from the boring and depth encountered.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), “Correct Well Design Improves Monitoring,” Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91

5. Attachments

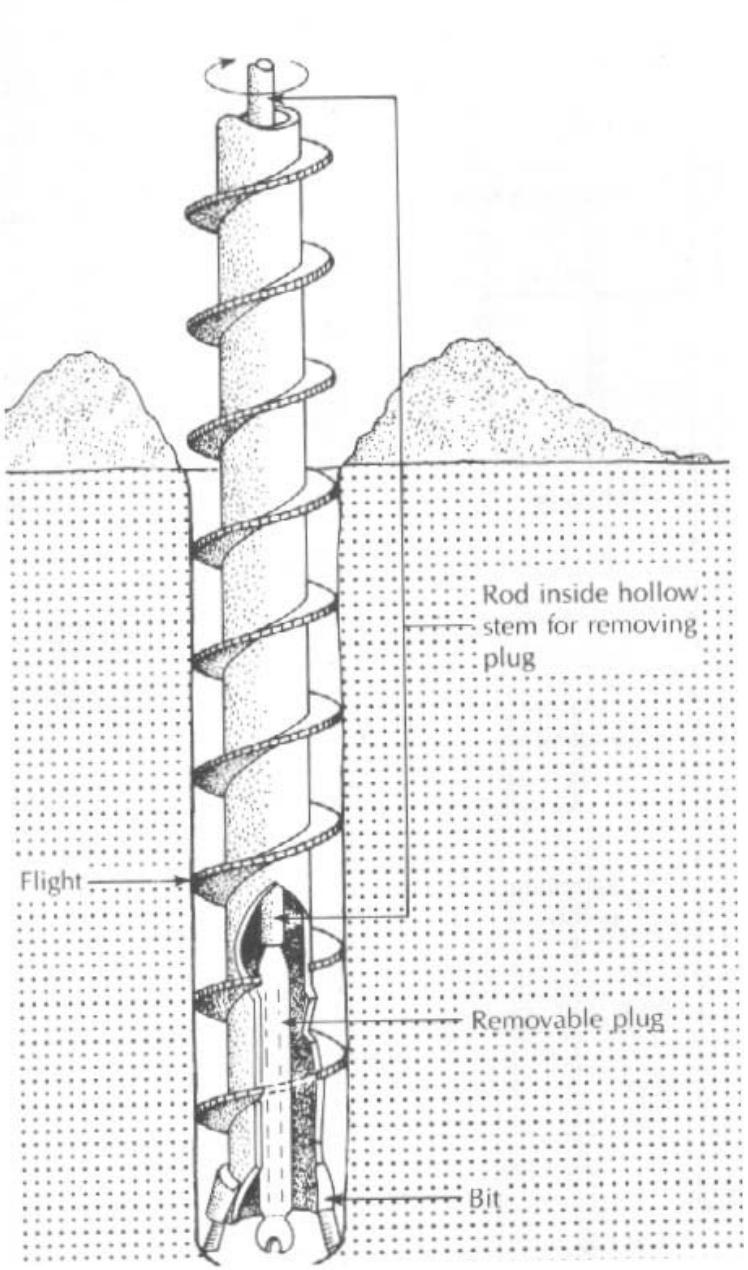
Attachment A – Hollow-Stem Auger

6. Contact

Gary Fuerstenberg
Cathy Johnson

SOP DM-002

Attachment A – Hollow Stem Auger



GEI Consultants

STANDARD OPERATING PROCEDURE

DM-004 Sonic Drilling

1. Objective

Describe common sonic drilling procedures.

Prior to drilling confirm that utility clearance has been completed and that the drilling rig has been appropriately decontaminated.

2. Execution

- Collect soil cores in runs of 5 to 10 feet. Some sonic rigs can collect a 20 foot sample, but the process generates a significant amount of heat that may degrade sample quality.
- Classify and sample the soil located within the liner.
- Excess soil should be placed in a 55-gallon drum for disposal.
- The core barrel should be cleaned with tap water following each use.
- The core barrel is then advanced within the isolation casing to collect the next soil core interval.
- Add water between the inner core barrel and the outer override casing. This will reduce friction between the casings and adsorb heat.
- Maximize drilling advance rate. The faster the core barrel is advanced, the less likely the core barrel will heat up. Drilling with a 3-inch diameter core barrel and a 5-inch diameter override casing, instead of the standard 4-inch core barrel and 6-inch over-ride casing, may increase advance rates and reduce the potential for soil core heating.
- If a significant decrease in drilling advance rate is observed, stop drilling and remove soil that has accumulated in the core barrel. Resume drilling through the resistant material (gravel, boulder, hard clay, etc.). When the resistant material has been penetrated and the drilling advance rate increases, stop drilling and remove what material has accumulated in the core barrel.
- Wash down the core barrel with cool water to cool the core barrel and associated casing, and resume drilling.
- If a well is to be installed in the borehole, the sandpack and grout are placed as the core-barrel and over-ride casing(s) are selectively vibrated out of the ground. The vibratory action should facilitate settlement of the sandpack and grout. Upon completion, no casing is left in the ground other than the well casing and screen.

3. Limitations

- Disturbance of the soil core is most likely to occur during removal of the soil core from the core barrel. The soil cores are usually vibrated out of the core barrel into plastic bags approximately 5 feet in length. As the plastic bags are

a little larger than the soil core itself, fragmentation of the soil core may occur as the core is extruded into the bag or while the bagged core is being moved in an unsupported manner. Soil conditions that are prone to disturbance include wet or dry zones that contain little or no fines, and well graded sands that contain significant volumes of water.

- If integrity of the soil core is of concern, the following procedures should be implemented:
  - Measures should be taken to ensure that the core, from the time it is extruded from the core barrel, is rigidly supported through the use of some type of cradle or carrying device.
  - The core should not be removed from its cradle until all sampling of the core has been completed. Acrylic liners are available for some core sizes and can be used to hold the core together upon removal from the core barrel.
  - If the soil is to be sampled for volatile organic compounds (VOCs), acrylic liners must be used.
  - Sampling of the soil core for VOCs or semi-volatile organic compounds (SVOCs) must be approved on a case by case basis. Proposals for VOC or SVOC soil core sampling must include provisions to minimize core fragmentation and heat generation, such as:
    - Acetate liners in the core barrel so that the soil core does not have to be extruded out of the core barrel.
    - Limit the length of soil core generated during a given downhole run.
    - Implement practices to reduce the residence time of the soil core in the core barrel.
- For the analysis of SVOCs, the use of the acetate liners is not required.
- The large diameter of the core barrel enables ground water sampling equipment to be placed inside the core barrel so that discrete depth groundwater samples can be collected during borehole advancement.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

5. Contact

Melissa Felter

STANDARD OPERATING PROCEDURE

DM-006 Geoprobe® Direct Push Boring

1. Objective

Describe standard operating procedures (SOP) for drilling of overburden soil borings using Geoprobe® and MacroCore® technologies.

2. Execution

- Confirm that appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been decontaminated (QA-001). Record condition of all down-hole drilling equipment.
- Make sure the sampler is fitted with a piston rod assembly to block the sample tube until the desired subsurface sample interval is attained. Upon reaching the target sample depth, the piston tip will be released and the discrete sampler device is then advanced to collect the representative sample. This reduces the volume of slough that is collected.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Log the soil sample using USCS procedures (SOP SM-003). Collect analytical samples if necessary (SOP SM-001).
- Decontaminate the cutting shoe if necessary (SOP QA-001 Equipment Decontamination) and have driller reassemble the parts with a new liner.
- Repeat the procedure described above until refusal or the boring is terminated.
- Periodically verify that depths cited by drillers are accurate.

3. Limitations

- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and re-evaluate health and safety conditions.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste Management*).
- If possible, plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at soil boring locations. These locations must also have been cleared by the state or local utility service prior to drilling.

4. References

ASTM D6001-05 Guide for Direct Push Water Sampling for Geoenvironmental Investigations, April 2005

Geoprobe Systems, "Geoprobe MacroCore MC-5 1.25-inch Light Weight Center Rod Soil Sample System SOP", Technical Bulletin No. MK 3139, November 2006

5. Attachments

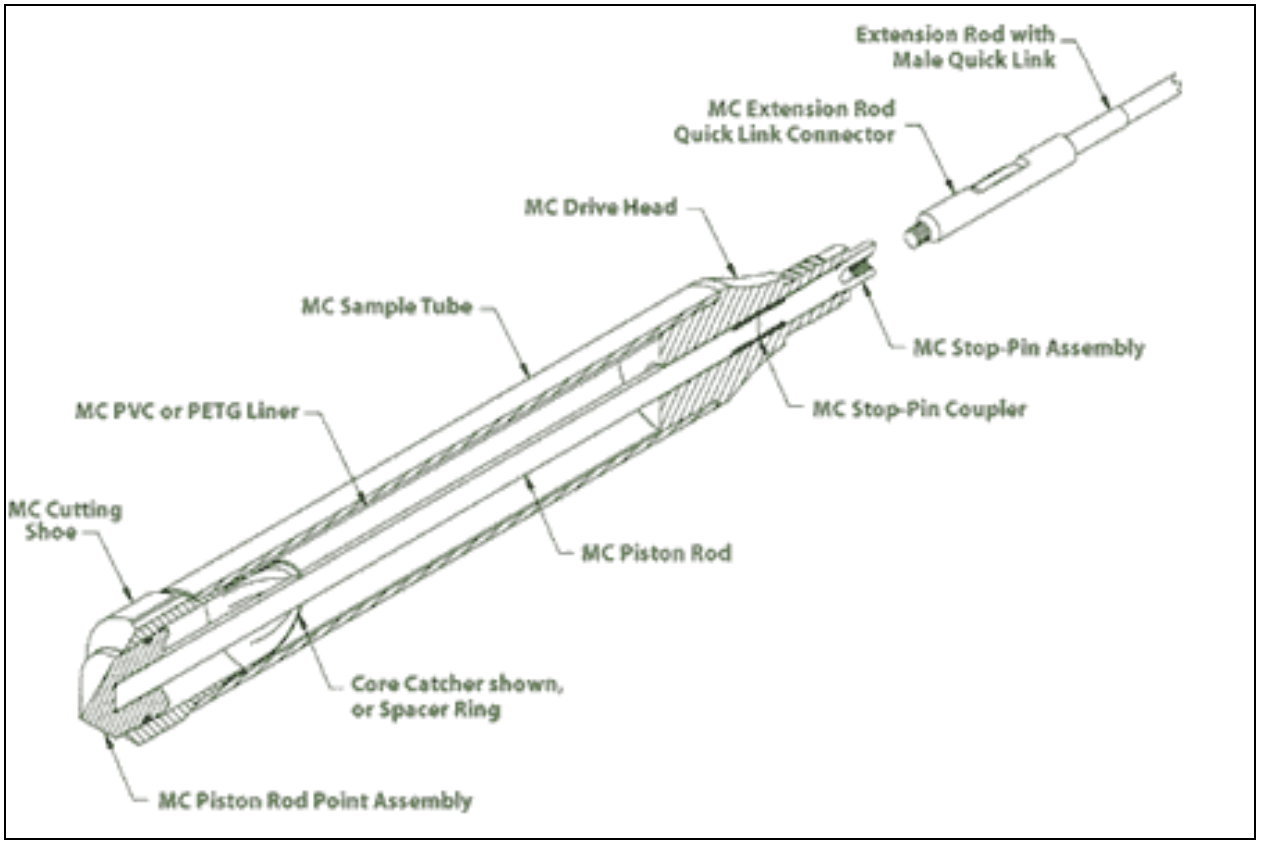
Attachment A – Geoprobe® with Macrocore® Sampler Assembly

6. Contact

Melissa Felter
Cathy Johnson

SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig



GEI Consultants

STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

1. Objective

Describe installation procedures for overburden monitoring wells screened across or below the groundwater table.

Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan. This SOP assumes the monitoring wells will be constructed of flush-joint PVC pipe and the screened section will have factory-slotted openings.

2. Execution

Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail. A Groundwater Monitoring Well Installation Log is in Attachment B.

- Measure and record the depth of the completed soil boring before beginning the well installation.
- If possible, measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- If it is not possible to accurately measure the depth to groundwater in the borehole due to low permeability in the formation, use the saturated soil depth observed in the collected samples or measured water depth in a nearby existing monitoring well to estimate the depth to water in the borehole.
- For shallow monitoring wells, select the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. Screen lengths of 15 feet or less are preferred and 10 foot screens are most common. If the water table is seasonally high or low or if the well is in a location where the water table is likely to be tidally influenced, appropriately place the screened section to allow for the screen to intersect likely future water tables.
- For intermediate or deep wells screened entirely below the water table, select the monitoring well screen and riser lengths as described in the Work Plan. Screen lengths of 10 feet or less are preferred.
- If the borehole is deeper than the desired well depth or the bottom of the well is close to a change in soil strata, then fill the base of the borehole with bentonite. Keep in mind that bentonite swells when hydrated, and that filter

sand should be placed at the bottom of the borehole above the bentonite before installing the well.

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- The driller should place a bentonite seal above the filter pack. If the seal is above the water table, use at least 5-gallons of potable water to hydrate the bentonite before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

the riser should be close enough to the top of the surface casing to allow reading of depth markings on a water level indicator tape.

- The protective surface casing is either a flush-mounted roadbox or a steel "stick up" pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement radially away from the protective casing at the ground surface to promote surface water runoff.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox flush with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area and is completed with a steel "stick up" pipe, additional protection such as steel pole bumpers around the steel "stick up" pipe may be necessary.
- If possible a locking cap should be placed on the steel "stick up" pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or till) unless specified in the Work Plan or approved by the Project Manager.

- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand should be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.

- Do not use drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

5. Attachments

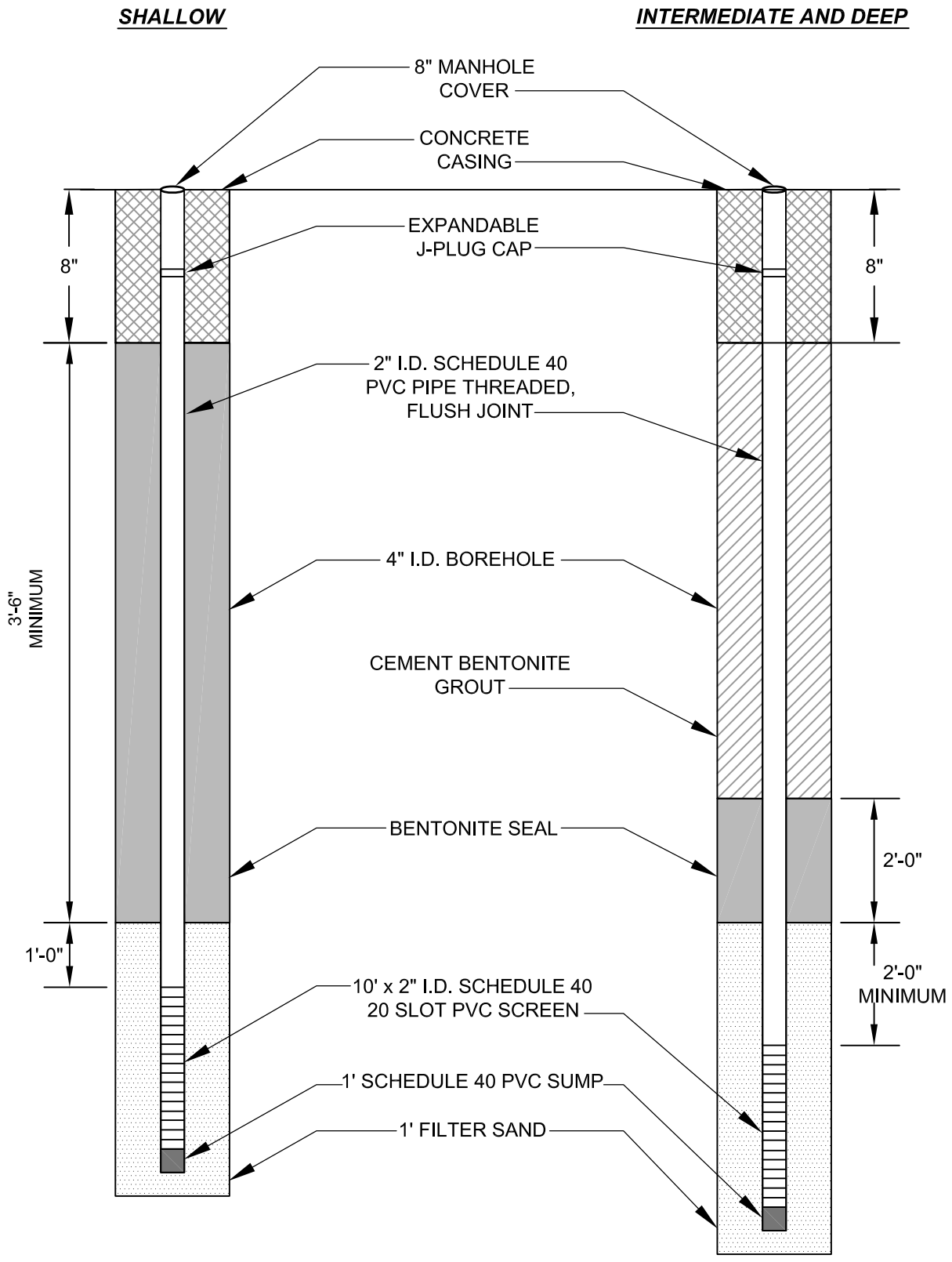
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



GEI Consultants

TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

I:\GEI\SOPs\ Well Detail.dwg \Jun 10, 2008

Groundwater Well Installation Log

Well ID

Project _____ **GEI Proj. No.** _____

City / Town _____ **Location** _____

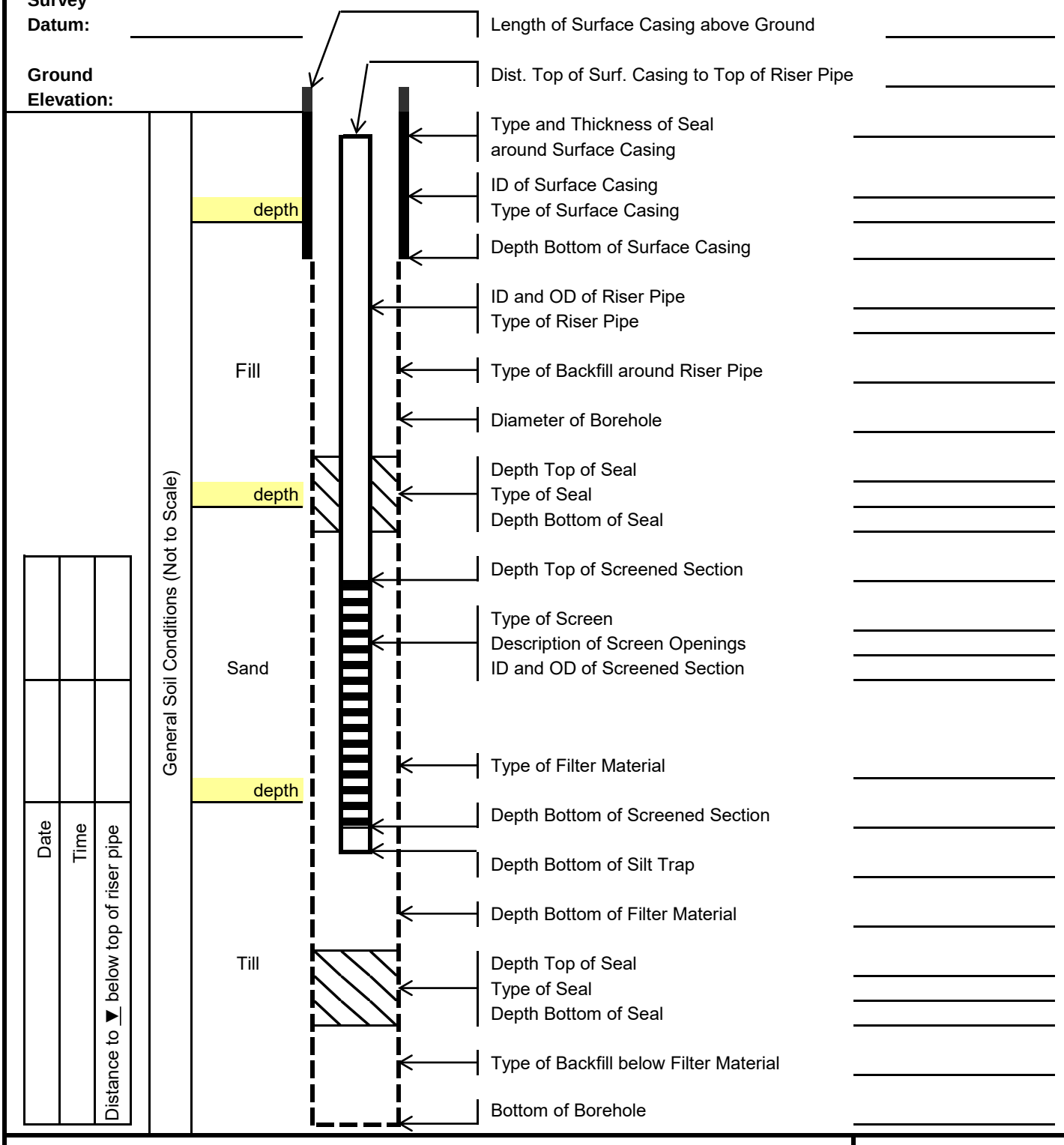
Client _____ N _____

Contractor _____ E _____

Driller _____ **GEI Rep.** _____ **Install Date** _____

Survey Datum: _____

Ground Elevation: _____



Notes:

GEI Consultants

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

1. Objective

Describe standard procedures to remove fluids from monitoring wells (introduced during drilling) and maximize the movement of groundwater into the well by removing fine particles in the well and sand pack around the screen.

2. Execution

To prevent cross contamination between monitoring wells, use dedicated equipment and/or appropriately decontaminated equipment to perform monitoring well development. See SOP QA-001 Equipment Decontamination and the Work Plan for more information.

For deep or large diameter monitoring wells, it may be necessary to use a re-usable pump system, such as a Grundfos pump, to develop monitoring wells.

- Calculate the volume of water in the monitoring well (one well volume) using the following table:

Well diameter (inches)	Volume (gal/ft)
1	0.04
1.5	0.09
2	0.16
3	0.36
4	0.65
6	1.50

  The equation used to establish these volumes is presented in Section 4.

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.

- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).

- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

Waterra system. Record the physical properties (color, turbidity, odors, etc.) of the sample.

- The volume of water that should be removed will depend on the work plan, local regulatory guidance, and/or the volume of water that was introduced during drilling and well installation. Typical guidance for the removal volume includes:

    - Ten well volumes.
    - The volume of fluid added during drilling.
    - The volume required to remove enough suspended particles so that the turbidity of the water is less than 50 nephelometric turbidity units.

If needed, pump the ground water into a 5-gallon pail so that the volumetric flow rate and total water volume from the pump or bailer can be calculated.

Measure the groundwater level in the well during development to assess if the pumping rate is sufficient to create a drawdown in the well.

Observe the groundwater every few well volumes during the pumping and record the physical properties (color and turbidity).

If required by the Work Plan, conduct surging in the monitoring well. See the Work Plan for the method of well surging to be used. If surging is necessary, do so only after initial pumping at the well has occurred and fine sediments have been removed.

Slowly move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.

3. Limitations

Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action. They may also damage the pump.

If the ground water in the monitoring well is contaminated, the water removed during well development may need to be placed in a properly-labeled drum and disposed of in accordance with local, state, and federal regulations (see SC-003 Investigation Derived Waste).

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous

techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

There are occasions when the turbidity of groundwater cannot be meaningfully reduced. On these occasions, a minimum of ten volumes should be removed, and the Project manager should be consulted.

Sampling of groundwater should generally not occur within one week after development. In some regions or regulatory jurisdictions, a minimum of two weeks may be required before sampling. If no water was introduced to the formation during drilling, this waiting period may be shortened if required by the project. See the Work Plan for additional information.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

"The Methods & Mechanics of Well Development, Part 2 of 5," National Drillers Buyers Guide, March 1993, p. 17.

Massachusetts Department of Environmental Protection, "WSC-310-91Standard References for Monitoring Wells, Section 4.5 Decommissioning of Monitoring Wells", January 1991
.

U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Gary Fuerstenberg
Anne Leifer

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Comments

STANDARD OPERATING PROCEDURE

DM-010 General Guidance on Monitoring Well Abandonment

1. Objective

Describe methods to abandon a monitoring well.

The goal of monitoring well abandonment is to seal the borehole so it cannot act as a conduit for movement of contaminants or liquids from the ground surface to the water table or between aquifers.

General procedures for well abandonment are provided below but do not supersede state or local regulations. Make sure all well abandonment procedures adhere to appropriate regulations.

2. Execution

The following methods for abandoning unconsolidated (overburden) and consolidated (bedrock) monitoring wells should be performed by a licensed drilling contractor, if required by law or regulatory authorities. The following listed methods are general guidance for abandoning monitoring wells. The Work Plan and state and local requirements should be reviewed for additional requirements.

2.1 Unconsolidated (overburden) Monitoring Wells

Unconsolidated (overburden) monitoring wells should be abandoned in the following manner, see the Work Plan for additional requirements:

- Remove the protective casing and concrete pad.
- If possible, overdrill the monitoring well casing and sand pack using hollow-stem augers or casing to at least one foot below the depth of the boring/well as indicated in the soil boring log.
- If possible, remove the monitoring well riser, sand pack, bentonite seals and grout.
- Once the well materials have been removed, add cement/bentonite grout using tremie methods starting at from the bottom of the borehole as the augers or casing are removed.
- If the well materials cannot be removed by overdrilling, the riser should be cut off at a depth of between two and five feet below the ground surface and the remaining well materials may be filled with grout using tremie methods. The grout mixture will be as specified for the well installation (see SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods)
- Add grout to the point where the riser was cut off or to a depth of approximately two feet below the ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

2.2 Consolidated (bedrock) Monitoring Wells

Consolidated (bedrock) monitoring wells or open holes will be abandoned in the following manner. See the Work Plan for additional requirements:

- Remove the protective casing and concrete pad;
- Remove the monitoring well materials from the hole. If the materials cannot be removed, cut off the well riser between two feet to five feet below grade. If feasible, cutting off the riser at five feet is optimal.
- Add cement/bentonite grout via tremie methods from the bottom of the well up to the ground surface. The grout mixture should be as specified for the well installation SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods
- Add grout to the point where the riser was cut off or to a depth of approximately 2 feet below ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

3. References

Environmental Protection Agency, Region 4, "Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Chapter 6 – Design and Installation of Monitoring Wells," November 2001.

Massachusetts Department of Environmental Protection, "313 CMR 3.00, Registration of Well Drillers and Filing of Well Completion Reports".

Massachusetts Department of Environmental Protection, "Standard References for Monitoring Wells, Section 4.6 Decommissioning of Monitoring Wells", January 1991

4. Contact

Gary Fuerstenberg
Anne Leifer

7. Sample Collection and Field Screening (SC)

- SC-001 General Guidance on Sample Collection
- SC-002 Sample Handling
- SC-003 Investigation Derived Waste
- SC-004 Head Space Screening

STANDARD OPERATING PROCEDURE

SC-001 Environmental Sample Types and Sampling Strategies

1. Objective

Describe types of samples and strategic approaches to sample locations.

Refer to Attachment A for guidance on compatible sampling materials.

2. Sample Types

Grab Samples

A grab (or discrete) sample is a single aliquot (part of the sampled media) collected from a single location at a specific time.

Surface soil samples are typically “grab” samples. Volatile organic samples are always grab samples because the least amount of sample disturbance is necessary.

Composite Samples

Composite samples are non-discrete samples composed of more than one aliquot collected from different sampling locations and/or at different points in time. Analysis of composite samples produces an average value.

Composite samples are frequently collected to characterize waste soil that has been stockpiled for eventual disposal. Several grab samples are collected from the stockpile and are blended together into a single sample.

Screening Samples

Screening samples may be grab or composite in nature. However, they offer potential advantages such as rapid results and low cost. The trade-off is that they may only provide results within a range and/or they may have elevated detection limits. Screening samples are most often used to evaluate presence/absence and/or indications of the potential magnitude of impacts.

3. Sampling Strategies

Generally, there are three sampling strategies: random, systematic, and judgmental sampling.

- Random sampling involves collection of samples in a non-systematic fashion from the entire site or a specific portion of a site.
- Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.
- Judgmental sampling is the collection of all other samples. This sampling might be from areas most likely to be contaminated, areas most likely to be clean, or areas where information is lacking.

Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

4. Attachments

Attachment A - General Guidelines for selecting equipment

5. Contacts

Jerry Zak
Ryan Hoffman

General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[✔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		Target analyte(s)	
Material	**Description**	**Inorganic**	**Organic**
		Plastics[1]	
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	✔ (potential source of fluoride)	✔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	✔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	✔ (potential source of Si)	**Do not use**
		Metals	
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	✔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	✔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	✔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	✔ Routinely used for CFCs Do not use if corroded[3]
		Glass	
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	✔ **Do not use** for trace element analyses. Potential source of B and Si	✔

[1]Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

1. Objective

Describe appropriate environmental sample handling procedures.

The procedures include collection and transport of environmental samples to a laboratory for chemical analysis. Appropriate sample handling should ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., FedEx or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- A waterproof or permanent ink pen should be used for all labels. The label should have an adhesive backing and be placed on the jar or bottle, not on the cap. In addition, clear packing tape can be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See SOPs FD-001 and FD-003):
    - Project number
    - Sample identification (i.e. MW-201 or SS-2)
    - Date and time (military time) of collection
    - Sampler's initials
    - Analysis methods
    - Preservative, if present
- Pre-preserved laboratory jars are preferable and should be used whenever practicable. If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples should be collected in order of volatility, most volatile first. Samples collected for volatile analysis should be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis should be collected without air bubbles.
- The collection and preservation method of soil samples for volatile analysis may depend on project, client, or state regulatory requirements. Check with your Project Manager and/or SOPs SM-001 and SM-002 where appropriate.

- Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing samples in the field, specify the basis for composite (i.e. volume, weight, spoon recovery, etc.) and record in the field book the procedure for compositing the sample.
- Once samples have been collected and labeled, place samples in a cooler with sufficient bagged ice or freezer packs (blue ice) (if allowed) to chill samples to 4°C. If using ice, use double-bagged ice.
- Complete the chain-of-custody (COC) (SOP FD-003).
- If transporting the samples by way of a shipper:
    i. The sample cooler should have water drains securely sealed with duct tape, both on the inside and outside of the cooler.
    ii. Place a layer of packing material on the bottom of the cooler as a cushion.
    iii. Individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
    iv. Methanol preserved samples for volatiles analysis should be packed so they remain upright with the soil completely covered by the methanol during transport.
    v. Place a layer of packing material on top of the sample bottles.
    vi. Place bagged ice or freezer packs on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
    vii. Place the completed and signed chain-of-custody form in a sealable plastic bag and place on top of the packing material in the cooler, or tape it to the inside lid of the cooler.
    viii. Fill out the appropriate shipping or courier forms and attach to the top or handle of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a signed and dated custody seal on the cooler.
- All samples should be submitted to the laboratory as soon as possible. In many cases, same day shipping will be required by the client or the project manager. Be clear on this before beginning the field work.
- A copy of the waybills should be kept by the field supervisor to track shipments if necessary.

3. Limitations

- If samples are shipped on a Friday, call the laboratory ahead of time to confirm that personnel will be at the laboratory to receive and log-in the samples.
- During warm weather, make sure to use plenty of ice in the shipping container.

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO_3), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc… unless these materials are of interest.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Preservation Techniques for Volatile Organic Compound (VOC) Soil Sample Analyses, WSC#99-415. Massachusetts Department of Environmental Protection.

5. Contacts

Jennifer Belonsoff
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

1. Objective

Describe characterization and management of Investigation Derived Waste (IDW) resulting from site investigation activities.

IDW is solid and/or aqueous waste generated during environmental site investigations.

2. Execution

- Determine the suspected contamination type and impacted media based on previous investigations, available analytical data, and/or site history.
- Consider the following when selecting IDW management option(s):
    - Anticipated volume of IDW to be generated during on-site activities
    - Potential contaminants and their concentrations
    - Proximity to population centers and the potential for unauthorized site access
    - Potential exposures to workers
    - Potential for environmental impacts
    - Community concerns
    - Potential storage areas
    - Regulatory constraints
    - Potential on-site treatment options
    - Duration of storage
    - Client concerns or requirements
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan or other project documents.

Considerations and guidelines for IDW management for specific field tasks are provided below.

2.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (such as two layers of 6-ml plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.

- Backfill test pits with uncontaminated soil, unless otherwise directed by project manager.
- If directed by the Project Manager to return contaminated soil to the test pit, backfill soil in the same order as the soil was excavated from the test pit.

2.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if it is acceptable to the client and the governing regulatory agency. If not, IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3. Well Development/Sampling

Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling may be poured on the ground near the well, if it is acceptable to the client and the governing regulatory agency. Otherwise, it should be containerized in drums or tanks.

2.4. Decontamination Fluids

Decontamination fluids may be poured on the ground in the vicinity of the well if approved by the project manager. Alternatively, the fluids may be containerized in drums or tanks.

2.5. Disposable Personal Protective Equipment

Disposable personal protective equipment (PPE) should be managed like any other IDW. However, with the clients' and project manager's approval, it may be removed from the site and disposed of as ordinary rubbish if it has not come into contact with contaminated materials.

3. Limitations

- The simplest IDW management option is to return the IDW to its source location.
- However, the selected IDW management options must meet state/federal regulations and have the client's approval. Consult with state/federal policies for IDW-related matters.

- The client is responsible for the disposal of IDW, should disposal be necessary.

4. References

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, Publication No. WSC-310-91.

5. Attachments

Attachment A - Summary of Investigation Derived Waste Management Options
Attachment B - CTDEP Waste Guidance

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source location immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Spread around boring, test pit, or original source location	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Containerize and temporarily store on site	Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure. Storage consistent with state/federal regulations.
		Send to off-site, treatment or disposal facility within appropriate timeframes	Requires proper shipping documents (i.e. manifest, Bill of Lading, etc.), analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Store temporarily awaiting laboratory analysis.	Storage consistent with state/federal regulations. Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure.
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Store temporarily on site.	Storage consistent with state/federal regulations.
		Send to off-site facility within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well	Non-hazardous liquids only. Should not exhibit a sheen or separate phase product. Do not discharge to the ground up-gradient of the source location. Ensure that it is permissible by local, state, and Federal regulations Is acceptable to the client, the governing regulatory agency, and the project manager.
		Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site commercial treatment unit within appropriate timeframes	Refer to State regulations for appropriate timeframe. Requires appropriate shipping documents (i.e., manifest, Bill of Lading), analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. Consistent with final remedial action
		Discharge to surface water	OK if it complies with state and federal regulations. Obtain appropriate discharge permit(s).
Decontamination fluids	Decontamination of PPE and equipment	Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site facility within appropriate timeframes	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Store temporarily on site	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required – must be acceptable to client and project manager
		Send to off-site facility within 90 days	Project-specific determination required
		Store for future treatment and disposal.	Storage consistent with state/federal regulations. Project-specific determination required

Notes:

1) PPE - personal protective equipment
2) POTW - publicly owned treatment works
3) Generation processes listed here are provided as examples.
   IDW may also be generated as a result of other site activities.
4) RCRA Container/Waste Pile/Tank requirements:
   Containers; 40 CFR 264 Subpart I and 265 Subpart I
   Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
   Tanks; 40 CFR 264 Subpart J and 265 Subpart J

Connecticut Department of Environmental Protection

Connecticut's RCRA "Contained-In" Policy

Characterization of Contaminated Soil and Groundwater

Policy
RCRA hazardous waste determinations for contaminated soil and groundwater may compare contaminant concentrations with the characterization criteria below. If the concentrations are below these criteria then the soil and groundwater do not need to be managed in Connecticut as RCRA hazardous waste. If the concentrations are above these levels then the soil/water must be treated, stored, transported, and disposed in the same manner as hazardous waste.

Purpose
To simplify the management of non-hazardous contaminated soil and groundwater and to encourage remediation of contaminated sites.

Applicability
This policy applies to contaminated soil and groundwater managed in Connecticut. It does not establish cleanup criteria. When contaminant concentrations are below the levels described in this policy, but are greater than applicable Connecticut Remediation Standard Regulations ("RSR") criteria, then the soil and groundwater must be handled as non-hazardous contaminated soil and groundwater subject to applicable RSR polluted soil reuse requirements and to Connecticut solid waste requirements.

Contaminant	Soil Characterization Criteria	Groundwater Characterization Criteria
Characteristically hazardous waste "**D codes**"	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table")[1]	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table")
Listed hazardous waste "**F,K,P,U codes**" See 40 CFR 261.33 for "**P**" & "**U**" See 40 CFR 261 Appendix VII to identify constituents for which "**F**" & "**K**" wastes are listed.	Non-hazardous if below the lower of A and B: **(A)** Industrial/Commercial Direct Exposure Criteria in RSR[2] **and** ---------- ---------- ---------- [choose one method from B]: **(B) either** TC Table[1] **or** 100 x GA Pollutant Mobility Criteria in RSR[3] **or** 100 x Groundwater Protection Criteria in RSR[4]	Non-hazardous if below 100 x GA Groundwater Protection Criteria in RSR

1. via Toxicity Characteristic Leachate Procedure ("TCLP")
2. via mass analysis
3. via mass analysis or leachate analysis
4. via leachate procedure (eg: TCLP or Synthetic Precipitation Leachate Procedure

STANDARD OPERATING PROCEDURE

SC-004 Headspace VOC Screening

1. Objective

Describe methods to obtain site-specific measurement of the total volatile organic compound (VOC) concentrations present in the headspace of a jar containing soil.

This information can be used for several purposes:

- Segregate soil based on degree of contamination.
- Identify samples for quantitative analysis of VOCs.
- Evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar headspace (JHS) screening.
- Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before JHS screening begins. Record the type of calibration gas, detector, lamp, and results of calibration in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing JHS screening. Record this as the initial background concentration.
- Half-fill a clean, glass jar with the soil. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the jar with the sample location and sample depth.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Vigorously shake the jar for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the jar in a heated vehicle or building during the headspace development period.
- After headspace development, remove the screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Record the highest VOC concentration that the instrument displays as the JHS concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building if possible.

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

5. Contacts

Lynn Willey
Leslie Lombardo

8. Solid Matrix Sampling (SM)

- SM-001 Soil Sampling Techniques Including Split-Spoon
- SM-002 VOC Soil Collection and Preservation Method
- SM-003 Soil Classification
- SM-005 Underground Storage Tank (UST) Removal and Closure Process

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

1. Objective

Describe standard procedures for the collection of surface and subsurface soil samples.

The definition of "surface" soil varies considerably between regulatory organizations. Surface soils may be classified as soils between the ground surface and 2 inches below ground surface, ground surface and 6 inches below ground surface, and even as much as ground surface and 24 inches below ground surface.

The definition of subsurface soil will vary in relation to the definition of surface soil. In general, subsurface soil is everything deeper than surface soil.

Refer to state-specific regulations for the definitions of surface and subsurface soils.

2. Execution

2.1. Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, scoops, etc. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a decontaminated stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic compound (VOC) analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, small diameter core device, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling with Hand Augers and Thin Wall Tube Samplers

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are generally better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and generally cannot be used below a depth of approximately three feet.

2.2.1 Auger Sampling

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- Attach the decontaminated auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- After reaching the desired depth, carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.2.2 Thin-Walled Core Sampling

- Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this may represent material knocked down from the sides of the boring and not the layer of interest. Place the remaining core into the appropriate labeled sample container.

One type of thin-wall sampler is depicted in Attachment A (this is typically used with a mechanical drill rig).

For either method, If VOC analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, small diameter core sampler, or equivalent and secure the cap tightly. VOC samples should be collected first to minimize the potential for losing volatiles prior to sample collection.

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.

Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

2.3. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used with a mechanical drill rig to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split-spoon soil sampling is performed to gain geologic information, work should be performed in accordance with ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D (2-inch O.D.). Specify spoon size and basket type to driller prior to mobilization to the site. Split spoon samplers are typically available in 1 3/8 – and 3 – inch I.D. sizes. A larger barrel may be necessary to obtain the required sample volume. Note on the boring log where larger split spoon barrels are used because the ASTM standard penetration test does not apply when driving split spoons larger than 1 3/8 I.D. (2-inch O.D.).

- Select a soft or stiff basket for the spoon (a softer basket generally works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is seated at the beginning of the desired sample interval. If it is seated above the interval, have driller clean out the hole prior to sampling. Record all depth measurements relative to ground surface.
- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer falling 30 inches to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site fieldbook or on field data sheets the length of the tube used to penetrate the material being sampled, the split-spoon inside and outside diameters, and the hammer weight,
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The length of recovery and soil type should be recorded on the boring log. If a soil sample is desired, a decontaminated stainless steel knife or spatula should be used to divide the tube contents in half, longitudinally. If possible, avoid collecting soil that has come in contact with the walls of the spoon, and soil at the top of the spoon.
- Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified by the project manager. When the most impacted interval is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.

3. Limitations

- Weather conditions (e.g., frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.
- Be aware of local laws regarding subsurface utility clearance prior to conducting subsurface investigations. Contact DigSafe or local utility companies as required.
- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up

into the augers (blow-in running sands). Upon recovery, determine if there is blow-in in the split spoon sampler. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).

- If soils consist of loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.
- Never sample more than two spoons consecutively without advancing the augers unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances, groundwater will fill the auger and the split-spoon.

4. References

ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". 2008.

United States Environmental Protection Agency, SOP 2012 "Soil Sampling", Revision 0.0, February 18, 2000.

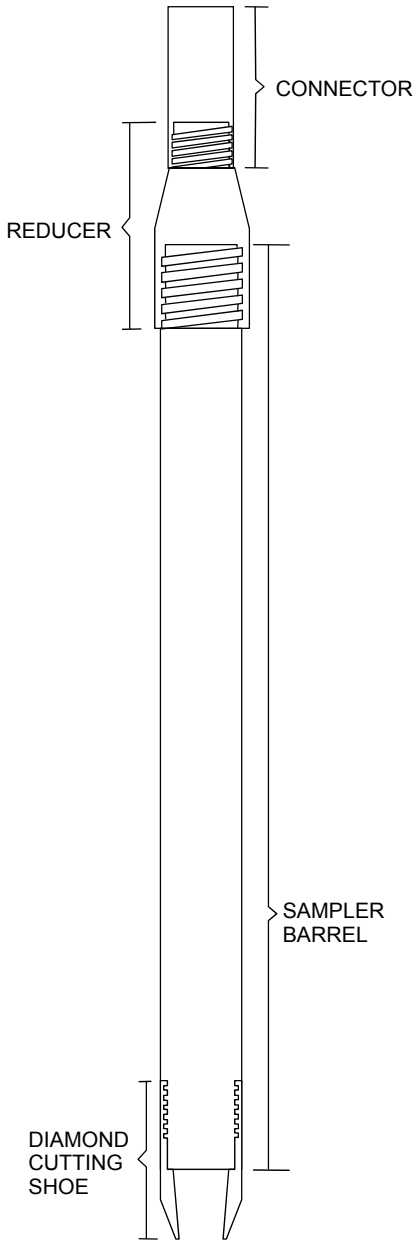
5. Attachments

Attachment A - Sampler Design Assembly

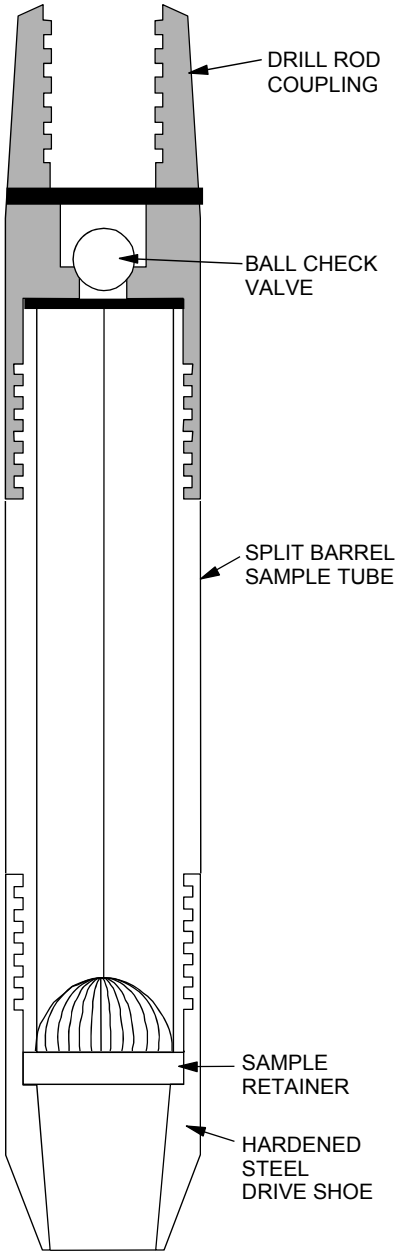
6. Contacts

Gary Fuerstenberg
Mark Ensign

THIN WALL HQ CORE SAMPLER
(2" width x 60" length)



SPLIT-SPOON SAMPLER
(2" width x 24" length)



STANDARD OPERATING PROCEDURES SM-001	GEI Consultants	**THIN WALL AND SPLIT-SPOON SAMPLERS**
NEW ENGLAND AND ATLANTIC REGIONS	June 2011	Attachment A

I:\STANDARD\DETAILS\SUBSURFACE\SAMPLERS\SPLIT-SPOON.ppt

STANDARD OPERATING PROCEDURE

SM-002 VOC Soil Sample Collection and Preservation Method

1. Objective

Describe methods to collect and preserve soil samples for analysis of Volatile Organic Compounds (VOCs) in accordance with the U.S. Environmental Protection Agency (EPA) Method 5035.

Some states have adopted soil sampling and preservation methods that vary from the procedures presented herein. Confirm that this method is appropriate for your project.

2. Execution

VOCs evaporate readily at normal temperatures and pressures. Care should be taken during sampling and preservation to limit the potential for VOCs to off-gas from the soil sample prior to being analyzed by the laboratory.

Soil samples should be obtained utilizing a small diameter core sampler such as a 10 milliliter (ml) plastic disposable syringe, an EnCore® sampler, an EasyDraw Syringe®. The EnCore® sampler is the only EPA-approved small diameter core sampler that can be used to collect the sample, store the sample, and transport the sample to the lab.

A separate soil sample must be collected and submitted to the laboratory for percent solids testing. At least approximately 20 grams of soil must be collected in a separate glass or plastic sampling container.

2.1. Collection and Preservation of Soil Samples

Three types of soil samples may be collected for VOCs analysis:

- High (typically >200 µg/kg) VOC concentration soil sample (Section 2.2 below)
- Low (typically 0.05-200 µg/kg) VOC concentration soil sample (Section 2.3 below)
- Synthetic Precipitation Leaching Procedure/Toxicity Characteristic Leaching Procedure (SPLP/TCLP) soil sample (Section 2.4 below)

2.2. Collection and Preservation of a Soil Sample with "High" Concentrations of VOCs (typically >200 µg/kg)

2.2.1. Option 1 – Methanol Preservation Method

Supplies include: an electronic field balance (in some cases), two VOC vials (per sample) with 10 ml methanol (the number of vials and amount of methanol might vary among labs), and a small diameter core sampler to collect an approximately 10 gram soil sample. Some labs, and EPA method 5035, specify a 5 gram soil sample. Check with the lab or project manager for the amount to collect.

Sampling Procedure:

- Weigh the VOC vials containing the methanol and record the weight. Some laboratories provide pre-weighed VOC vials.
- If you are weighing your samples, take a test sample with the sampler and weigh it to evaluate how close you are to the appropriate sample weight. If the laboratory VOC vial is pre-marked with a line, then you do not need to weigh the soil, just fill the VOC vial with soil until the methanol and soil mixture reaches the line.
- Collect the sample using the sampling device and extrude the sample into the preserved VOC vial. Be sure that the VOC vial and cap threads are free of soil, and then screw the cap tightly onto the VOC vial. Gently swirl the methanol in the VOC vial to coat the soil sample. Do not vigorously shake the vial.
- If necessary, weigh the VOC vial and record the weight. Some laboratories will weigh the vials at the lab, and it is not required in the field.
- Collect separate soil samples from the same area for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.2.2. Option 2 – EnCore® Sampling Method

Supplies needed: One 5 or 10 ml EnCore® sampler.

Sampling Procedure:

- Label the EnCore® sampling container.
- Collect the soil sample quickly, wipe the sampler free of soil, and seal the sampler.
- Place sampler in a clean ziplock bag and place on ice in a cooler.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen, or preserved, or analyzed within 48 hours (requires coordination with the laboratory).

2.3. Collection and Preservation of a Soil Sample with "Low" Concentrations of VOCs (typically 0.5 to 200 µg/kg)

2.3.1. Option 1 – Water Preservation Method

Supplies required: an electronic field balance, two 40 ml VOC vials pre-weighed and containing 5 ml of water, a magnetic stirrer, and a sampling device.

Sampling Procedure:

- Use a small diameter core sampler to collect two soil samples (5 grams each) into pre-weighed 40 ml VOC vials with 5 ml of water and a magnetic stirrer. Wipe threads and cap and seal the VOC vial. Repeat for the second VOC vial.
- Weigh the VOC vials and record the weights.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.3.2. Option 2 – Collection into Unpreserved VOC Vials

Supplies required: electronic field balance, two 40 ml VOC vials pre-weighed, and a sampling device.

Sampling Procedure:

- Collect the sample using the sampling device and extrude the sample into the VOC vial. Be sure that the threads are free of soil, and cap and seal the VOC vial. Repeat for the second vial.
- Weigh the VOC vials and record the weights.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 48 hours (requires coordination with the laboratory).

2.3.3. Option 3 – Collection in VOC Vials Preserved with Sodium Bisulfate

Supplies required: electronic field balance, two VOC vials pre-weighed with 5 ml of sodium bisulfate, a magnetic stir bar, and a sampling device.

Sampling Procedure:

- Collect the sample using the sampling device and extrude a 5 gram sample into the VOC vial containing the sodium bisulfate. Wipe threads and cap and seal the VOC vial. Repeat for the second VOC vial.
- Weigh the VOC vials and record the weights.

- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.3.4. Option 4 –EnCore® Sampling Method

Supplies required: two 5 gram EnCore® samplers.

Sampling Procedure:

- Label the EnCore® sampling container.
- Collect the soil sample quickly, wipe the sampler free of soil, and seal the sampler.
- Place sampler in a clean ziplock bag and place on ice in a cooler.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Repeat previous steps with the second EnCore® device.
  Samples must be frozen, or preserved, or analyzed within 48 hours (requires coordination with the laboratory).

2.4. Collection of samples being analyzed for VOCs by the TCLP or SPLP method

Sampling methods for TCLP or SPLP are similar to the methods presented above. The appropriate method is determined by local regulations. If using an EnCore® sampler, a 25 gram sampler should be used.

3. General Guidance

- Each state and federal regulatory agency has unique soil preservation requirements. Always verify collection and preservation methods with governing bodies.
- Verify preservation techniques with laboratory prior to sample collection.

4. Contacts

Lynn Willey
Mark Ensign

STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

1. Objective

Describe methods to classify soil samples collected in the field in a consistent manner.

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* and Attachments A and B. This standard is the basis for the Unified oil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client. If the client requires that we use the Burmister method, obtain the details from the client. An example breakdown is shown below, but some clients (MassDOT, for example) have their own breakdown.

- “and” = 35-50%
- “some” = 20-35%
- “little” = 10-20%
- “trace” = 1-10%

- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

- The ASTM Standard Practice for Classification of Soils for Engineering Purposes (D2487) may be used in conjunction with the Visual-Manual Method to confirm the soil classification. D2487 includes laboratory testing.

4. References

ASTM D2487-06e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM, 2006.

ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM, 2009.

Field Guide for Soil and Stratigraphic Analysis, Midwest Geosciences Group Press, 2001-2005.

Coarse-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

Fine-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

5. Attachments

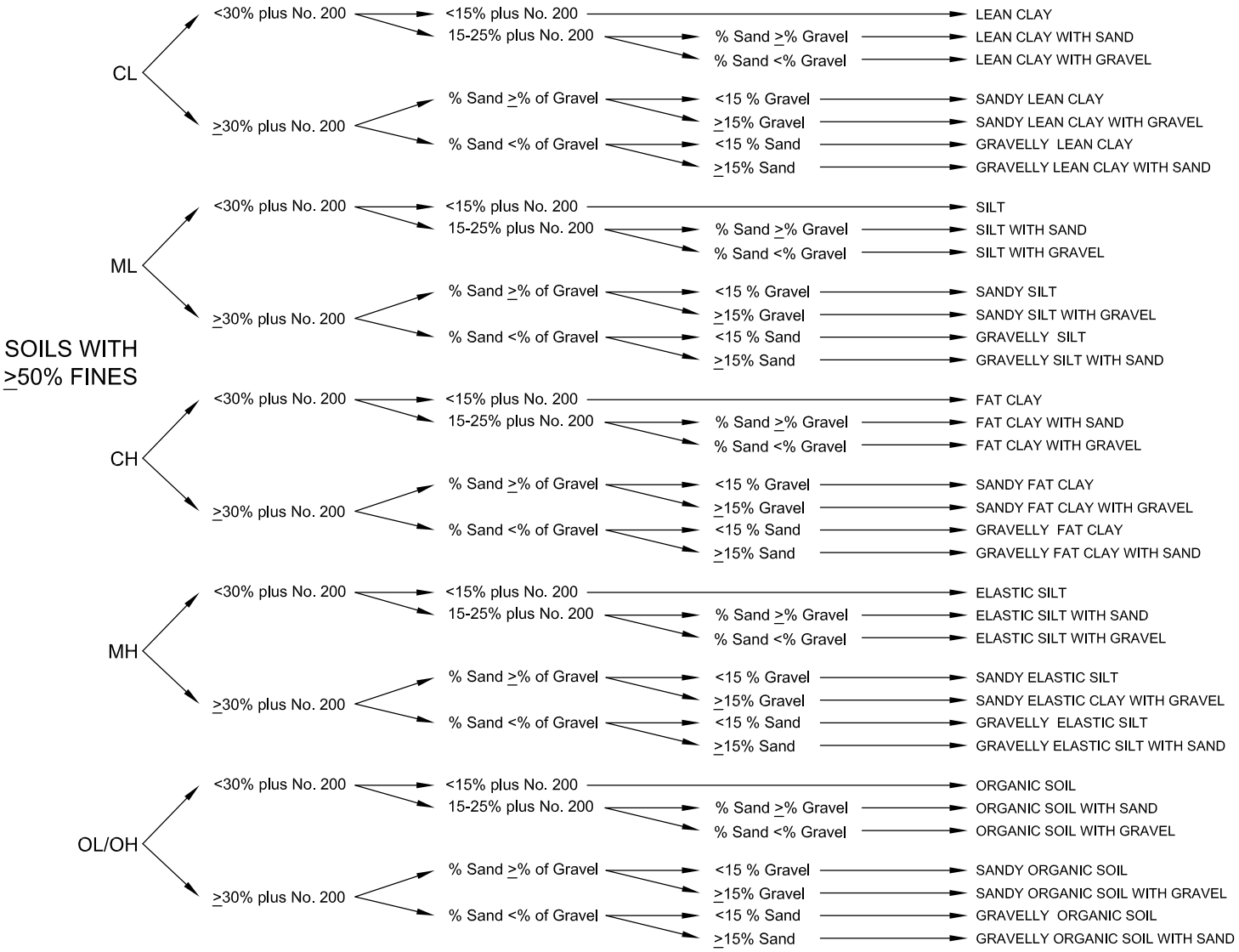
Attachment A – GEI Soil Description Charts (2007)
Attachment B – Visual Manual Descriptions with example boring log
Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Lynn Willey
Cathy Johnson

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

COARSE-GRAINED SOILS

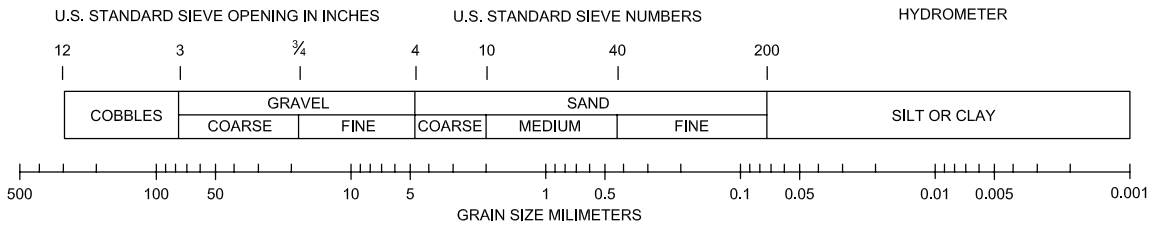
VISUAL-MANUAL DESCRIPTIONS

GEI Consultants

TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

				GROUP SYMBOL	GROUP NAME
GRAVEL (% Gravel > % Sand)	≤5% Fines	WIDELY GRADED		GW	<15% Sand → WIDELY GRADED GRAVEL
					≥15% Sand → WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand → NARROWLY GRADED GRAVEL
					≥15% Sand → NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand → WIDELY GRADED GRAVEL WITH SILT
					≥15% Sand → WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand → WIDELY GRADED GRAVEL WITH CLAY
					≥15% Sand → WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand → NARROWLY GRADED GRAVEL WITH SILT
					≥15% Sand → NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand → NARROWLY GRADED GRAVEL WITH CLAY
					≥15% Sand → NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand → SILTY GRAVEL
					≥15% Sand → SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand → CLAYEY GRAVEL
					≥15% Sand → CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES					
SAND (% Sand ≥ % Gravel)	≤5% Fines	WIDELY GRADED		SW	<15% Gravel → WIDELY GRADED SAND
					≥15% Gravel → WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel → NARROWLY GRADED SAND
					≥15% Gravel → NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel → WIDELY GRADED SAND WITH SILT
					≥15% Gravel → WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel → WIDELY GRADED SAND WITH CLAY
					≥15% Gravel → WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel → NARROWLY GRADED SAND WITH SILT
					≥15% Gravel → NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel → NARROWLY GRADED SAND WITH CLAY
					≥15% Gravel → NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel → SILTY SAND
					≥15% Gravel → SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel → CLAYEY SAND
					≥15% Gravel → CLAYEY SAND WITH GRAVEL





1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

Describing the Plasticity of Soil Samples

M. Paster – November 2008

References ASTM D 2487 – Soil descriptions – lab
ASTM D 2488 – Soil descriptions – field
ASTM D 4318 – Atterberg limits testing

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic
Low plasticity (The GEI laminated sheets incorrectly use "slightly plastic" for "low plasticity.")
Medium plasticity
High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

You should use these tests to help decide how plastic the fines are. Record the results in the remarks column of the field log, but not in the soil description and not necessarily in the typed log.

On final logs, if Atterberg limits tests have been performed:

Do not use the descriptive terms non-plastic, low plasticity, etc. for samples on which Atterberg limits tests have been run. Instead, just give the percentage of fines and then report the actual Atterberg limits at the end of the description.

For example, the end of a silty sand description might be:
. . . ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

(Atterberg limits tests are performed on the fraction of the sample finer than the No. 40 sieve, not just the fines. So the Atterberg limits data applies to the sample, not just to the fines.)

Hints:

High plasticity soils are rare in New England. If you think it's high plasticity, it's probably medium. Some Boston blue clay and some Connecticut River varved clays are high plasticity, but if you think you've found some, check with the project manager.

In New England, if ~10% fines or more, generally stick with GM, SM, ML, and CL. Occasionally GC, SC, CH. Don't use MH unless you have Atterberg limits data.

Estimating plasticity in the field, GEI guidance based on ASTM D 2488:

Plasticity	1/8-inch thread	Dry strength	Toughness
non	Cannot be rolled at any water content.	Dry specimen crumbles when handled.	Only slight pressure needed to roll thread near plastic limit.
low	Thread can barely be rolled.	Dry specimen crumbles with some finger pressure.	Slight to medium pressure needed to roll thread near plastic limit.
medium	Thread is easy to roll. Not much time needed to reach plastic limit.	Dry specimen crumbles with considerable finger pressure.	Medium pressure needed to roll thread near plastic limit.
high	Takes considerable time rolling and kneading to reach plastic limit.	Dry specimen cannot be broken with finger pressure.	Considerable pressure needed to roll thread near plastic limit.

Non-plastic vs. low plasticity:

ASTM D 2488 (soil descriptions - field) defines non-plastic and low plasticity based on the 1/8-inch thread as shown in the table above.

ASTM D 4318 (Atterberg limits testing) indicates that a sample should be called non-plastic for either of the following cases:

- The liquid limit test (dropping the cup) or the plastic limit test (rolling out the thread) cannot be performed because the plasticity is too low.
- The plastic limit is greater than or equal to the liquid limit.

Unfortunately, there are some soils that are low plasticity based on D 2488 (a thread can be rolled), but are non-plastic based on D 4318 (the liquid limit cannot be measured or PL≥LL).

GEI considers these soils to have low plasticity, because that is how they "look" and "feel." We want to document this information so that other people will have a better feel for what the soil looks like and how it behaves. So, if the soil was low plasticity based on D 2488, but non-plastic based on D 4318, that should be explained in the letter or report, and possibly in a note on the log.

BORING LOCATION Maple Ave Sidewalk
GROUND ELEVATION (NGVD) _____
GROUNDWATER EL. _____ DATE _____
DATE START/FINISH 2/14/07 - 2/15/07
DRILLED BY Geologic: M. Costigan
LOGGED BY T. Kahl/M. Yako TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
	0						FILL	4" pavement
	2.5	S1	13-9 17-14	24	0	0.5 ppm		S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill.
	5					hard drilling 3 to 4 ft, possible boulder		S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill.
		S2	7-7 11-13	24	8	2.0 ppm		
	7.5	S3	9-10 2-1	24	16	0.0 ppm	ORGANICS	S3 (0-10"): Similar to S2.
	10							S3 (10"-16"): ORGANIC SILT (OL) ~100% slightly plastic fines, dark gray, organic odor, contains white shell fragments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm		S4: Similar to S3, bot 6".
	15					hard drilling at 15.5 ft		
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20						ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.
	22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft		
	25							Bottom of Boring 25 ft
	27.5							Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.
	30							

BLOWS PER 6 IN.–140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN–PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC–RECOVERY LENGTH OF SAMPLE
RQD–LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, %
S–SPLIT SPOON SAMPLE
U–UNDISTURBED SAMPLES, UF–FIXED PISTON UO–OSTERBERG
▽ GROUNDWATER

NOTES:
1: Groundwater at 10 ft depth at start of day 2/15/07.

PROJECT 07999-0
DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. Sv = 0.5, 0.5, 0.8 tsf, Qp = 1.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Argillite.

GEOPROBE AND ROTOSONIC

When SPTs are not performed, note sample density (sands) or stiffness (clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch O.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash -** Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material -** If it looks like coal but you aren't sure.
- **Clinker -** Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag -** Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen -** Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained -** Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated -** Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated -** The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs -** Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil -** Exhibits a petroleum odor, different from MGP odors.
- **Tar -** Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors -** Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

STANDARD OPERATING PROCEDURE

SM-005 Underground Storage Tank (UST) Removal and Closure Process

1. Objective

Describe a standardized approach for observing Underground Storage Tank (UST) removals and methods to manage environmental issues that may be encountered.

Consult state regulations and the work plan to ensure proper closure procedures in addition to this standard operating procedure (SOP).

Prior to excavation confirm that utility clearance has been completed.

2. Execution

- Verify that all appropriate parties (contractors, owner, fire department, etc.) have been contacted and notified regarding the intended UST removal(s). Verify, with the contractor or owner, that all necessary permits have been obtained by the appropriate parties prior to tank removal.

- Prepare a site diagram/sketch detailing location of tank(s), structures, the location of any known fill and vent pipes, adjacent properties, buildings, utilities (where known), and any adjacent surface water(s). Record information in the field notebook (see SOP FD-001 Field Notebook).

- Record the removal contractor's activities in the field notebook.

- Confirm with the removal contractor that all liquids have been removed from the tank and associated piping.

- Confirm that exposed product lines are drained, disconnected, and capped with sorbent padding to catch any leakage.

- Confirm with the removal contractor that proper steps have been taken to inert remaining vapors in the UST.

- Request that any pavement or blacktop on top of the tank area is removed and segregated away from excavation and soil stockpile areas.

- Observe soil as it is being removed from excavation and perform soil screening (see SOP SC-004 Head Space Screening). If contaminated soil is observed notify the project manager and initiate soil segregation procedures (see SOP SM-004 Test Pit Excavation and the Work Plan).

- Once the tank is exposed, observe the tank, piping, and other tank features for corrosion, holes, etc. Photograph tank, piping, and excavation in accordance with SOP FD-004 Photodocumentation.

- If contaminated soil is excavated, it should be stockpiled on and covered with polyethylene sheeting. See the Work Plan for further detail on managing contaminated soils encountered during UST removal.

- If contaminated soil has been identified manage the impacted soil in accordance with the Work Plan and/or directions provided by the Project Manager. If appropriate, once the extent of contaminated soil has been defined (based on visual observation and headspace readings), collect sidewall and bottom samples for confirmatory analysis. Note the location, depth, and description of the samples in the field notebook.

- If groundwater is encountered, note any sheen or separate phase product observed on the surface of the groundwater table.

- A Tank Removal Checklist is in Attachment A. Consult state regulations and policies, and the Work Plan to ensure proper closure procedures. A list of applicable state regulations is provided n Section 4.

- Backfill excavation according to the Work Plan guidelines and/or applicable state requirements (clean backfill, excavated materials).

- If contaminated soil is excavated, it should be stockpiled on and covered with polyethylene sheeting. See the Work Plan for further detail on managing contaminated soils encountered during UST removal.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health & Safety Plan.
- Note that excavation does not undermine adjacent structures, footings, etc.
- Trucks pumping flammable liquids should always be properly grounded to eliminate any spark hazard.
- No GEI personnel may ever enter the UST.

- Contractors must have appropriate Health and Safety and confined space entry training.
- The Field Plan should specify the responsibilities of GEI, the client, and the contractor.

4. References

GEI Technical Manual, dated July, 1987.

Removal and Disposal of Used Underground Storage Tanks, API.

Commonwealth of Massachusetts Underground Storage Tank Closure Assessment Manual,(1996) Massachusetts Department of Environmental Protection Policy # WSC-402-96.

Sampling and Analytical Methods for Underground Storage Tank Closure State of Connecticut Department of Environmental Protection, update December 7, 2006.

Recommended Practice 1604 (1987), American Petroleum Institute, Washington, D.C.

Tanks and Containers (1989), Massachusetts Board of Fire Prevention, 527 CMR 9.00.

Management Procedures for Excavated Soils Contaminated With Virgin Petroleum Oils (1989), Massachusetts DEP BWSC, Policy #WSC-400-89.

State of Vermont Guidelines for Performing a Site Assessment at Petroleum UST Closure Sites (undated).

5. Attachment

Attachment A - GEI Tank Removal Checklist

6. Contact

Brian Conte
Bill Simons

GEI

TANK REMOVAL CHECKLIST (SM-005)

GENERAL INFORMATION

Facility Name and Address

Removal Date

Weather Conditions

Removal Contractor

PERMIT INFORMATION

Fire Department Identification No. (FDID)

Permit No. **Dig Safe No.**

Date of Issuance

Tank Contents

Tank Hauler Name and Address

Tank Disposal Facility Name and Address

Approved Disposal Facility No.

ON-SITE PERSONNEL

GEI

State/Local

Contactor

Other

TANK INFORMATION

Age of Tank **Size (Capacity)**

Dimensions **Material**

Construction **Coatings**

Interstial Monitoring **Cathodic Protection**

PIPING

Supply and Return Line Material

Secondary Containment Material

Vent Line Material

Removed from Excavation (if no why?)

ANTI-FLOTATION DEVICE

Hold Down Straps (type and material)

Concrete Pad or Deadman Anchors

TANK REMOVAL

Time **Tank Disposal Receipt No.**

Removal Method and Equipment

Condition of Tank

Condition of Piping

Cleaning Procedure T

O_2/LEL Reading

Items Abandoned in Place and Why?

MANIFEST INFORMATION

Amount of Sludge and Waste Removed

State Manifest and Document No.

EXCAVATION INFORMATION

Dimensions

Free Product/Staining on Soils and Locations (if any)

Suspected Source of Release

Odor (location and description)

Description of Soils Stockpiled

Estimated Volume (yd^3)

Side Wall Geologic Composition/Adjacent Buildings

Was Shoring of the Excavation Necessary?

Description of Desired/Required Restoration to be Performed

GROUNDWATER INFORMATION

Presence of Groundwater

Depth from Surface	**Odor**
Sheen/Oil on Water	**Dewatering Necessary**

Sample Name and Location

SOIL ANALYSIS

Equipment Used for Field Screening (make/model/GEI No.)

Field/Office Calibration Performed		**Date**
Calibrant	**Reading**	**Span**

CONFIRMATORY SAMPLES	SEE SKETCH:	
Sample No.	Sample Location*	Headspace
Sample No.	Sample Location*	Headspace
Sample No.	Sample Location*	Headspace
Sample No.	Sample Location*	Headspace
Sample No.	Sample Location*	Headspace
Sample No.	Sample Location*	Headspace
Sample No. (*=N,S,E,W, Sidewall, Bottom)	Sample Location (soil stockpile)	Headspace

SAMPLE INFORMATION	
Laboratory Name and Address NA	
Date Submitted	No. of Samples
Composite Sample Locations	
Analysis	
General Soil Description	
Dry/Wet	Odor
Staining/Color	

SITE SKETCH

Include tank location, excavation location, sample locations, buildings, streets, north arrow, and any schools, supply wells, or sensitive environmental receptors within 500 feet of tank location (and any sensitive environmental receptors).

Attached Site Plan (depicting location of tank(s), streets, etc.)

Pictures Attached and Labeled

Report Prepared by **Date**

9. Groundwater (GW)

- GW-001 Water Level and Non-Aqueous Phase Liquid (NAPL) Measurement
- GW-002 Non-Aqueous Phase Liquid (NAPL) Recovery
- GW-003 Low Flow (Low Stress) Groundwater Sampling
- GW-004 pH and Temperature Measurement
- GW-005 Turbidity Measurement
- GW-006 Specific Conductance Measurement
- GW-007 Dissolved Oxygen Measurement
- GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

Describe procedures to measure the depth to water and non-aqueous phase liquid (NAPL) thickness in an open borehole, cased borehole, monitoring well or piezometer.

2. Equipment and Materials

Field forms and/or field notebook.

- Decontamination fluids
- Bailer
- Weighted cotton string
- Oil/Water interface probe
- Water level meter (if oil/water interface probe is not available)

Water level and NAPL measurements can be collected by a variety of methods. A water level meter is used to collect depth to water measurements however an oil/water interface probe or other methods must be used to gauge NAPL depths. An electronic oil/water interface meter, consists of a cable divided into incremental measurements of 0.01 feet, and probe that consists of an infra-red circuit that detects the presence of a liquid, and a conductivity circuit that differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or dense non-aqueous phase liquid [DNAPL] product). Typically, a steady tone and light indicate a non-conductive liquid (e.g. product) and an intermittent tone and light indicate a conductive liquid (e.g. water). Refer to the manufacturer's instructions for details. Alternately, water level and NAPL measurements can be collected using a water level meter, clear bailer and weighted cotton string. Each method of data collection is described below.

3. General Information

- The water level in a monitoring well or piezometer should be allowed to stabilize for a minimum of 24 hours after development or construction before groundwater elevation and/or NAPL measurements are collected. The water level in a borehole can be measured during drilling; however, this should be noted in the field notebook.
- Water levels in multiple wells should be collected within the shortest timeframe practicable.
- Water and NAPL levels should be measured from the designated survey point as specified by the surveyor or highest point (or "V" notch) on the PVC. If the well is new, mark the datum point with an indelible marker and note reference location in

field book. Discuss with the project manager what reference point should be used to collect water measurements for specific sites.

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- LNAPL Depth (if present): Measure the LNAPL/air interface by slowly lowering the interface probe to the LNAPL surface. Be ready to stop as soon as the probe signals the LNAPL surface.
- Record the depth to LNAPL.
- Groundwater Depth: Continue slowly lowering the probe until it signals the presence of water.
- Record the depth to water.
- The LNAPL thickness is determined by subtracting the water depth from the LNAPL depth.

The depth and thickness of DNAPL can sometimes be determined by slowly lowering the interface probe past the LNAPL (if present) and water layers. Record the depth to the DNAPL layer. Finally, measure the depth to the well bottom.

The DNAPL thickness is determined by subtracting the DNAPL depth from the depth to well bottom.

- Decontaminate the interface probe and tape according to SOP QA-001.
- Dispose of any NAPL-impacted debris properly.
- Check with the Project Manager if you are uncertain of the appropriate disposal method.

4.2 LNAPL Measurements Using Clear Bailer

If LNAPL is suspected at a site, an oil/water interface probe should be used when gauging water level and NAPL measurements. However, a water level meter and a clear bailer may be used instead to estimate approximate LNAPL thickness if an oil/water interface probe is not available.

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- Slowly lower the water level meter until contact with fluid is indicated by the meter.
- Record the depth to fluid measurement.
- Lower a clear bailer into the well and slowly into the LNAPL. Do not submerge the bailer.
- Slowly raise the bailer out of the well and measure LNAPL thickness in the bailer using a ruler or tape measure.

Calculating Depth to Groundwater

The depth to water can be calculated as follows:

DTW = DTF + PT
DTW = Depth to Groundwater
DTF = Depth to Fluid
PT = Measured Product Thickness

Calculating Corrected Depth to Groundwater

Once the LNAPL thickness is known and the depth to groundwater is known, the corrected depth to groundwater can be calculated.

Corrected DTW = Static DTW – (PT x G)
DTW = Depth to Ground Water
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

A weighted cotton string may be used to estimate approximate DNAPL thickness.

- Secure cotton string.
- Secure clean steel nuts and/or washers.

- Tie the string to the nuts/washers, so that there is adequate weight.
- Lower the weighted string into the well slowly, until a firm bottom is sensed.
- Remove the weighed string and measure the DNAPL coated portion of the string.
- Record the thickness.
- Dispose of any NAPL-impacted debris properly. Check with the Project Manager if you are uncertain of the appropriate disposal method.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

6. Considerations

- Weak batteries in water level and oil/water interface meters frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.

- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 2/11/00

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

8. Contacts

Brian Conte – (860) 368-5412 Glastonbury
Mark Ensign – (781) 721-4010 Boston
Ryan Hoffman – (781) 721-4091 Boston

STANDARD OPERATING PROCEDURE

GW-002 Non-Aqueous Phase Liquid (NAPL) Recovery

1. Objective

Provide procedural guidance for routine recovery of non-aqueous phase liquids (NAPL).

2. Equipment and Materials

The following materials and equipment may be necessary for this procedure:

- SOP GW-001 Water Level and NAPL Measurement
- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper personal protective equipment (PPE) including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and health and safety plan (HASP)

3. General Information

Refer to SOP GW-001 and record the depth to NAPL and depth to water measurements If you are using an oil/water interface probe, first check to see if the unit is functioning correctly. Note: De-ionized water will not provide a correct reading. Check the interface probe battery and replace if necessary.

Interface probes usually distinguish between NAPL and water by sounding solid or intermittent tones. See the manufacturer's instructions for details.

4. Execution

4.1 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to NAPL in each monitoring well. Refer to probe manual to determine changes between liquid types (water, light non-aqueous phase liquid [LNAPL] and dense non-aqueous phase liquid [DNAPL]). To achieve accurate depth measurements, ensure the oil/water interface

probe is decontaminated (GEI SOP QA-001) prior to and between each measurement taken at each well.

To calculate the volume of NAPL in monitoring wells with well diameters specified below, use the following respective equations:

Light non-aqueous Phase Liquid (LNAPL) Volume

$$LNAPL\,V = (DTW - P_1) \times C$$

Dense Non-Aqueous Phase Liquid (DNAPL) Volume

$$DNAPL\,V = (TD - P_2) \times C$$

Where, V = Volume
DTW = Depth to Water
TD = Total Depth
P_1 = Depth to LNAPL
P_2 = Depth to DNAPL

Conversion factors (C) for wells based on well diameter size are noted in the table below.

Well Diameter (inches)	Conversion Factor (liters)	Conversion Factor (gallons)
2	0.6178	0.1632
4	2.4711	0.6528
6	5.561	1.469

Note: Well diameter sizes are noted for outer diameter. Conversion factors assume Schedule 40 PVC riser and screen, if well is constructed of different material appropriate conversion factors must be used to calculate accurate NAPL volume.

Once measurements have been taken and calculations have been made, collection of NAPL may commence.

4.2 NAPL Collection Procedures

Collection of NAPL shall be accomplished using common recovery techniques or technologies including:

- Peristaltic pump
- Bailer

Some projects require on-going NAPL recovery efforts. For these projects installation of dedicated recovery methods should be considered.

Special care shall be taken to prevent any recovered NAPL from spilling or coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection

container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. The specific operating procedures for common recovery methods are discussed in the following sections.

4.2.1 Sampling and Recovery via Peristaltic Pump:

LNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend approximately 12-inches beyond the LNAPL layer. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.
- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just below the top of LNAPL.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly increase the pump rate to begin LNAPL removal from the well. Use the oil/water interface meter to measure the depth to LNAPL. Lower the intake tubing as necessary until all of the LNAPL has been recovered from the well.
- Once the LNAPL has been recovered from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of LNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

DNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend to the bottom of the well including additional length to attach to the pump intake. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the

peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.

- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just above the bottom of the well.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly begin to remove DNAPL from the well. DNAPL removal will be complete when the pump begins to discharge water. Use the oil/water interface meter to check the DNAPL thickness during the removal process. Take care not to pump an excessive amount of water.
- Once the DNAPL has been purged from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of DNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

4.2.2 Sampling and Recovery via Double Check Valve Bailer:

LNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach just below the LNAPL layer. Use the oil/water interface meter to determine the appropriate depth.
- Using slow and controlled motions while lowering (and raising) the bailer to the appropriate depth, commence bailing LNAPL out of the well and draining the bailer directly into collection container.
- Once the LNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

DNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom, commence bailing DNAPL out of the well and draining the bailer directly into collection container.
- Once the DNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

4.3 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. DNAPL waste management and disposal should be evaluated on a site by site basis.

4.4 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

4.5 Data and Records Management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to water, NAPL, etc.) and all calculations (NAPL column length, volume of NAPL, etc.) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

4.6 Limitations

- NAPL gauging and recovery can be challenging and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to NAPL can accelerate the required maintenance/replacement intervals for tools and equipment.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this standard operation procedure, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed JSA should be completed prior to the start of work.

6. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

7. Contact

Jerry Zak (860) 368-5404 Glastonbury

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

Describe methods to collect groundwater samples most likely to produce results that represent aquifer conditions.

Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Prior to groundwater sampling consult with the project manager to confirm that the type of pump is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Slowly and gently measure the depth to water with a water level probe and/or oil-water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level in accordance with SOP GW-001 Water Level Measurement.
- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.

- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less, is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or using a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).
- While purging, record water levels every 3 to 5 minutes and monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified in the field sampling plan also include ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:

    - pH (+/- 0.1 standard units)
    - temperature (+/- 3%)
    - SC (+/- 3%)
    - turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
    - DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
    - ORP (+/- 10 mV)

- Dispose of purge water according to the field plan.

Sample Collection:

- Following purge, remove the discharge tubing from the flow-through cell. Do not disturb pump and tubing between stabilization and sample collection.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples are collected first; see SOP SC-002 Sampling Handling). Fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- If not using a dedicated pump, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination). Discard used tubing.
- Store samples in a cooler on ice for transport to the laboratory.
- Measure depth to bottom of well.

- Secure the well cap.

3. Limitations

- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If possible, when using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- If water quality indicator parameters do not stabilize after removing 3 to 5 well volumes or 2 hours, contact the Project Manager. Three options will be available: 1) continue purging until stabilization; 2) discontinue purging and do not sample; or 3) discontinue purging and sample.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the project manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (2010), EQASOP-GW 001 Low Stress (Low Flow) SOP, Revision 3, U.S. Environmental Protection Agency, Region I, January 19, 2010.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Brian Conte
Saskia Oosting

MONITORING WELL SAMPLING RECORD

PID Reading _____ Job Name _____

Job Number _____ By _____ Date _____

Location _____ Measurement Datum _____

Well Number _____

Pre-Development Information Time (start) _____

Water Level _____ Total Depth of Well _____

One Purge Vol _____ Three Well Volume _____

Water Characteristics

Color _____ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material _____

Volume **(gal)**	**Time**	**pH**	**Temp (°C)**	**Spec. Conductance (µS/cm)**	**Turbidity (NTU)**	**DO Conc. (mg/L)**	**ORP (mV)**	**TDS**

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information

Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material _____

Comments

Low-Flow Groundwater Sampling Form

Project number and name _____ Sampling personnel _____ Sample date _____ Well ID _____

Well location description: _____

_____

Well Construction

Well diameter _____

Well measurement point _____

Roadbox condition _____

Well screen interval _____

Well depth _____

Sampling Information

Initial depth to water _____ Time: _____

Sample intake depth _____

Pump type and ID _____

Stabilized flow rate _____

Stabilized flow rate = flow rate with no further drawdown

Samples Collected

VOCs 8260	
SVOCs 8270	
VPH	
EPH	
Metals	
PCBs	
Other	

Field values at time of sample collection:

Time: _____ Depth to water: _____

Sp.Cond. _____ mS/cm

DO _____ mg/L

ORP _____ mV

pH _____ s.u.

Temp. _____ °C

Turb. _____ NTU

Cumulative Time (min.)	Volume (gal)	Water depth (ft)	Temp. (°C)	Sp.Cond. (mS/cm)	D.O. (mg/L)	pH (s.u.)	ORP (mV)	Turb. (NTU)
Typical Groundwater Values			5 to 15	0.05 to 5	0 to 4	5 to 7	-100 to +500	aim for <10

STANDARD OPERATING PROCEDURE

GW-004 pH and Temperature Measurement

1. Objective

Describe methods for measuring the pH and temperature of liquids using a combination pH/temperature meter.

2. Execution

Calibration

- Calibrate the meter according to the equipment manufacturer's instructions at the beginning of each day of use. Calibration for pH shall be performed using at least two buffer solutions. Solutions chosen should be similar to the expected pH of the liquids tested (pH 7 and 4 buffer solutions are preferred in most cases for groundwater or surface water measurements).
- Check calibration at the end of the day by reading the two solutions used in calibration. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). Record measurements and time of measurement in the field book or sample sheet. If the readings are outside +/– 0.2 pH units, recalibrate the meter.

Sample Measurement

- Immediately prior to testing a sample, decontaminate testing container and probe assembly with one rinse of distilled water. Do not use methanol to rinse the probe. Methanol rinses could damage the probe.
- Gently dry the probe with a paper towel and shake beaker to remove excess solution. Visually inspect the bottom of the probe to ensure that liquid or sediment is not trapped between outer casing and probe.
- Pour the sample into the testing container and insert both temperature and pH probe. Stir sample for 30 seconds using both probes. Let the probes equilibrate in the sample solution for another 30 seconds. Measure and record the temperature. Measure and record pH reading after stabilization or 60 seconds, whichever is sooner. A reading has stabilized if pH units have not changed +/– 0.1 pH units during a 30 second period.
- Record pH to the nearest 0.1 unit and temperature to the nearest whole number.

3. Limitations

- Coatings and particulates may affect the response of the probe; more thorough cleaning using a weak alconox solution and distilled water rinse

and gently wiping the probe surface with a paper towel may be required to clean the surface of the probe.

- Temperature affects both the response of the instrument to pH and the actual pH of the sample. The Automatic Temperature Compensation (ATC) function compensates for the variation in the response of the meter only. Therefore, the pH must always be reported with temperature.
- The probe is a fragile thin glass bulb surrounded on three sides by a plastic casing. Care must be taken in handling the probe to avoid breakage.
- Do not use buffer solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-005 Turbidity Measurement

1. Objective

Describe calibration and use of a Hach nephelometer/turbidimeter.

The meter is used to measure turbidity of liquids by quantifying how much light passes through them. Turbidiity readings are required to be read using a portable (e.g Hach) instrument directly from the tubing before going through the flow-through cell.

This SOP is specific to a Hach turbidimeter. Follow manufacturer's recommendations for other meters.

2. Execution

i. Turn the meter "ON".
ii. Rinse the sample cell 3 times with distilled water.
iii. Fill the cell to the fill line with distilled water and then cap the cell.
iv. Wipe off excess water and streaks with a non-abrasive lint-free paper or cloth (preferably lens paper).
v. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
vi. Press "READ" and wait for the 'light bulb' icon to go off. Record the reading.
vii. Using the Gelex standards, repeat steps above. Record all measurements (note anomalies).
viii. Fill the cell with sample liquid to the fill line (about 15 mL) and replace the cap on the cell.
ix. Wipe off excess water and any streaks with a non-abrasive lint-free paper or cloth (lens paper).
x. Press "I/O" and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
xi. Insert the sample cell, arrow to the front, in the instrument. Close the lid.
xii. Select manual or automatic range selection by pressing the range key.
xiii. Use signal average mode if the sample causes a noisy signal (display changes constantly). Select signal averaging mode by pressing the "Signal Average" key.
xiv. Press Read. The display will show "---- NTU" and then the turbidity in NTU. Record the result after the lamp symbol turns off.
xv. Rinse the cell with distilled water.
xvi. Confirm the validity of the sample measurement by double-checking with one of the Gelex standards.

xvii. Periodically check the turbidity meter during the day by using the Gelex secondary standards provided.
xviii. Perform a post calibration at the end of the day and record all measurements.

3. Limitations

If the turbidity measurements are for National Pollutant Discharge Elimination System (NPDES) reporting purposes, all samples with values above 40 NTU must be diluted with turbidity free water (e.g. distilled water) and sample turbidity is calculated by multiplying the reading of the diluted sample by the dilution factor.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-006 Specific Conductance Measurement

1. Objective

Describe standard methods to measure conductivity of water using a field conductivity meter.

2. Execution

- Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use. Calibration shall be performed using a standard KCl or other solution recommended by the manufacturer.
- Record the make, model, and serial or identification number of the instrument and calibration information in the field notebook.
- Check calibration at the end of the day by measuring the standard used in calibration and record in field book. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). If the readings are outside +/- 0.02 mS/cm, the meter must be recalibrated. Initial calibration should be conducted under the same conditions (i.e., temperature, and location) of field testing.
- Immediately prior to testing a sample, decontaminate testing container and probe assembly with distilled water.
- Gently dry the probe with a paper towel and shake container to remove excess solution.
- Pour sample into the container and insert probe. Stir sample with the probe for approximately 10 seconds. Let the probe equilibrate in the sample solution for another 30 seconds. Measure conductivity and record in the field notebook.
- Record conductivity to the nearest whole number.

3. Limitations

- Oily coatings and particulates may affect the probe's response; more thorough cleaning using a weak alconox solution and distilled water rinse and gently wiping the probe surface may be required to clean the surface of the probe.
- If sample liquid is contaminated, (e.g. stained, conductance >0.75 mS/cm), rinse probe with distilled water immediately after measuring sample to minimize fouling of probe.
- Do not use calibration solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contact

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-007 Dissolved Oxygen Measurement

1. Objective

Describe calibration and field use of dissolved oxygen meter.

2. Execution

- Place instrument in the intended operating position (vertical, tilted, or horizontal) before it is prepared for use and calibrated.
- Recalibration may be necessary when the instrument operating position is changed.
- Attach the prepared probe to the Probe connector of the instrument and adjust the retaining ring finger tight. Check that membrane is intact and check for presence of air bubbles under membrane. If bubbles are present or membrane is damaged, prepare probe again according to manufacturer's instruction.
- Place approximately 1/8 inch of water into the bottom of the calibration cup. Place the probe into the cup and engage only one thread of the calibration cup onto the probe to ensure that the DO probe is readily vented to the atmosphere. Make sure the DO and temperature probes are not in contact with the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- Calibrate meter according to the procedures outline in the instrument manual. Calibrate probe to a zero oxygen solution provided by manufacturer, and water saturated air.
- The calibration procedure may require correction factors or input of site-specific barometric pressure and temperature. Correction factors can be found at:

  http://water.usgs.gov/owq/FieldManual/Chapter6/6.2_v2.1.pdf

- Otherwise, use appropriate instruments at the site to determine temperature and pressure.
- Perform Dissolved Oxygen Measurement using the following procedure:
  i. Submerge probe in flow-through chamber or water body.
  ii. Gently raise and lower probe in sample.
  iii. Allow sufficient time for probe to stabilize to sample temperature and dissolved oxygen.
  iv. Read and record the temperature and the value of the dissolved oxygen in mg/L.
  v. Document field analysis data and general observations in the field log book or groundwater sampling sheet.

3. Limitations

- Collect DO measurements in the field during sampling. Storing samples in containers will alter the DO concentration of the sample.
- Detection Limit (DL) = 0.1 mg/L for 0-10 mg/L range; do not record values less than Detection Limit: a zero reading is recorded < 0.1 mg/L.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery

1. Objective

Provide procedural guidance for routine gauging and recovery of dense non-aqueous phase liquids (DNAPL) related to former manufactured gas plant (MGP) operations.

2. Execution

2.1 Equipment and materials

The following materials and equipment are necessary for this procedure:

- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper PPE including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and HASP
- Example specifications of DNAPL management equipment is included as Attachment A.

2.2 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to product in each monitoring well. Refer to probe manual to determine changes between liquid type. To achieve accurate depth measurements, ensure the oil/water interface probe is decontaminated (GEI SOP QA-001 prior to and between each measurement taken at each well.

To calculate the volume of product in monitoring wells with these specifications, take the following measurements:

- Total well length
- Depth to water
- Depth to product (s) – c1 and c2

Using the following equations, determine the length of the water column and the length of the product column:

[1] (a) – (b) = Water column length (d)
[2] (a) – (c1) = Product column length (e) dense non-aqueous phase liquid (DNAPL)

Calculate the volume of DNAPL product in the well using the following equation:

DNAPL for a 2" diameter well
[4] (e) x 0.1632 = Volume (gallons) of product in well
(e) x 0.6178 = Volume (liters) of product in well

DNAPL for a 4" diameter well
[4] (e) x 0.6528 = Volume (gallons) of product in well
(e) x 2.4711 = Volume (liters) of product in well

DNAPL for a 6" diameter well
[4] (e) x 1.469 = Volume (gallons) of product in well
(e) x 5.561 = Volume (liters) of product in well

Once measurements have been taken and calculations have been made, collection of dense non-aqueous phase liquid (DNAPL) may commence.

2.3 DNAPL Collection Procedures

Collection of DNAPL shall be accomplished using common recovery techniques or technologies as follows:

- Peristaltic pumps
- Bailers
- Positive displacement down hole pumps (e.g. Hammerhead, Blackhawk pumps, etc)

Special care shall be taken to prevent any purged DNAPL causing a spill and coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. Examples of DNAPL specific management equipment and tools are included as Attachment A. The specific operating procedures for common recovery methods are discussed in the following sections.

2.3.1 Sampling and recovery via peristaltic pump with dedicated tubing:

- Take and record the required measurements prior to commencing pumping.
- Connect the dedicated tubing to the peristaltic pump with the long end of the silicon tubing set to discharge water and product directly into either a 5-gallon bucket or a 55-gallon closed-top drum, ensuring that the entire set-up is underlain by plastic sheeting.
- Begin purging the well, occasionally checking the depth to water and depth to product.
- Once the DNAPL has been purged from the well, a sample will be collected and preserved if required, in accordance with laboratory standards.

- Following completion of NAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

2.3.2 Sampling and recovery via double check valve bailer:

- Take and record the required measurements prior to commencing bailing.
- Ensure the entire work area is covered in plastic sheeting to avoid potential spills of water and/or product.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom of the well, commence bailing product out of the well and draining the bailer directly into either a 5-gallon bucket or a 55-gallon closed-top drum.
- Once the NAPL has been purged from the well, collect and preserve the analytical sample, if required, in accordance with laboratory standards.

2.3.3 Sampling via piston-style pumps (HammerHead, Blackhawk etc)

For significant accumulations of DNAPL a variety of dedicated pumping technologies exist. Refer to manufacturer-specific operating procedures and site specific means and methods.

2.4 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. Additional care should be taken with DNAPL while infrequent the potential for hazardous waste characteristics does exist. DNAPL waste management and disposal should be evaluated on a site by site basis as discussed in Section 3.

2.5 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

2.6 Data and records management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to

water, product, *etc.*) and all calculations (product column length, volume of product, *etc.*) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

2.7 Health and safety considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

3. Limitations

- DNAPL gauging and recovery can be problematic and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to DNAPL can accelerate the required maintenance/replacement intervals for tools and equipment.
- A site specific work plan, HASP and JSA needs to be developed prior to commencing work. The documents should address: safety, recovery technologies, waste containment and waste management.

4. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

5. Attachments

Attachment A – Example specifications of DNAPL recovery and management tools and equipment.

6. Contact

Jerry Zak

nationalgrid

Tracey Bell
Manager
Environmental Asset Management

April 13, 2009

Mr. Amen M. Omorogbe, P.E.
Project Manager
New York State Department of Environmental Conservation
MGP Remedial Section, Division of Environmental Remediation
Bureau of Western Remedial Action, 11th Floor
625 Broadway
Albany, New York 12233-7017

Re: DNAPL Recovery Wells Pilot Test Work Plan
Carroll Gardens/Public Place
Former Citizens Gas Works Manufactured Gas Plant Site
Brooklyn, New York
Site No.: C224012

Dear Mr. Omorogbe:

The DNAPL Recovery Wells Pilot Test Work Plan (Work Plan) program is intended to characterize and assess the mobility and potential for recovery of dense non-aqueous phase liquid (DNAPL) at the Former Citizens Gas Works Manufactured Gas Plant (MGP) site (Site) located in the Carroll Gardens/Public Place neighborhood of Brooklyn, New York (Figure 1). The pilot test program will generate data required to develop a final DNAPL recovery approach for the Site, which will be presented as part of the Remedial Design Work Plan (RDWP).

The Final Remedial Investigation Report (RI), dated October 2005, and the Remedial Design Work Plan, dated September 12, 2007, included the recommendation that an on-site DNAPL recovery system be evaluated as one mechanism to control potential DNAPL migration on Parcels I, II, and III. The DNAPL recovery test wells will be installed at boring locations where DNAPL (tar) saturated soils, considered to have the potential for DNAPL recovery, were observed during boring installations. The intended recovery test well locations were selected based on the following investigations:

- During the RI field effort, a number of locations were identified as meeting the criteria for potential DNAPL recovery wells and were noted for consideration in the RDWP. These locations were further evaluated by additional borings at each location during the RDWP pre-design field investigation.

- During the RDWP pre-design field activities, additional locations were identified and investigated as potential DNAPL recovery well locations.

The final proposed wells are listed in Table 1 with locations shown on Figure 2. A brief summary of RDWP findings, pertinent to the activities proposed in this Work Plan, is provided below. The complete RDWP findings will be presented and submitted to the New York State Department of Environmental Conservation (NYSDEC) in a Data Report to follow the pre-design investigation as outlined in the RDWP. The soil boring and test pit logs utilized to develop this Work Plan are attached.

The pertinent findings from the RI and RDWP pre-design investigation used to locate potential recovery well stratigraphic zones are as follows:

- **Parcel I**: DNAPL saturated soils were observed at a number of locations within the intermediate zone soils to approximately El.-51 ft (the zone is defined as being approximately El -20 ft to -90 ft NAVD 88). No DNAPL saturated soils, considered to have the potential for DNAPL recovery, were observed in the shallow zone soils (above approximately El. -20 ft) and the deep zone soils (below El. -90 ft).

- **Parcel II**: DNAPL saturated soils were observed beneath a clay layer bordering the Gowanus Canal in the shallow and intermediate zone soils from approximately El.-15 ft to El.-57 ft (CGSB-127). No DNAPL saturated soils, considered to have the potential for DNAPL recovery, were observed in the deep zone soils (below El. -90 ft).

- **Parcel III:** DNAPL saturated soils were observed in shallow zone soils in test pit CGTP-103B located adjacent to the bulkhead of the Gowanus Canal at approximately El. 1.5 ft. A clay layer was observed along the bulkhead of the Gowanus Canal between approximately El.-4 ft and El.-17 ft between borings CGSB-120 and CGSB-123. DNAPL saturated soils were observed above the clay layer in the shallow zone soils in the vicinity of CGSB-121, CGSB-122 and CGSB-125. DNAPL saturated soils were observed within the intermediate zone soils and slightly into the deep zone soils. Specifically, DNAPL saturated soils were observed between approximately El.-69 ft and El.-91 ft at CGSB-121, and at CGSB-122 between El.-74 ft and El.-81 ft. These observations are consistent with the findings for the adjacent RI monitoring well CGRW-08D (boring log indicated tar saturated soil and tar veins from El.-76 ft to El.-86 ft).

The activities proposed in this Work Plan will address each of the following primary objectives.

- **Assess DNAPL mobility and recovery rates.**
  DNAPL recovery evaluation activities will include monitoring the wells for DNAPL accumulation, performing periodic recovery pumping and disposal events, and assessing the DNAPL recharge rates.

- **Evaluate the location of productive DNAPL recovery zones.**
  The results of the investigations will be used to evaluate which recovery wells have the potential to effectively and efficiently collect DNAPL.

- **Evaluate DNAPL recovery methods and equipment.**
  A number of different recovery methods and equipment will be evaluated as well as options for stand alone or manifolded well collection systems.

The remainder of this Work Plan has been organized into the follow sections: Scope of Work, Pilot Test Report, and Proposed Schedule. The scope of work includes details on recovery well construction, DNAPL monitoring and pumping frequency, and data analysis.

1.0 Scope of Work

1.1 Recovery Well Construction

As detailed above, potential DNAPL recovery zones exist in the intermediate zone soils in Parcel I, the shallow and intermediate zone soils in Parcel II, and the shallow, intermediate and deep zone soils in Parcel III. Well screens for the proposed DNAPL recovery pilot test wells will be placed within these zones and terminate above lower permeability soils (i.e. clay, till), if present. In general, the proposed screen interval was selected to intercept soil layers containing DNAPL saturated soils within a grain matrix conducive to potential DNAPL migration (i.e. sand, silty sand, gravel, etc.). The screen interval was also extended to include adjacent soil layers containing DNAPL saturated soil lenses. The supporting boring and test pit logs from the RDWP pre-design investigation used to site the recovery wells are attached. Table 1 summarizes the construction details of each proposed recovery well, and lists each well with the corresponding soil boring that was installed during RDWP pre-design investigation. The selected locations of the recovery wells are depicted on Figure 2. Parcel I and II recovery wells will be installed at their corresponding RDWP pre-design investigation soil boring locations. Since these were logged and soil samples were collected during the RDWP pre-design investigation, no additional samples or logs will be taken upon installation of these recovery wells.

For Parcel III, at proposed recovery pilot test well locations CGRW-05, CGRW-06 and CGRW-07, multiple recovery wells will be installed in a cluster formation within the vicinity of the corresponding RDWP pre-design investigation soil boring. Each cluster will contain a shallow, intermediate, and deep recovery well as described below. Each recovery well within a cluster will be installed within approximately 5 feet of the other wells in the cluster. For wells in the cluster that are not located at an existing boring location, drilling will advance to the proposed top of screen depth with continuous

sampling thereafter to confirm the screen and sump location. When installation requires extension beyond the previous terminal depth due to the boring not terminating in a clean zone, the well boring will be continuously sampled below the former termination depth until approximately 10 feet of soil with minimal DNAPL impact is observed.

Due to the DNAPL chemistry at the Site, the PVC monitoring wells installed during the RI degraded and were subsequently abandoned. Therefore, as detailed below, the pilot test wells will be constructed using 6-inch diameter stainless steel. Based on the volume of DNAPL that was delineated during RI activities and coupled with the observations made during the RDWP pre-design field program, a 5-foot sump is proposed below the screen interval to facilitate DNAPL accumulation and collection. This is an increase from the 2-foot sump recommendation made in the RDWP.

Table 1 summarizes the proposed screen depth intervals and sump locations. These depths are approximate, and may be adjusted accordingly in the field based on subsurface conditions identified at the time to maximize potential DNAPL recovery. The recovery wells will be installed using hollow stem auger drilling techniques (or other appropriate methods) to the targeted depth of the recovery well, and will create a bore hole of approximately 10 inches in diameter. The recovery wells will be constructed of 6-inch inside diameter (ID), flush-threaded stainless steel continuous-slot well screen and solid casing with a 5-foot sump. The screen slot size and filter pack gradation will be developed as a function of the related soil formation. A 5-foot bentonite seal will be placed surrounding the sump. The annular space between the well screen and the borehole will be backfilled with filter sand to approximately 2-feet above the top of the screen interval. A 2-foot bentonite seal will be placed at the top of the sand pack. The remaining annular space will be filled with a cement/bentonite grout to the ground surface by tremie method. Each well will be protected with a lockable traffic rated well vault (Parcel II) or steel surface casing (Parcels I and III) secured with cement. Figure 3 depicts typical recovery well construction.

Final proposed recovery well locations vary from those initially proposed in the RDWP as follows:

- **Parcel I:** CGRW-01 has been added south of former Holder 3 due to the presence of potentially recoverable DNAPL; CGRW-02 has been moved about 50-feet north of its original location (CGMW-02) due to the limited recoverable DNAPL observed at the original location; and CGMW-03 has been deleted as a location due to the poor recharge rate noted during RI testing (2.5% DNAPL recovery after 6 months of recharge).

- **Parcel II:** The CGMW-07 location was deleted due to limited recoverable DNAPL observed at the original location; and CGRW-03 and CGRW-04 have been added due to the presence of potentially recoverable DNAPL.

- **Parcel III:** Clustered recovery wells (shallow (S), intermediate (I), and deep (D)) are proposed for each location. Specifically, recovery wells CGRW-05 S/I/D, -06 S/I/D and -07 S/I/D are proposed. The recovery well 06-cluster is located adjacent to the former CGMW-08 location. The remaining proposed wells (05- and 07-clusters) are at new locations farther north due to the presence of potentially recoverable DNAPL.

- Original well location CGMW-06 is located off site across Huntington Street along the southeast boundary of Parcel III. Due to its off-site location and permitting difficulties, the potential recovery well location is proposed on site across the street from the original well, designated as CGRW-08. This location is presently within the warehouse on the parcel. However, the warehouse and slab are presently being demolished and the approved Parcel III Pre-Design Investigation Work Plan will be implemented following the demolition. Under the Parcel III pre-design program a boring (CGSB-77) will be installed at the potential well location. Following the pre-design plan, this boring will be continuously sampled to a minimum depth of 95-feet bgs (El.-85 ft) or until approximately 10 feet of soil with minimal DNAPL impact is observed. Appropriateness as a recovery well location will be based on this boring.

- Other recovery well locations will be evaluated based on the finding of the Parcel III Pre-Design Investigation.

1.2 DNAPL Monitoring, Recovery and Disposal

Development of the recovery wells will be delayed for 3 to 5 days to distinguish between initial or stagnant DNAPL flow into the well versus DNAPL flow into the well that was influenced by well development procedures. Development procedures will follow the GEI standard operating procedures for well development included in the approved Field Sampling Plan of the Parcel III Pre-Design Investigation Work Plan. Recovery wells may be developed using a high flow pump and will be monitored for drawdown and recovery. Well development fluids will be pumped into 55-gallon drums, a large volume tank, or mobile tanker truck. All groundwater and DNAPL generated during development activities will be disposed off site at an appropriate facility. For the first month after a recovery well has been installed, the recovery well will be gauged and monitored weekly for depth to water, depth to DNAPL, and accumulated DNAPL thickness in the well sump.

If DNAPL is observed in a recovery well after 1 month, DNAPL recovery and monitoring activities will begin at the well and continue for 4 to 5 months in accordance with the following:

- After the DNAPL is recovered or pumped from the recovery well, the well will be gauged at a minimum of every 15 minutes for a period of up to 3 hours.

- If less than 10 percent recovery of the pre-pumping DNAPL level is measured during the initial 3-hour period, then the well will be gauged daily for 1 week and then weekly for up to 3 months or until 85 percent recovery is achieved. If 85 percent recovery is achieved within 1 month following the pumping event, then a second recovery event will proceed and be monitored according to the recharge rate observed after the initial pumping event.

- If greater than 10 percent recovery of the pre-pumping DNAPL level is measured during the initial 3-hour period, then hourly gauging would continue for a period of up to 8 hours or until the DNAPL level recovers to within 20 percent of its original level prior to pumping. After the 8 hours or 20 percent of the pre-pumping DNAPL level is recovered, gauging will proceed daily for 1 week and then weekly until 85 percent recovery is achieved. If 85 percent recovery is achieved within 1 month following the pumping event, then a second recovery event will proceed and be monitored according to the recharge rate observed after the initial pumping event.

- The general parameters may be modified based on observations made in the field.

Different methods of DNAPL recovery will be evaluated throughout the pilot test. These methods may include, as appropriate, pneumatic pumping, belt skimmer, periodic manual removal (bailers), peristaltic pumps, etc. If a bailer is used to recover the DNAPL, then time will be allotted (i.e. 1 to 2 hours) to allow for settlement of any DNAPL that may have been agitated by the bailer. Recovered DNAPL will be temporarily stored onsite in 55-gallon drums or other appropriate storage vessels pending off-site disposal.

Fieldwork will be performed under the approved Health and Safety Plan (HASP) of the RDWP.

2.0 Pilot Test Report

After the field recovery and monitoring program, a Pilot Test Report will be prepared and submitted to the NYSDEC. This report will summarize the recovery well installation and DNAPL recovery activities. The summary will include a calculation of DNAPL recovery rates, and an evaluation of the productivity of each recovery well and the recovery methods. Based on the estimated DNAPL recovery rates and evaluations

provided in this report, a determination will be made on the viability of each well for an active DNAPL recovery system, a passive DNAPL recovery program, or abandonment of the well due to limited recovery potential.

3.0 Proposed Schedule

Work is anticipated to begin following NYSDEC approval of this Work Plan. It is anticipated that the field work detailed in this Work Plan can be completed within 6 months of NYSDEC approval of the plan.

If you have any questions or require additional information, please feel free to contact me at (718) 963-5645 or via e-mail at tracey.bell@us.ngrid.com.

Sincerely,

Tracey Bell
Manager

Enclosure

ec: G. Cross (NYSDEC)
C. Doroski (NYSDOH)

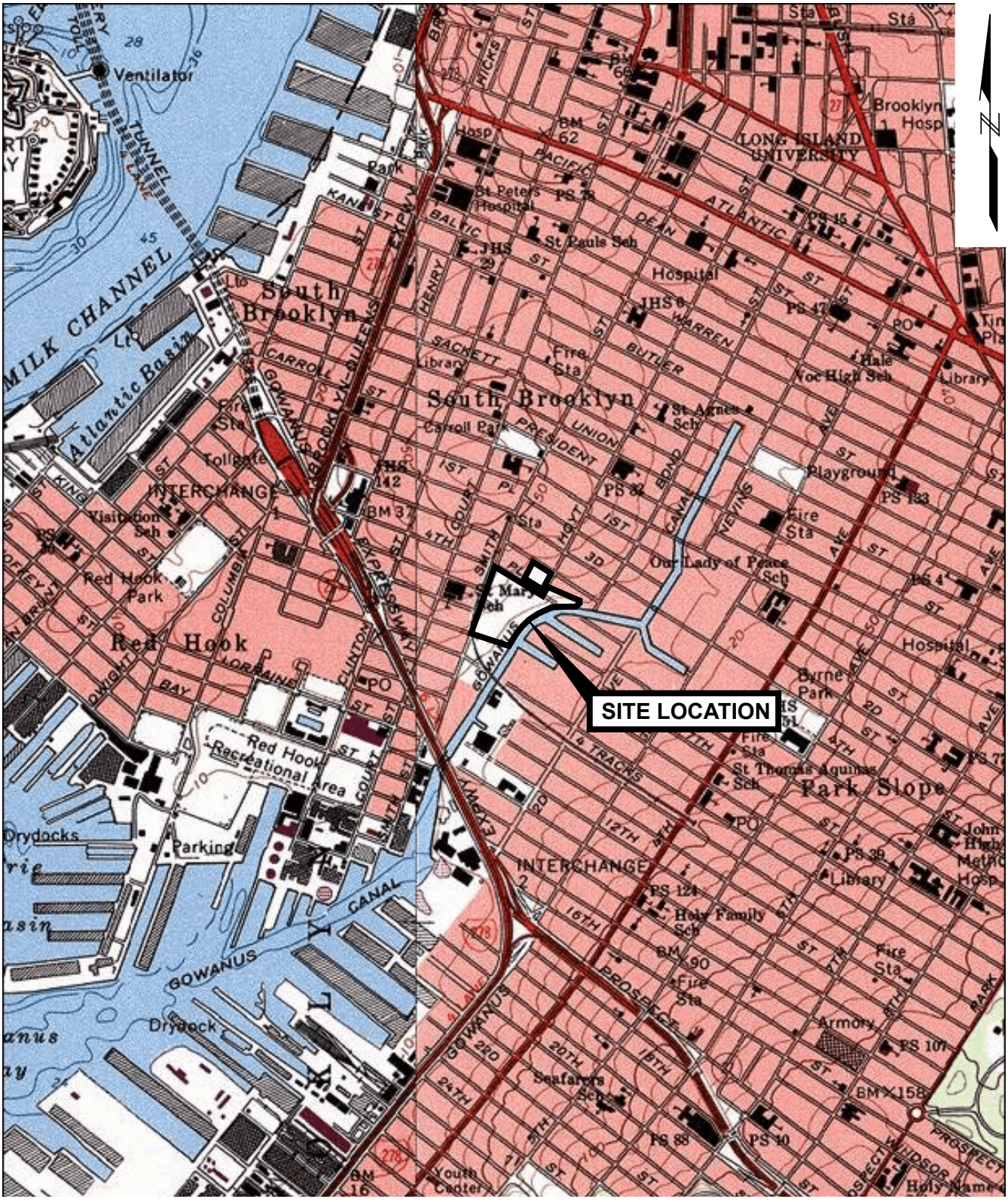
MZ/at H:\WPROC\Project\KEYSPAN\Citizen's Gas\Remedial Design\Remedial Design Investigation\DNAPL Recovery\Pilot Test\Work Plan\DNAPL Recovery WP Final to DEC (4-13-09).docx

Table 1
Proposed Pilot Test Recovery Well Construction
Carroll Gardens/Public Place Former MGP Site
Brooklyn, New York

Pilot Test Recovery Well (at/near RDWP pre-design investigation boring location noted)	Total Depth[1] (ft bgs)[2]	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Interval Length (ft)/ Elevation (ft NAVD 88)	Adjacent RI/RDWP pre-design investigation Boring/Test Pit/Monitoring Well
Parcel I					
CGRW-01(at CGSB-117)	70	30	65	35 (-3 to -38)	CGSB-04
CGRW-02(at CGSB-119)	50	30	45	15 (-16 to -31)	CGSB-10/CGMW-02
Parcel II					
CGRW-03 (at CGSB-128)	57	22	52	30 (-10 to -40)	CGSB-23
CGRW-04 (at CGSB-127)	72	27	67	40 (-15 to -55)	CGSB-8 & 23/CGMW-07
Parcel III					
Shallow Recovery Wells					
CGRW-05S (near CGSB-121)	25	10	20	10 (0 to -10)	CGSB-28/CGMW-08
CGRW-06S (near CGSB-125)	25	10	20	10 (0 to -10)	CGSB-28/CGMW-08
CGRW-07S (near CGSB-122)	30	15	25	10 (-5 to -16)	CGSB-27/CGTP-15
CGRW-08S (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06
Intermediate Recovery Wells					
CGRW-05I (near CGSB-121)	74	39	69	30 (-29 to -59)	CGSB-28/CGMW-08
CGRW-06I (near CGSB-125)	67	32	62	30 (-22 to -52)	CGSB-28/CGMW-08
CGRW-07I (near CGSB-122)	62	47	57	10 (-37 to -47)	CGSB-27/CGTP-15
CGRW-08I (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06
Deep Recovery Wells					
CGRW-05D (at CGSB-121)	106	81	101	20 (-71 to -91)	CGSB-28/CGMW-08
CGRW-06D (at CGSB-125)	101	86	96	10 (-76 to -86)	CGSB-28/CGMW-08
CGRW-07D (at CGSB-122)	96	81	91	10 (-71 to -81)	CGSB-27/CGTP-15
CGRW-08D (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06

1 - Includes a 5 foot sump at depth. Recovery wells in Parcel II will be completed with a flush-mounted lockable steel and/or concrete vault. All other well will be completed with a steel riser pipe with locking cap.

2 - Feet below current ground surface.



SOURCE: Map created with TOPO! ® ©2001 National Geographic (www.nationalgeographic.com/topo)

0 2000 4000

SCALE, FEET

DNAPL RECOVERY PILOT PROGRAM
CARROLL GARDENS/PUBLIC PLACE
BOROUGH OF BROOKLYN, NEW YORK

nationalgrid

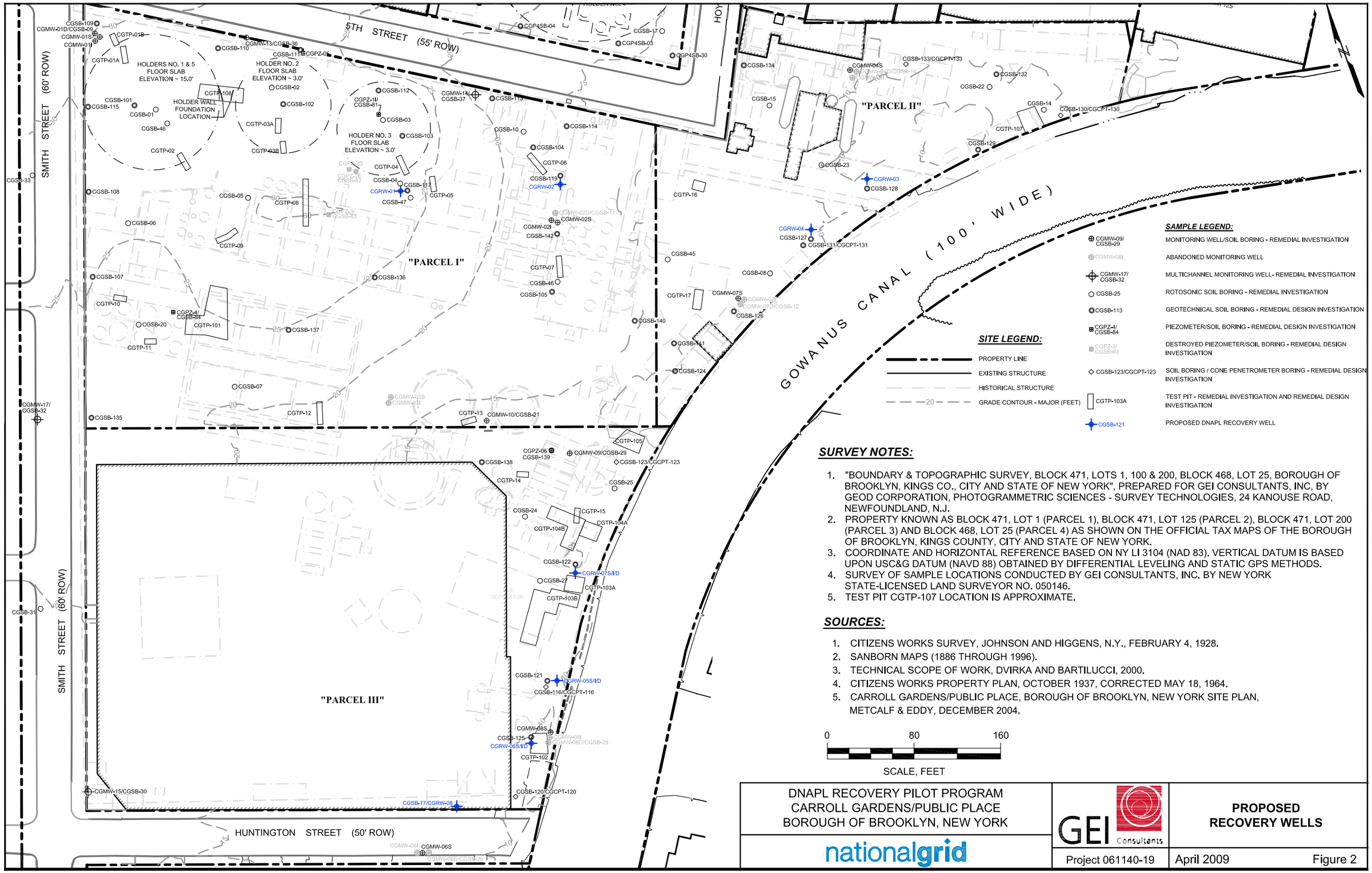
GEI Consultants

Project 061140-19-2807

SITE LOCATION MAP

April 2009 Figure 1

NATIONAL GRID\CITIZENS\19-2817\CITIZENS-LOCATION MAP.CDR



SITE LEGEND:

- PROPERTY LINE
- EXISTING STRUCTURE
- HISTORICAL STRUCTURE
- 20 GRADE CONTOUR - MAJOR (FEET)

SAMPLE LEGEND:

- CGMW-09/ CGSB-29 — MONITORING WELL/SOIL BORING - REMEDIAL INVESTIGATION
- CGMW-08I — ABANDONED MONITORING WELL
- CGMW-17/ CGSB-32 — MULTICHANNEL MONITORING WELL- REMEDIAL INVESTIGATION
- CGSB-25 — ROTOSONIC SOIL BORING - REMEDIAL INVESTIGATION
- CGSB-113 — GEOTECHNICAL SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- CGPZ-4/ CGSB-84 — PIEZOMETER/SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- CGPZ-3/ CGSB-83 — DESTROYED PIEZOMETER/SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- CGSB-123/CGCPT-123 — SOIL BORING / CONE PENETROMETER BORING - REMEDIAL DESIGN INVESTIGATION
- CGTP-103A — TEST PIT - REMEDIAL INVESTIGATION AND REMEDIAL DESIGN INVESTIGATION
- CGSB-121 — PROPOSED DNAPL RECOVERY WELL

SURVEY NOTES:

1. "BOUNDARY & TOPOGRAPHIC SURVEY, BLOCK 471, LOTS 1, 100 & 200, BLOCK 468, LOT 25, BOROUGH OF BROOKLYN, KINGS CO., CITY AND STATE OF NEW YORK", PREPARED FOR GEI CONSULTANTS, INC, BY GEOD CORPORATION, PHOTOGRAMMETRIC SCIENCES - SURVEY TECHNOLOGIES, 24 KANOUSE ROAD, NEWFOUNDLAND, N.J.
2. PROPERTY KNOWN AS BLOCK 471, LOT 1 (PARCEL 1), BLOCK 471, LOT 125 (PARCEL 2), BLOCK 471, LOT 200 (PARCEL 3) AND BLOCK 468, LOT 25 (PARCEL 4) AS SHOWN ON THE OFFICIAL TAX MAPS OF THE BOROUGH OF BROOKLYN, KINGS COUNTY, CITY AND STATE OF NEW YORK.
3. COORDINATE AND HORIZONTAL REFERENCE BASED ON NY LI 3104 (NAD 83). VERTICAL DATUM IS BASED UPON USC&G DATUM (NAVD 88) OBTAINED BY DIFFERENTIAL LEVELING AND STATIC GPS METHODS.
4. SURVEY OF SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. BY NEW YORK STATE-LICENSED LAND SURVEYOR NO. 050146.
5. TEST PIT CGTP-107 LOCATION IS APPROXIMATE.

SOURCES:

1. CITIZENS WORKS SURVEY, JOHNSON AND HIGGENS, N.Y., FEBRUARY 4, 1928.
2. SANBORN MAPS (1886 THROUGH 1996).
3. TECHNICAL SCOPE OF WORK, DVIRKA AND BARTILUCCI, 2000.
4. CITIZENS WORKS PROPERTY PLAN, OCTOBER 1937, CORRECTED MAY 18, 1964.
5. CARROLL GARDENS/PUBLIC PLACE, BOROUGH OF BROOKLYN, NEW YORK SITE PLAN, METCALF & EDDY, DECEMBER 2004.

0 80 160

SCALE, FEET

DNAPL RECOVERY PILOT PROGRAM
CARROLL GARDENS/PUBLIC PLACE
BOROUGH OF BROOKLYN, NEW YORK

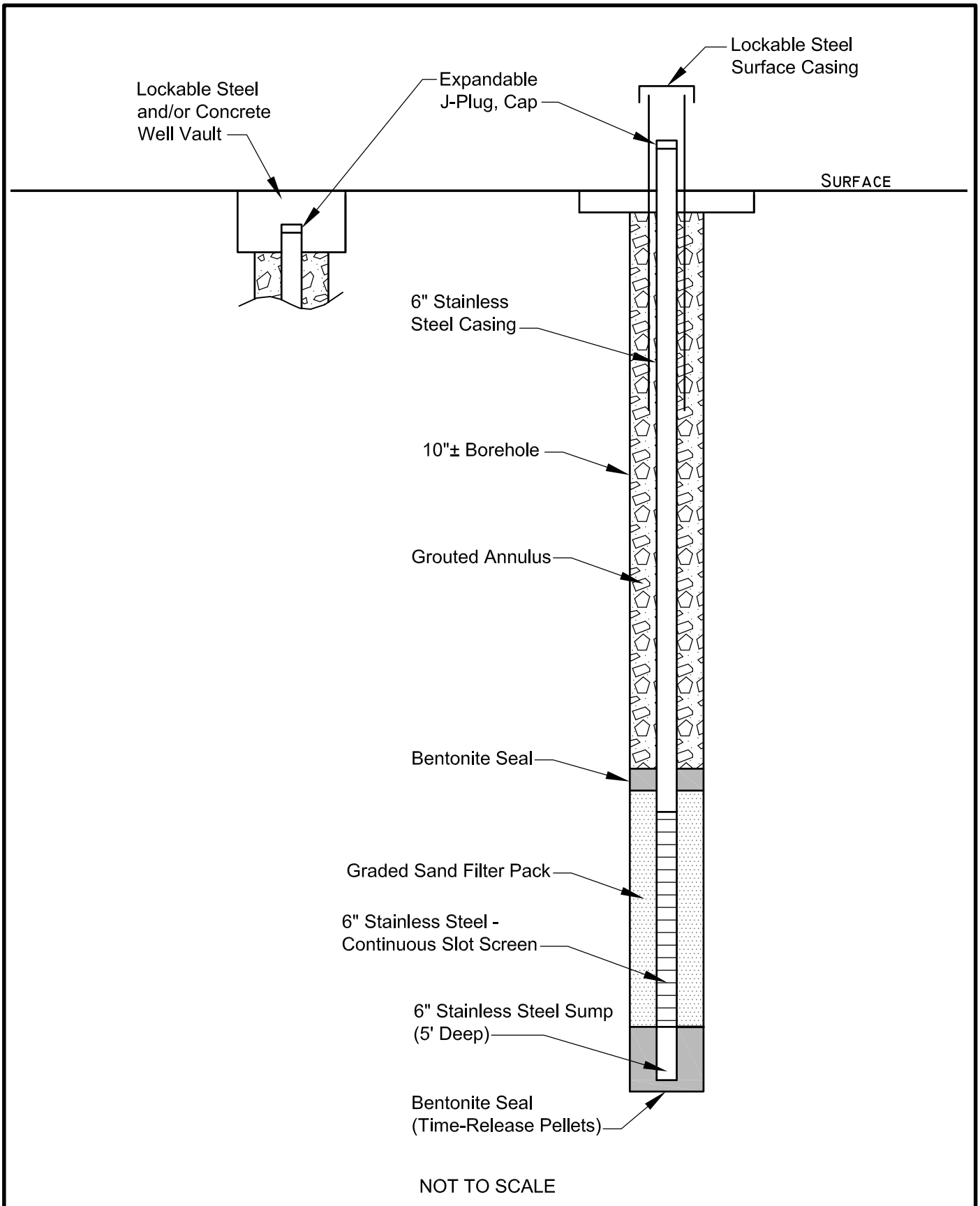
nationalgrid

GEI Consultants

PROPOSED RECOVERY WELLS

Project 061140-19 | April 2009 | Figure 2

I:\GEI\National Grid\CITIZENS\19-2817\ Figure 2 Proposed Recovery Wells.dwg \Apr 13, 2009



NOT TO SCALE

DNAPL RECOVERY PILOT PROGRAM
CARROLL GARDENS/PUBLIC PLACE
BOROUGH OF BROOKLYN, NEW YORK

nationalgrid

GEI Consultants

TYPICAL RECOVERY WELL CONSTRUCTION DETAILS

Project 061140-19-2817 | April 2009 | Figure 3

I:\GEI\National Grid\CITIZENS\19-2817\ Figure 3 Citizens-Well Detail.dwg \Apr 13, 2009

10. Soil Gas Sampling (SG)

- SG-001 General Guidance on Soil Vapor Intrusion Evaluations
- SG-002 Soil Vapor Sample Collection
- SG-003 Sub-Slab Soil Vapor Collection
- SG-004 Ambient Air Sample Collection

STANDARD OPERATING PROCEDURE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling

- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

- Direction of groundwater flow from the contaminant source to the residential or commercial building;
- The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
- Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
- Potential “smear zones” (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.
- Location, depth, extent of NAPL, if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Department of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling

has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the

building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).
- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Attachments

Attachment A - NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory Form

5. Contact

Chris Berotti

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: _____

Property: _____

Sampling Date: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

Preparer's Name: _____ Date/Time Prepared: _____

Preparer's Affiliation: _____ Phone No.: _____

Purpose of Investigation:_____

1. OCCUPANT Interviewed: Yes □ No □

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants_____

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes □ No □

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

4. PROPERTY LOCATION: _____

Relative to Site:

Direction _____ Direction to Nearest Cross Street: _____

Distance _____ Distance to Nearest Cross Street: _____

Surrounding Land Use:

North: _____ East: _____

South: _____ West: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Yes □ No □

If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Yes □ No □ How air tight? Tight / Average / Not Tight

Construction Material _____

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

_____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor surface:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
	unpainted	painted	painted with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes □ No □

Is, is there water in the sump? Yes □ No □

Describe sump conditions:_____

_____

Have you observed standing water in your basement? Yes □ No □

If so, what is the frequency of this observation? _____During rain events? □

Have you observed sheen atop the standing water? Yes □ No □

Basement/Lowest level depth below grade: _____(feet)

Are there any cracks in the floor of your basement? Yes □ No □

Description: _____

_____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: _____

_____

What activities occur in the finished basement?

Description: _____

_____

Approximately how many hours per day (or week) do you spend in your basement? _____

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: _____
Property: _____
Sampling Date: _____

Hot Air Circulation	Hot Water Baseboard	Steam Radiation
Electric Baseboard	Heat Pump	Wood Stove
Space Heaters	Radiant Floor	Outdoor wood boiler

Unvented Kerosene Heater Other _____

The primary type of fuel used is:

Fuel Oil	Natural Gas	Electric
Kerosene	Propane	Solar
Wood	Coal	Other? _____

Time of use of each type of heating? _____

Domestic hot water tank fueled by: _____

Boiler/furnace located in: Basement Outdoors Main Floor Other_____

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Yes □ No □

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

Type of insulation (e.g. blown, fiber, etc.)? _____

Does building have energy efficient windows (e.g. double paned) Yes □ No □

Was weather-stripping recently added/upgraded? Yes □ No □

Particleboard used in construction? Yes □ No □

9. OCCUPANCY

Property Location/Address: _____
Property: _____
Sampling Date: _____

Level General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)

Basement _____

1st Floor _____

2nd Floor _____

3rd Floor _____

4th Floor _____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? _____ Condition? _____

Last inspected? _____ Location: _____

Describe conduits to building (type, location, and entry portal condition): _____

_____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other _____

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other _____

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)
Yes ☐ No ☐ NA ☐ Please specify_____

Is gasoline stored in the garage? Yes ☐ No ☐

Quantity? _____

d. Has the building ever had a fire? Yes ☐ No ☐

When?_____

e. Is a kerosene or unvented gas space heater present? Yes ☐ No ☐

Where? _____

f. Is there a workshop or hobby/craft area? Yes ☐ No ☐

Where & Type? _____

g. Is there smoking in the building? Yes ☐ No ☐

How frequently? _____

h. Have cleaning products been used recently? Yes ☐ No ☐

When & Type? _____

i. Have cosmetic products been used recently? Yes ☐ No ☐

When & Type? _____

j. Has painting/staining been done in the last 6 months? Yes ☐ No ☐

Where & When? _____

Is house paint stored inside? Yes ☐ No ☐

Where? _____

k. Is there new carpet, drapes or other textiles? Yes ☐ No ☐

Where & When? _____

l. Have air fresheners been used recently? Yes ☐ No ☐

When & Type? _____

m. Is there a kitchen exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

n. Is there a bathroom exhaust fan? Yes ☐ No ☐

If yes, where vented?_____

o. Is there a clothes dryer? Yes ☐ No ☐

If yes, is it vented outside? Yes ☐ No ☐

p. Has there been a pesticide/chemical fertilizer application? Yes ☐ No ☐

Property Location/Address: _____
Property: _____
Sampling Date: _____

When & Type?_____

Conducted by Owner or Private Yard Service _____

Is yard waste/trash burned on-site? Yes □ No □

Do any of the building occupants use solvents at work? Yes □ No □

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Yes □ No □

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly) No

Use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Yes □ No □

Date of Installation: _____

Is the system active or passive? Active □ Passive □

Are there any recent/past improvements to building? Yes □ No □

Interior painting? _____

Any landscaping improvements that involved bringing fill on site? Yes □ No □

Other _____

Approximately when (how long ago) did these improvements occur? _____

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Property Location/Address: _____
Property: _____
Sampling Date: _____

b. Furniture refinishing Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

c. Model building(e.g. planes,boats,cars) Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

d. Gardening Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

e. Automotive work Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

f. Ammunition reloading Yes □ No □

Name: _____ Age: _____ Sex: _____

Name: _____ Age: _____ Sex: _____

Is there a wood burning stove? Yes □ No □

If so, how frequently is it used?

_____

_____

Is there a barbeque grill? Yes □ No □

If so, how frequently is it used? What is the type of fuel?

_____

_____

Has the building ever had fumigation? Yes □ No □

Property Location/Address: _____
Property: _____
Sampling Date: _____

If so, when and how frequently? Type?

_____

_____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? _____

_____

_____

_____

_____

History of odor observation – date of onset, duration, severity, etc.

_____

_____

_____

_____

_____

_____

_____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Property Location/Address: _____
Property: _____
Sampling Date: _____

Product Inventory
Off-Site Property Sampling Documentation
Soil Vapor Intrusion Investigation

Property Address:	**Performed by:**
Date of Inventory:	**Field Instrument Make & Model:**

Location	**Product Description**	**Size (units)**	**Condition ***	**Chemical Ingredients**	**Field Instrument Reading (units)**	**Photo ** Y/N**

Notes

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)

** Photographs of the front and back of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

STANDARD OPERATING PROCEDURE

SG-002 Soil Vapor Sample Collection

1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a porous backfill

material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing

laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on

the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil

vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases where sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.

- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the

surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-004 Ambient Air Sample Collection

1. Objective

Describe procedures to collect ambient air samples. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Execution

2.1. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sample Collection

- Samples should be collected in laboratory-certified clean SUMMA® canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (1-hour, 8-hour, etc.). The regulator flow rate should not exceed 0.2 liters per minute.
- Place the canister at the sampling location. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.

- Connect the tubing to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- If possible, monitor the vacuum pressure in the canister routinely during sampling. During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Determine whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contacts

Chris Berotti
Bill Simons

11. Quality Control – Quality Assurance (QA)

- QA-001 Equipment Decontamination
- QA-002 Field Quality Control Samples

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

This SOP describes methods used to decontaminate reusable sampling equipment for projects that require collection of organic and inorganic analytical samples. The goal is to minimize cross-contamination between samples. This maximizes confidence that field samples will be representative of specific locations and conditions.

Refer to the work plan or project manager to determine if different decontamination methods are acceptable.

2. Execution

- All contractor-provided equipment (augers, rods, spoons, backhoe buckets) should be decontaminated by steam cleaning or pressure washing prior to coming on site. If there is doubt about cleanliness of drilling tools, they should be decontaminated before use at the site.
- Sampling equipment decontamination is a sequential procedure consisting of the following steps:

    - Alconox-solution wash (or equivalent non-phosphate detergent)
    - Potable water rinse
    - A ten percent reagent grade nitric acid wash should be used to strip potential inorganic contaminants from sampling devices.
    - Laboratory grade 100 percent methanol, should be used to strip potential organic contaminants from sampling devices.
    - Three distilled/deionized water rinses.

- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution to remove visible contamination or dirt from sampling devices.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The procedure follows:

    - Overall wash and scrub in a bucket of Alconox solution
    - Potable water rinse.
    - 10% nitric rinse
    - 100% laboratory grade methanol rinse
    - Three distilled-water rinses.

    The same procedure is applied to all devices that may contact soil or groundwater slated for analytical samples - spoons and knifes used to inspect or sample soils; water level indicators; oil/water interface probes.

Equipment used for well development of multiple wells must be decontaminated between wells.

Pumps and tubing should be flushed using a minimum of one gallon of Alconox-solution followed by a gallon of potable water. Some projects may require methanol (in much lower quantities) and distilled water instead of or in addition to the Alconox-solution and potable water.

For pumps and tubing, a final rinse of the sampling equipment may be performed with the water being sampled.

Equipment blanks measure the effectiveness of the decontamination procedures. Blanks should be collected per guidance provided in QA-002, Field Quality Control Samples.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- Decontamination procedures may also require modification based on state or federal requirements.
- Steam cleaning or pressure washing with potable water is generally an acceptable decontamination method for drilling equipment (i.e., augers). Check with the work plan.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Contacts

Brian Conte
Bill Simons

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatiles analysis (e.g. volatile organic compounds) shipment.
- Consider submitting a trip blank when sample shipment is by Fed Ex or other large carrier, or laboratory courier.
- Trip blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.2. Equipment blanks

- Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection. Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions
- Equipment blanks are collected by pouring laboratory supplied or distilled or deionized water over sampling tools that have been decontaminated per the work plan, into sample containers.
- Equipment blanks are stored with the associated field samples until submitted for analysis.
- Generally collected when site conditions indicate site related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.
- Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the decontaminated sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.

- If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.
- Equipment blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.3. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternating filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Field duplicates are generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory – as if they are separate, primary samples.
- Field duplicates should be recorded in the field notebook and on the chain-of-custody that same as all other samples.
-

2.4. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.
- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- Generally, the laboratory is required to extract and analyze MS or MS / MSDs at a minimum frequency of 5% of samples being analyzed for the target analyte(s). If the project or client criteria require an MS or MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS or MS/MSD on the chain of custody.
- Calculate the percent recovery for all spiked analytes for both the MS and MSD. For MS/MSDs also calculate the relative percent difference (RPD). The

RPD for each spiked analyte is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the % recovery and the RPD will generally be determined by the validator.

2.5. Typical QA/QC Frequency

- QA/QC frequency is determined by project, client or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described below:

Duplicate Samples	One per sampling event, one per 10 samples collected, or one every two weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable - one per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS or MS / MSDs	One MS or MS/MSD per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.

3. Limitations

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

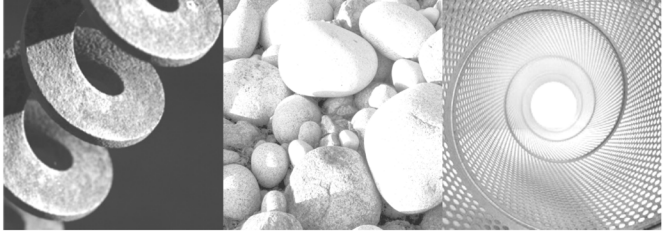
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Contact

Brian Conte
Pat King

Appendix C Quality Assurance Project Plan (QAPP)



Quality Assurance Project Plan

Hunts Point 600 Food Center Drive
NYSDEC BCP Site No. C203104

For the Property located at:
600 Food Center Drive, Bronx, New York

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233

On Behalf of:
New York City Economic Development Corporation
1 Liberty Plaza
New York, New York 10006

Submitted by:
GEI Consultants, Inc.
530 7th Avenue, Suite 2007
New York, NY 10018
212.687.8282

February 2026
Project No. 2303564



Stacey Ng, P.G.
Project Manager

Kevin P. McCarty
Senior Project Manager/Environmental Lead

Table of Contents

Acronyms and Abbreviations iii

Quality Assurance Glossary v

1. Purpose 1

2. Project Goals and Objectives 2

3. Project Organization and Responsibility 3

4. Quality Assurance Objectives 5

4.1. Required Quantification Limit 5
4.2. Accuracy 6
4.3. Precision 6
4.4. Completeness 7
4.5. Representativeness 7
4.6. Comparability 7

5. Sampling Plan 9

5.1. Sample Type, Location, and Frequency 9
5.1.1. Subsurface Soil Samples 9
5.1.1.1. Soil Sampling of Per-and Polyfluoroalkyl Substances 9
5.1.2. Groundwater Samples 10
5.1.2.1. Groundwater Sampling of Per-and Polyfluoroalkyl Substances 10
5.1.3. Soil Vapor and Sub-Slab Vapor Samples 10
5.1.4. Indoor and Ambient Air Samples 11
5.1.5. Field QC Sample Collection 11
5.2. Sample Preservation and Containerization 12
5.3. Equipment Decontamination 12

6. Documentation and Chain of Custody (COC) 13

6.1. Sample Collection Documentation 13
6.1.1. Field Notes 13
6.1.2. COC Records 13
6.1.3. Sample Labeling 13
6.1.4. Sample Handling 14
6.2. Sample Custody 14
6.2.1. Field Custody Procedures 15
6.2.2. Laboratory Custody Procedures 16

7. Calibration Procedure 17

7.1. Field Instruments 17

7.2. Laboratory Instruments 17

8. Sample Preparation and Analytical Procedures 19

9. Data Reduction and Reporting 20

9.1. Field Data Evaluation 20

9.2. Analytical Data 20

10. Internal Quality Control 21

11. Performance and System Audits 22

12. Preventative Maintenance 23

13. Specific Procedures to Assess Data Quality Indicators 24

13.1. Detection Limits 24

13.1.1. Method Detection Limit 24

13.1.2 Reporting Limit 24

13.2. Precision 25

13.3. Accuracy 25

13.4. Completeness 26

13.5. Representativeness 26

13.6. Comparability 27

14. Corrective Action 28

14.1. Immediate Corrective Action 28

15. References 29

List of Tables

Table 3-1. Key Project Personnel and Responsibilities 3

Table 3-2. Eurofins Certifications 4

Table 6-1. Sample Labeling 14

Tables

Table 1. Summary of Samples and Analysis

Table 2. Analytical Methods/Quality Assurance Summary Table

Appendices

Appendix A Eurofins Quality Assurance Manual

Appendix B Eurofins PFAS Standard Operating Procedure

Appendix C Environmental Data Services (EDS) Resume

SM/SN/KM

B:\Working\NYCEDC\2303564 600 FCD RIWP\RIWP\Appendix C - QAPP\600 FCD QAPP_FINAL_20260213.docx

Acronyms and Abbreviations

ASP	Analytical Service Protocol
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH_4	Methane
CLP	Contract Laboratory Protocol
CO_2	Carbon dioxide
COC	Chain Of Custody
DF	Dilution factor
DO	Dissolved Oxygen
DQO	Data Quality Objective
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
FCD	Food Center Drive
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectroscopy
GEI	GEI Consultants, Inc.
HDPE	High-density polyethylene
LCS	Laboratory Control Sample
LDPE	Low-density polyethylene
LEL	Lower Explosive Limit
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2	Oxygen
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PFAS	Per- and Polyfluoroalkyl Substances
PID	Photoionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance

QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limits
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SCG	Standards, Criteria, and Guidance
SD	Standard Deviation
SOP	Standard Operating Procedures
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCL+30	Target Compound List Plus 30
US EPA	United Stated Environmental Protection Agency
VOC	Volatile Organic Compound
%R	Percent Recovery

Measurements

ppm	Parts per million
ppb	Parts per billion
ppmv	Parts per million by volume
ppbv	Parts per billion by volume
msl	Mean Sea Level
µg/L	Microgram per liter
µg/Kg	Microgram per kilogram
µg/m^3	Microgram per cubic meter
mg/L	Milligram per liter
mg/kg	Milligram per kilogram

Quality Assurance Glossary

"Alteration" means altering a sample collected for analysis in any way other than by adding a preservative, such as nitric acid to lower pH. Examples of alteration include, but are not limited to: filtering, settling and decanting, centrifuging and decanting, and acid extracting.

"Analytical Services Protocol" or "ASP" means the New York State Department of Environmental Conservation (NYSDEC)'s compendium of approved United Stated Environmental Protection Agency (US EPA) and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

"Correlation Sample" means a sample taken, when using a field-testing technology, to be analyzed by an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory to determine the correlation between the laboratory and field analytical results.

"Confirmatory Sample" means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as "post remediation sample."

"Contract laboratory program" or "CLP" means a program of chemical analytical services developed by the US EPA to support Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

"Data Usability Summary Report" or "DUSR" is a document that provides a thorough evaluation of the analytical data to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and use.

"Effective solubility" means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

"Environmental Laboratory Accreditation Program" or "ELAP" means a program conducted by the New York State Department of Health (NYSDOH), which certifies environmental laboratories through onsite inspections and evaluation of principles of credentials and proficiency testing.

"Filtration" means the filtering of a groundwater or surface water sample, collected for metals analysis, at the time of collection and prior to preservation. Filtering includes, but is not limited to, the use of any membrane, fabric, paper or other filter medium, irrespective of pore size, to remove particulates from suspension.

"**Final delineation sample**" means a sample taken as an endpoint sample, used to make a decision regarding the extent of contamination at a site, which is to be analyzed by an ELAP-certified laboratory.

"Intermediate Sample" means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

"Minimum reporting limit" means the lowest concentration at which an analyte can be detected and which can be reported with a reasonable degree of accuracy. It is the lowest concentration that can be measured, a lab-specific number, developed from minimum detection limits, and is also referred to as the practical quantitation limit (PQL).

"Nephelometric Turbidity Unit" or "NTU" is the unit by which turbidity in a sample is measured.

"Non-targeted compound" means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound, or an internal standard compound.

"Practical quantitation level" or "PQL" means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

"Preservation" means preventing the degradation of a sample due to precipitation, biological action, or other physical/chemical processes between the time of sample collection and analysis. The most common examples involve refrigeration at 4 degrees Celsius and lowering sample pH by the addition of acid to keep dissolved metals in solution or to reduce the biodegradation of dissolved organic analytes.

"PAH" means polycyclic aromatic hydrocarbon as defined by US EPA Method 8270.

"Quality assurance" or "QA" means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment, and quality improvement efforts to meet data end-use requirements.

"Quality assurance project plan" or "QAPP" means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control (QA/QC) activities designed to achieve the data quality goals or objectives of a specific project or operation.

"Quality control" or "QC" means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

"Semi-volatile organic compound" or "SVOC" means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semi-volatiles are those target compound list compounds identified in the statement of work in the current version of the US EPA Contract Laboratory Program.

"Target analyte list" or "TAL" means the list of inorganic compounds/elements designated for analysis as contained in the version of the US EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/ elements.

"Targeted compound" means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis as contained in the version of the US EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this chapter, a Target Compound List+30 scan means the analysis of a sample for Target Compound List (TCL) compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted semi-volatile organic compounds using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the US EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"Tentatively identified compound" or "TIC" means a chemical compound that is not on the target compound list but is detected in a sample analyzed by a GC/MS analytical method. TICs are only possible with methods using mass spectrometry as the detection technique. The compound is tentatively identified using a mass spectral instrumental electronic library search and the concentration of the compound estimated.

"Unknown compound" means a non-targeted compound which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organic compounds" or "VOC" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this chapter, analysis of volatile organics means the analysis of a sample for either those priority pollutants listed as amenable for analysis using US EPA Method 624 or those target compounds identified as volatiles in the version of the US EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil, and vegetable oil, which has not subsequently been refined.

"Well development" means the application of energy to a newly installed well to establish a good hydraulic connection between the well and the surrounding formation. During development, fine-grained formation material that may have infiltrated the sand pack and/or well during installation is removed, allowing water from the formation to enter the well without becoming turbid and unrepresentative of groundwater in the formation.

1. Purpose

GEI Consultants, Inc. (GEI) has prepared this Quality Assurance Project Plan (QAPP) to address analytical groundwater, soil, and soil vapor sampling at 600 Food Center Drive (FCD), Bronx, New York (the Site). The QAPP is a companion document and attachment to the 600 FCD *Remedial Investigation Work Plan (RIWP)*. The QAPP presents the project scope and goals, organization, objectives, sample handling procedures, and Quality Assurance Quality Control (QA/QC) procedures associated with the site.

Furthermore, this QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of-custody (COC) protocols.
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures.
- All aspects of the investigation, from field to laboratory, are documented to provide data that are technically sound and legally defensible.

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the United States Environmental Protection Agency (US EPA) and New York State Department of Environmental Conservation (NYSDEC) including:

- *Analytical Service Protocol*, New York State Department of Environmental Conservation. July 2005.
- *DER-10, Technical Guidance for Site Investigation and Remediation*, New York State Department of Environmental Conservation. May 3, 2010.
- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5,* United States Environmental Protection Agency. March 2001.
- *Guidance for Quality Assurance Project Plans, EPA QA/G-5*, United States Environmental Protection Agency. December 2002.
- *Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs,* New York State Department of Environmental Conservation. April 2023.

2. Project Goals and Objectives

The RIWP has been prepared to develop a remedial analysis of the 600 Food Center Drive Brownfield Cleanup Program (BCP) site (Site No. C203104) located in the borough of Bronx, New York. Soil and groundwater will be sampled and analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-Volatile Organic Compounds (SVOCs), Target Analyte List (TAL) Metals, Trivalent Chromium and Hexavalent Chromium, Polychlorinated Biphenyls (PCBs), Pesticides, Total Cyanide, 1,4-Dioxane, and Per- and Polyfluoroalkyl Substances (PFAS). Soil vapor samples will be collected and analyzed for VOCs, as well as Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and naphthalene.

The RIWP program will include:

- Soil borings
- Soil vapor probes
- Permanent groundwater monitoring well installations
- Soil field screening
- Soil boring analytical sampling
- Soil vapor and sub-slab vapor analytical sampling
- Indoor air analytical sampling
- Groundwater analytical sampling

3. Project Organization and Responsibility

GEI is responsible for the implementation of the scope of work associated with the RIWP, including the supervision of contractors, field activities, and the evaluation and interpretation of data. GEI will perform the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for GEI are listed below along with the primary responsibilities of each personnel:

Table 3-1. Key Project Personnel and Responsibilities

Position	GEI Personnel	Areas of Responsibilities
In-House Consultant	Gary Rozmus, P.E.	• Provide strategic guidance of project activities • Client contact regarding strategic issues • Review of project deliverables
Program Manager	Kevin McCarty	• Overall program oversight • Project management • Project schedule • Client contact regarding project related issues • Personnel and resource management • Review of project submittals • Budgeting
Project Manager	Stacey Ng, P.G.	• Client contact regarding project related issues • Coordination of contractors • Technical development and implementation of RIWP and related documents • Personnel and resource management • Preparation and review of project submittals • Budgeting
Field Team Leader	Savanna Marino	• Client contact regarding project related issues on day-to-day basis as part of field operations • Coordination of contractors • Implementation of RIWP and Field Sampling Plan • Personnel and resource management • Preparation of project submittals
Quality Assurance Officer	Jaimie Wargo	• QA/QC for sampling and laboratory performance
Data Manager	Savanna Marino	• Manage raw data from the laboratory • Maintain copies of COCs in the project file

Resumes of the project team are included in Appendix A of the RIWP.

Eurofins Environment Testing Northeast (Eurofins), located in Edison, New Jersey, has been selected to perform the following standard analytical chemistry parameters for soil, soil vapor, indoor air, and groundwater samples including:

- TCL VOCs by US EPA Method 8260D;
- TCL SVOCs by US EPA Method 8270E;
- TAL Metals by US EPA Method 6020B/7471B/7470A;
- Trivalent Chromium and Hexavalent Chromium by US EPA Method 7196A;
- PCBs by US EPA Method 8082A;
- Pesticides by US EPA Method 8081B;
- Total Cyanide by US EPA Method 9012B;
- 1,4-Dioxane by US EPA Method 8270E SIM;
- PFAS by US EPA Method 1633A; and
- TCL VOCs, BTEX, and naphthalene in soil vapor and indoor air by US EPA Method TO-15.

Eurofins' relevant certifications are summarized in the following table.

Table 3-2. Eurofins Certifications

Location	Responsible Agency	Certification
New York	New York State Department of Health	• Environmental Laboratory Approval Program (ELAP) for non-potable water, air and emissions, solid and hazardous waste • **Eurofins** Contract Laboratory Protocol (CLP): 10670
	New York State Department of Environmental Conservation	July 2005 Analytical Service Protocol (ASP)
United States	United States Environmental Protection Agency	• **CLP-Lab: Eurofins** (VOCs/SVOCs/Inorganics/Pesticides/PCBs/ Cyanide/PFAS/ TO-15)

Table 1 provides a summary of soil, soil vapor, and groundwater analyses while Table 2 provides a summary of quality assurance samples, holding times, and analysis for each media.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit (MDL), reporting limit (RL), precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality, and (2) that the quality is acceptable to achieve the project's technical objectives.

Quantitation Limits (QL) are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil, soil vapor, and groundwater compared to New York State Standards, Criteria and Guidance (SCG) values, and for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, COC, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP.

The data quality indicators are presented in Sections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13.

4.1. Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the MDL or some quantitative level defined in terms relative to the program. It should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The MDL presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL is determined from analysis of a sample in a given matrix type containing the analyte.

Practical Quantitation Limit: The practical quantitation limit (PQL) (also referred to as the reporting limit [RL]) is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

4.2. Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless-steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MSs), matrix spike duplicates (MSDs) and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds.

4.3. Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per 20 investigative samples per matrix per analytical parameter, with the exception of the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPDs) as described below in Section 13.2. The resulting information will be used to assess sampling and analytical variability. Duplicate samples are described below in Section 5.1. Table 2 summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty 20 primary samples per matrix. Duplicate samples are described below in Section 5.1. Table 2 summarizes the number of duplicates per media sampled.

4.4. Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified, and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of 1) valid measurements obtained from all the measurements taken in the project and 2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

To ensure that these percentages are met, materials for crucial parameters will be retained if re-sampling is required and strict adherence to holding times will be required.

4.5. Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that any future work plans are followed, and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times.

4.6. Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RIWP is followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized US EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., mg/kg]); for liquids (weight/unit volume [i.e., µg/L]); for air (weight/unit volume [i.e., µg/m^3]).
- Use common chemical name with corresponding chemical abstracts service (CAS) code.
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling will include subsurface soil, groundwater and soil vapor. Direct push (Geoprobe®) or compact roto-sonic drill rig will be the method used for obtaining subsurface soil samples. Groundwater samples will be collected utilizing low-flow sampling methods. Soil vapor points will be installed via Geoprobe or hammer drill. Sampling methods and procedures are presented in the Field Sampling Plan (FSP) of the RIWP.

5.1. Sample Type, Location, and Frequency

5.1.1. Subsurface Soil Samples

Subsurface soil samples will be collected using either a direct-push (Geoprobe®) rig or roto-sonic rig. The depth, location, and number of soil borings is specified in the RIWP. Soil samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP (Appendix B of the RIWP). Borings will be advanced throughout the Site to evaluate the horizontal and vertical extent of impacts, assess the condition of soils to be left onsite, evaluate potential sources, and assist in the presentation of remedy recommendations. A summary of soil samples and analysis is presented in Table 1**.**

5.1.1.1. Soil Sampling of Per-and Polyfluoroalkyl Substances

Soil samples will be collected and submitted to the laboratory for PFAS analysis via US EPA Method 1633. Samples will be collected and transported to the laboratory in high-density polyethylene (HDPE) containers in designated coolers; pre-cleaned containers, coolers, labels, and COC will be provided by the laboratory. PFAS-dedicated sampling equipment, such as spoons, bowls, shovels, and augers, shall be comprised of only acceptable materials, including stainless steel, HDPE, polyvinyl chloride (PVC), silicone, acetate, and polypropylene. No equipment shall contain or come in contact with aluminum foil, low-density polyethylene (LDPE), glass, or polytetrafluoroethylene (PTFE; also known as Teflon™). Any non-dedicated sampling equipment shall be decontaminated between each use utilizing detergent (e.g., Alconox) and certified PFAS-free water provided by the laboratory.

Field personnel shall wear nitrile gloves while conducting field sampling and handling containers; a new pair shall be worn prior to the collection of each sample. Field personnel shall wear clothing that has been laundered more than once and avoid wearing clothing that contains PTFE or PFAS materials; if PFAS-containing PPE is deemed necessary, this shall be documented in the field notes. Additionally, field personnel should avoid contact with potential PFAS-containing materials such as waterproof field books, food packaging, and tools during sampling efforts.

If samples intended for PFAS analysis are collected, equipment blanks should be collected at a minimum frequency of one per day, per matrix, or a minimum of one equipment blank per 20 samples. PFAS-designated coolers shall be maintained at 4 ± 2 degrees Celsius using regular ice only. The PFAS analyte list, as well as the MDLs and PQLs for each respective analyte, are included in the laboratory's Standard Operating Procedure (Appendix C).

5.1.2. Groundwater Samples

Low-flow groundwater samples will be collected from groundwater monitoring wells. Groundwater samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP. Water quality parameters including temperature, pH, turbidity, salinity, dissolved oxygen (DO), oxidation reduction potential (ORP), and specific conductance, will be collected prior to laboratory analysis. A summary of groundwater samples and analysis is presented in Table 1.

5.1.2.1. Groundwater Sampling of Per-and Polyfluoroalkyl Substances

Groundwater samples shall be collected and submitted to the laboratory for PFAS analysis via US EPA Method 1633. Samples will be collected and transported to the laboratory in HDPE containers in designated coolers; pre-cleaned containers, coolers, labels, and COC will be provided by the laboratory.

Sampling equipment and components, such as bladder, inertia and/or peristaltic pumps, tubing, and bailers, shall be comprised of only acceptable materials, including stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. No equipment shall contain or come in contact with aluminum foil, LDPE, glass, or PTFE (i.e., Teflon™) including seal/plumbing tape and sample bottle caps containing a PTFE coating. Any non-dedicated sampling equipment shall be decontaminated between each use utilizing detergent (e.g., Alconox) and certified PFAS-free water provided by the laboratory. If samples intended for PFAS analysis are collected, equipment blanks should be collected each day at a minimum frequency of one per site, per matrix, and a minimum of one 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" (NYSDEC, 2023).

Field personnel shall wear nitrile gloves while conducting field sampling and handling containers; a new pair shall be worn prior to the collection of each sample. Field personnel shall wear clothing that has been laundered more than once and avoid wearing clothing that contains PTFE or PFAS materials; if PFAS-containing PPE is deemed necessary, this shall be documented in the field notes. Additionally, field personnel should avoid contact with potential PFAS-containing materials such as waterproof field books, food packaging, and tools during sampling efforts.

PFAS-designated coolers shall be maintained at 4 ± 2 degrees Celsius using regular ice only. The PFAS analyte list, as well as the MDLs and PQLs for each respective analyte, are included in the laboratory's Standard Operating Procedure (Appendix C).

5.1.3. Soil Vapor and Sub-Slab Vapor Samples

Soil vapor samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP. Prior to sample collection, a multi-gas meter will be used to measure the concentration of oxygen (O_2), carbon dioxide (CO_2), and methane (CH_4) in each probe, to assess the subsurface chemistry (e.g. redox state). Additionally, the sampling point will be screened for VOCs via Photoionization Detector (PID). A summary of soil vapor and sub-slab vapor samples and analysis is presented in Table 1.

5.1.4. Indoor and Ambient Air Samples

Indoor and ambient air samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP. The indoor air samples will be collected at co-located sub-slab vapor sample locations along with a simultaneous ambient air sample outside of the building. A summary of indoor and ambient air samples and analysis is presented in Table 1**.**

5.1.5. Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled, transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks (if non-dedicated sampling equipment is used), trip blanks, field duplicates and MS/MSDs. The quantity, field QC sample type and analysis with holding times and preservation types are detailed in Table 2.

Equipment Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment which may cause sample contamination. Non-dedicated field equipment will be decontaminated as specified below in Section 5.3.

Equipment blanks will only be collected for all analyses (except PFAS) if non-dedicated sampling equipment is used, at a frequency of one per 20 samples, per matrix. If PFAS analysis is requested/intended, then equipment blank samples are to be submitted to the laboratory at a frequency of at least one per day per matrix, and a minimum of one per 20 samples.

Equipment blanks will be collected by routing the distilled and PFAS-free water through a decontaminated piece of sampling equipment or disposable sampling equipment (for PFAS only) into laboratory supplied bottles.

Trip Blank Samples will consist of analyte-free water and will be prepared by the laboratory. Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler which contains soil and/or groundwater samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted from the same interval using the same sample procedures. Field duplicates will be used to assess sampling and analytical reproducibility. Both samples are collected utilizing the same methods and are submitted for the same laboratory analysis, however, different sample identification numbers are used. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix

spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one per 20 investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to Table 2 for a summary of QC sample preservation and container requirements.

5.2. Sample Preservation and Containerization

The analytical laboratory will supply sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest US EPA's *Specifications and Guidance for Contaminant-Free Sample Containers* (US EPA, 1992). Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to US EPA specifications. The containers will be pre-preserved, where appropriate. Sample preservation and containerization details are outlined in Table 2.

5.3. Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface.
- Tap water rinse.
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture.
- Tap water rinse.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

6. Documentation and Chain of Custody (COC)

6.1. Sample Collection Documentation

6.1.1. *Field Notes*

Field notes documenting field activities will be maintained in a field notebook in general accordance with the FSP. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

6.1.2. *COC Records*

Sample custody is discussed in detail below in Section 6.2. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include:

- The project name
- Signature(s) of sampler(s) responsible for sample custody
- Sample ID number
- Date and time of collection
- Whether the sample is grab or composite
- Names of individuals involved in sampling
- Air bill or other shipping number (if applicable)

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in Section 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in Section 6.2.2 of this Plan.

6.1.3. *Sample Labeling*

Each sample will be labeled with a pre-printed adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, analyses to be performed, preservative (if applicable), and a unique identification. The following identification scheme will be used:

Table 6-1. Sample Labeling

PRIMARY SAMPLE TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES	**EQUIPMENT BLANKS**
Boring-ID (SAMPLE DEPTH-FEET)	SAMPLE-ID [DATE]
SB-01 (10-15)	EB-20251010
GROUNDWATER SAMPLES	**MATRIX SPIKE/DUP**
Monitoring Well-ID	SAMPLE-ID [DEPTH] [EITHER MS OR MSD]
MW-01S	SS-01 (10-15) MS/MSD
SOIL VAPOR SAMPLES	**TRIP BLANKS**
Soil Vapor Point-ID	SAMPLE-ID [DATE]
SV-01	TB-20251010
INDOOR AIR SAMPLES	**FIELD/BLIND DUPLICATES**
Indoor Air Location-ID	SAMPLE-ID [DATE]
IA-01	DUP-20251010

The sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the Project QA Officer.

6.1.4. Sample Handling

Samples will be handled in general accordance with the FSP.

6.2. Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is considered to be under a person's custody if:

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person
- The item was in the actual physical possession of the person but is locked up to prevent tampering
- The item is in a designated and identified secure area

6.2.1. Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the FSP. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in Section 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented above in Section 6.1.3.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and provided to the Data Manager and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the

laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2. Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact.
- Examine all sample containers for damage.
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records.
- Compare samples received against those listed on the COC.
- Verify that sample holding times have not been exceeded.
- Examine all shipping records for accuracy and completeness.
- Determine sample pH (if applicable) and record on COC forms.
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill.
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory Project Manager (PM), who will be responsible for contacting the GEI Data Manager.
- Attach laboratory sample container labels with unique laboratory identification and test.
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The completed COC, air bills, and any additional documentation will be placed in the project file.

7. Calibration Procedure

7.1. Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily. If concentrations of VOCs are encountered above the reference gas standard, the soil screening PID may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment may be used during sampling activities.

Subsurface Soil Sampling Activities:

- RAE Systems MiniRAE 3000 (PID) with 10.6 eV lamp or equivalent.

Groundwater Sampling Activities:

- Horiba U-52 Multiparameter Water Quality Meter or equivalent.
- Solinst 122 Oil/Water Interface Probe or equivalent.
- Solinst Peristaltic Pump or equivalent.

Soil Vapor Sampling Activities:

- RAE Systems MiniRAE 3000 (PID) with 10.6 eV lamp or equivalent.
- Landtec GEM5000 Gas Analyzer or equivalent.
- MGD-2002 Helium Leak Detector or equivalent.

Community Air Monitoring Activities:

- TSI DUSTTRAK II Desktop 8530 Dust/Aerosol Monitor or equivalent.
- RAE Systems MultiRAE IR Plus with PID Gas Monitor or equivalent.

7.2. Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration.

The laboratory quality plan for Eurofins is located in Appendix A.

8. Sample Preparation and Analytical Procedures

Analytical samples will be collected in general accordance with the FSP and as specified in the RIWP. Table 1 provides a summary of sample collection matrices for soil, groundwater, soil vapor, and indoor air.

9. Data Reduction and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Data Management will be performed under the direction of Jaimie Wargo, Data Group Coordinator – Data Management.

9.1. Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed, and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the Field Team Leader and PM will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSP and RIWP, and that any deviations were documented and approved by the appropriate personnel.

9.2. Analytical Data

Laboratory deliverables will consist of an electronic data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements. All data generated as part of the remedial investigation (RI) will be submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. Data Usability Summary Reports (DUSRs) will be prepared for all soil, groundwater, indoor air and soil vapor samples. The review of the RIWP laboratory data will be performed by Environmental Data Services, Ltd. (EDS), a third-party environmental data validation firm (resume included in Appendix C).

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives. At a minimum, this will include:

- MS and/or MSD samples
- Matrix duplicate analyses
- Laboratory control spike samples
- Instrument calibrations
- Instrument tunes for VOC 8260B analyses
- Method and/or instrument blanks
- Surrogate spikes for organic analyses
- Internal standard spikes for VOC 8260B analyses
- Detection limit determination and confirmation by analysis of low-level calibration standard

Field quality control samples, as identified in Table 2, will include:

- Equipment blanks as outlined
- Field duplicate samples as outlined
- Trip blanks as outlined
- MS/MSDs as outlined

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of known and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA Officer, PM, Program Manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA Officer is the interface between management and project activities in matters of project quality. The QA Officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance of rented field equipment will be provided by Pine Environmental Services.

Laboratory equipment calibration and maintenance procedures are specified in Eurofins' laboratory quality assurance manual provided in Appendix A.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1. Detection Limits

13.1.1. Method Detection Limit

The MDL is defined as follows for all measurements:

MDL = (t[n-1,1-a=0.99]) x (s)

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The RL is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$RL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)} x \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)} x\ DF\ x \frac{100}{(100 - \%M)}$$

where: DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio

%M = percent moisture for solid samples.

13.2. Precision

Variability will be expressed in terms of the RPD when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger Value - Smaller Value)}{[(Larger Value + Smaller Value)/2]} x\,100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ \ RSD = \frac{Standard\ \ Deviation}{Mean}\ x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation

y_i = measured value of the ith replicate

y = mean of replicate measurements

n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

D = |first measurement - second measurement|

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3. Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\% \ Recovery = \frac{Css - Cus}{Csa} X \ 100\%$$

where: Css = measured concentration in spiked sample

Cus = measured concentration in unspiked sample

Csa = known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$Bias = pH_m - pH_t$

where: pH_m = measured pH

pH_t = the true pH of the standard reference sample

13.4. Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level} x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. It is anticipated that 95 percent of the data will be complete. Data validation criteria discussed in Section 9 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5. Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the FSP and RIWP.

13.6. Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA Officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA Officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection, laboratory analysis, and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the RIWP and FSP. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1. Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations other than those specified in the RIWP), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA Officer. The PM and QA Officer will approve the corrective measure. The Field Team Leader and Program Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action
- The action taken in response
- The final resolution
- Any necessary approvals

Corrective action in the laboratory will be completed in accordance with the quality assurance procedures located in Appendix A. Any corrective actions completed by the laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

15. References

NYSDEC (2005). Analytical Service Protocol. New York: Department of Environmental Conservation, Division of Water, July.

NYSDEC (2010). DER Technical Guidance for Site Investigation and Remediation. DER-10. New York: Department of Environmental Conservation, Division of Environmental Remediation, May.

NYSDEC (2023). Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs. New York: Department of Environmental Conservation, April.

US EPA (1992). Specifications and Guidance for Contaminant-Free Sample Containers. District of Columbia: United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, December 1992.

US EPA (2002). Guidance for Quality Assurance Project Plans EPA QA/G-5. District of Columbia: United States Environmental Protection Agency, Office of Environmental Information, December.

Tables

Table 1. Summary of Samples and Analysis

Table 2. Analytical Methods/Quality Assurance Summary Table

Table 1. Summary of Samples and Analysis
600 Food Center Drive (BCP Site No. C203104)
Remedial Investigation Work Plan
Bronx, New York

			Field Samples (a)				QC Blanks		
Matrix	**Parameter**	**Analytical Method**	**Field Samples**	**Field Duplicate (a)**	**MS/MSD (Total) (a)**	**Sub-Total**	**Trip Blank (b)**	**Equipment Blank (c)**	**Total**
Soil Samples	TCL VOCs	EPA 8260D	145	8	8/8	169	25	8	202
	TCL SVOCs	EPA 8270E	145	8	8/8	169	0	8	177
	TAL Metals	EPA 6020B/7471B	145	8	8/8	169	0	8	177
	Tri & Hex Chromium	EPA 7196A	145	8	8/8	169	0	8	177
	Total Cyanide	EPA 9012B	145	8	8/8	169	0	8	177
	PCBs	EPA 8082A	145	8	8/8	169	0	8	177
	Pesticides	EPA 8081B	145	8	8/8	169	0	8	177
	1,4-Dioxane	EPA 8270E SIM	145	8	8/8	169	0	8	177
	PFAS	EPA 1633A	145	8	8/8	169	0	25	194
Groundwater Samples	TCL VOCs	EPA 8260D	11	1	1/1	14	4	1	19
	TCL SVOCs	EPA 8270E	11	1	1/1	14	0	1	15
	TAL Metals	EPA 6020B/7470A	11	1	1/1	14	0	1	15
	Tri & Hex Chromium	EPA 7196A	11	1	1/1	14	0	1	15
	Total Cyanide	EPA 9012B	11	1	1/1	14	0	1	15
	PCBs	EPA 8082A	11	1	1/1	14	0	1	15
	Pesticides	EPA 8081B	11	1	1/1	14	0	1	15
	1,4-Dioxane	EPA 8270E SIM	11	1	1/1	14	0	1	15
	PFAS	EPA 1633A	11	1	1/1	14	0	4	18
Soil Vapor/ Sub-Slab Vapor	VOCs, BTEX, Naphthalene	EPA TO-15	15	1	0	16	0	0	16
Indoor & Ambient Air	VOCs, BTEX, Naphthalene	EPA TO-15	8	1	0	9	0	0	9

Samples will be analyzed in accordance with the Field Sampling Plan
(a) - Field Duplicate, Matrix Spike and Matrix Spike Duplicates collected at a rate of one each for every 20 samples.
(b) - Trip blanks will be submitted for each cooler containing samples to be analyzed for VOCs. This may result in a different quantity of trip blanks than the number presented here.
(c) - Equipment blanks for all analyses (except PFAS) will only be collected if non-dedicated sampling equipment is used at a rate of one each for every 20 samples.
Equipment blanks for PFAS will be collected per day per matrix for dedicated and non-dedicated/decontaminated equipment).
(d) - TBD - To be determined. The number of free product samples collected for analysis (if any) will be determined in the field
BTEX - Benzene, Toluene, Ethylbenzene, and Xylene
VOCs - Volatile Organic Compounds
SVOCs - Semi-Volatile Organic Compounds
PCBs - Polychlorinated Biphenyls
TCL - Total Compound List
TAL - Target Analyte List
PFAS - Per- and Polyfluoroalkyl Substances
EPA - United States Environmental Protection Agency

Table 2. Analytical Methods/Quality Assurance Summary Table
600 Food Center Drive (BCP Site No. C203104)
Remedial Investigation Work Plan
Bronx, New York

Media	Number of Proposed Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	EPA Method	Preservative	Holding Time	Container*
		DUP	MS/MSD	EB**	TB						
Soil	145	1/20	1/20	1/20	1/Cooler (est. 25)	202	TCL VOCs	8260D	Cool to 4°C	48 hours to lab prep, then 14 days preserved	(3) 40-mL vials (2 with stir bars) or (3) 5-gram Encores
	145	1/20	1/20	1/20	NA	177	TCL SVOCs	8270E	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/20	NA	177	TAL Metals	6020B/7471B	Cool to 4°C	28 days for mercury; 6 months for other metals	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/20	NA	177	Trivalent & Hexavalent Chromium	7196A	Cool to 4°C	30 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/20	NA	177	Cyanide	9012B	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/20	NA	177	PCBs	8082A	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/20	NA	177	Pesticides	8081B	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/21	1/20	NA	177	1,4 Dioxane	8270E SIM	Cool to 4°C	7 days	(1) Wide mouth 4-oz. clear glass jar
	145	1/20	1/20	1/day (est. 25)	NA	194	PFAS	1633A	Cool to 4°C	14 days until extraction, 28 days after extraction	(1) 4-oz. HDPE or polypropylene containers
Groundwater	11	1/20	1/20	1/20	1/Cooler (est. 4)	19	TCL VOCs	8260D	pH<2 with HCl, Cool to 4°C	14 days	(3) 40-mL VOA vials w/HCL
	11	1/20	1/20	1/20	NA	15	TCL SVOCs	8270E	Cool to 4°C	7 days	(1) 1-liter amber glass
	11	1/20	1/20	1/20	NA	15	TAL Metals	6020B/7470A	pH<2 with HNO3 Cool to 4°C	28 days for mercury; 6 months for other metals	(1) 250-mL HDPE container w/HNO3
	11	1/20	1/20	1/20	NA	15	Trivalent & Hexavalent Chromium	7196A	Cool to 4°C	24 hours	(1) 250-mL HDPE container
	11	1/20	1/20	1/20	NA	15	Cyanide (total)	9012B	NaOH, Cool to 4°C	14 days	(1) 250-mL HDPE container w/NaOH
	11	1/20	1/20	1/20	NA	15	PCBs	8082A	Cool to 4°C	7 days until extraction, 40 days after extraction	(1) 1-liter amber glass
	11	1/20	1/20	1/20	NA	15	Pesticides	8081B	Cool to 4°C	7 days	(1-2) 1-liter amber glass
	11	1/20	1/20	1/20	NA	15	1,4 Dioxane	8270E SIM	Cool to 4°C	7 days	(1) 1-liter amber glass
	11	1/20	1/20	1/day (est. 4)	NA	18	PFAS	1633A	Cool to 4°C	14 days until extraction, 28 days after extraction	(1-2) 250-mL HDPE or polypropylene containers
Soil Vapor/ Sub-Slab Vapor	15	1	NA	NA	NA	16	VOCs, BTEX, Naphthalene	TO-15	None	30 Days	(1) 1-liter, stainless-steel SUMMA canister
Indoor & Ambient Air	8	1	NA	NA	NA	9	VOCs, BTEX, Naphthalene	TO-15	None	30 Days	(1) 6-liter, stainless-steel SUMMA canister

Notes:
*Sample volume required dependent on laboratory
**Equipment blanks for all analyses (except PFAS) will only be collected if non-dedicated sampling equipment is used.
Equipment blanks for PFAS will be collected per day per matrix for dedicated and non-dedicated/decontaminated equipment).

BTEX - Benzene, Toluene, Ethylbenzene, and Xylene
VOCs - Volatile organic compounds
SVOCs - Semivolatile organic compounds
PCBs - Polychlorinated Biphenyls
PFAS - Per-and Polyfluoroalkyl Substances
TCL - Target Compound List
TAL - Target Analyte List
EPA - United States Environmental Protection Agency
°C - Degrees Celsius
L - Liter
oz. - Ounce
mL - Milliliter
TBD - To be Determined
HDPE - High-density polyethylene

Appendix A Eurofins Quality Assurance Manual

eurofins	Always check on-line for validity. **Environmental Quality Policy Manual**	Level: **Quality Manual**
Document number: **QA-QM11872**		
Old Reference: **1-P-QM-GDL-9015377; DOD - EQPM**		
Version: **22**		Organisation level: **5-Sub-BU**
Approved by: **UKL3** Effective Date: **07-JAN-2025**	Document users: **4_EUUSLA_ELLE_All_Support, 4_EUUSLA_ELLE_All_Technical**	Responsible: **5_EUUSLA_Env Quality Assurance_All**

This documentation has been prepared by Eurofins Lancaster Laboratories Environment Testing, LLC and its affiliates ("Eurofins"), solely for their own use. The user of this document agrees by its acceptance to return it to Eurofins upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

THIS DOCUMENT CONTAINS VALUABLE CONFIDENTIAL AND PROPRIETARY INFORMATION. DISCLOSURE, USE OR REPRODUCTION OF THESE MATERIALS WITHOUT THE WRITTEN AUTHORIZATION OF EUROFINS IS STRICTLY PROHIBITED. THIS UNPUBLISHED WORK BY EUROFINS IS PROTECTED BY STATE AND FEDERAL LAW OF THE UNITED STATES.

Title Page
Revision Log
1) INTRODUCTION
- 1.1) Mission Statement
- 1.2) Quality Policy Statement
- 1.3) Value Statement
- 1.4) Scope
- 1.5) Company History

2) MANAGEMENT REQUIREMENTS
- 2.1) Organizational Structure
- 2.2) Roles and Responsibilities
  - 2.2.1) Business Unit Manager (BUMA)
  - 2.2.2) Technical Director - Laboratory Certifications
  - 2.2.3) Quality Assurance Manager
  - 2.2.4) Quality Assurance Department
  - 2.2.5) Director - of Inorganics, Organics, and Specialty Departments
  - 2.2.6) Technical Managers
  - 2.2.7) Client Services/Project Management Department
- 2.3) Business Continuity and Contingency Plans

3) PERSONNEL
- 3.1) Personnel Qualifications and Responsibilities
- 3.2) Personnel Training
- 3.3) Business Conduct

4) BUILDING, FACILITIES, AND ENVIRONMENTAL CONDITIONS
- 4.1) Physical Facilities
- 4.2) Environmental Monitoring
  - 4.2.1) Water Systems
  - 4.2.2) Housekeeping/Cleaning
  - 4.2.3) Insect & Rodent Control
  - 4.2.4) Facility Changes
  - 4.2.5) Labware Cleaning
- 4.3) Employee Safety
- 4.4) Emergencies
- 4.5) Security and Building Access
- 4.6) Computer System Security and Access
  - 4.6.1) Passwords
  - 4.6.2) Viruses
  - 4.6.3) Software Policy

5) QUALITY SYSTEM
- 5.1) Quality System Overview

5.2) Ethics and Data Integrity
5.3) Quality System Documents
5.3.1) Level 1 - Quality Policy Manual and Company Policies
5.3.2) Level 2 - Standard Operating Procedures
5.3.3) Level 3 - Work Instructions (at a department level)
5.3.4) Level 4 - Quality Records
5.4) Overview of the Quality Assurance Program
5.5) Quality Control Charts for Quality Indicators
5.6) Statistical Quality Control
5.7) Quality Metrics
6) DOCUMENT CONTROL
6.1) Overview
6.2) Document Approval, Issue, Control, and Maintenance
6.3) Client-Supplied Methods and Documentation
6.4) Control of External Documents
7) SERVICE TO CLIENTS
7.1) Overview
7.2) Review of Work Requests, Tenders, and Contracts
7.3) Balancing Laboratory Capacity and Workload
7.4) Communication and Documentation
7.5) Client Feedback
8) SUBCONTRACTING
8.1) Overview
8.2) Qualifying and Monitoring Subcontractors
8.3) Responsibilties
8.4) Use of NELAP and A2LA Logo
9) PURCHASING SERVICES AND SUPPLIES
9.1) Supplier Evaluation
9.2) Procurement
10) COMPLAINTS
10.1) Receipt and Investigation of Complaints
11) CONTROL OF NON-CONFORMING WORK
11.1) Evaluation of Significance and Actions Taken
11.2) Responsibilities
11.3) Prevention of Nonconforming Work
12) CORRECTIVE ACTION
12.1) Investigation Process
12.2) Root Cause Analysis
13) PREVENTATIVE ACTION AND RISK ASSESSMENT
13.1) Preventative Actions
13.2) Change Control
14) CONTROL OF RECORDS
14.1) Data Documentation Requirements
14.1.2) Laboratory Notebooks, Logbooks, and Forms
14.1.2) Electronic Data
14.2) Data Storage, Security, and Archival
14.2.1) Computer System Backup, Data Restoration, and Data Archival
15) AUDITS
15.1) Internal Audits
15.2) Client Audits
15.2.1) Confidentiality
15.3) Agency Inspections
15.4) Proficiency Testing
15.5) Good Laboratory Practice Critical Phase Inspections
16) MANAGEMENT SYSTEM REVIEW
16.1) Quality Reports
16.2) Annual Management Review
17) TEST METHODS AND METHOD VALIDATION
17.1) Scope of Testing
17.2) Analytical Test Methods
17.2.1) Procedural Deviation

17.2.2) Client Supplied Methods
17.3) Method Validation
17.4) Reporting Limits
17.5) Measurement Uncertainty
18) EQUIPMENT AND CALIBRATIONS
18.1) Laboratory Equipment Requirements
18.2) Calibration
18.3) Maintenance
19) MEASUREMENT TRACEABILITY
19.1) Reference Standards and Materials
19.2) Calibration Standards
20) SAMPLING
20.1) Sample Collection
20.2) Sampling Instructions
20.3) Sample Containers
21) SAMPLE HANDLING
21.1) Chain of Custody
21.1.1) Legal Chain of Custody
21.2) Sample Receipt
21.2.1) Sample Acceptance / Rejection Policy
21.2.2) Sample Preservation Check
21.3) Sample Entry
21.4) Sample Identification and Tracking
21.5) Sample Storage
21.6) Representativeness of Samples
21.7) Sample Return/Disposal
22) ASSURING THE QUALITY OF TEST RESULTS
22.1) Ongoing Evaluation of Data Quality
22.2) Reagents and Solvents
22.3) Laboratory Quality Control Samples and Acceptance Criteria
22.3.1) Quality Control Sample Frequency and Corrective Action
22.4) Negative Controls
22.4.1) Method Blanks (MB)
22.4.2) Instrument Blanks
22.4.3) Trip and Field Reagent Blanks
22.4.4) Storage Blanks
22.5) Positive Controls
22.5.1) Laboratory Control Samples (LCS)
22.5.2) Second Source Check
22.5.3) Duplicates, Matrix Spike Duplicates and Laboratory Control Sample Duplicates (DU, MSD, LCSD)
22.6) Sample Matrix Controls
22.6.1) Matrix Spikes (MS)
22.6.2) Surrogates
22.6.3) Internal Standards
23) REPORTING RESULTS
23.1) Sample and Data Flow
23.1.1) Identification of Approved Signatories
23.1.2) Timely Delivery
23.2) Data Reporting
23.2.1) Safe Drinking Water Regulatory Compliance Reporting (SDWA)
23.3) Data Calculations
23.4) Data Review
23.5) Data Qualification
23.6) Client and Data Confidentiality

Title Page

Environmental Quality Policy Manual

Eurofins Lancaster Laboratories Environment Testing, LLC (ELLE)

2425 New Holland Pike
Lancaster, PA, 17601
Phone: 717-656-2300
Fax: 717-656-2681

Reviewed and Approved by:
President
Vice President (BUMA)
Technical Director
Quality Assurance Manager
(as recorded in the electronic document control system)

Revision Log

	Revision: 22	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Section 7.5	Current Process	Updated client feedback process.
Section 14.1.2	Current Process	Updated requirements for tracking software and firmware version.
Section 14.2	Requirement	DOE-requirement for written approval before destruction of records.
Section 20.2	Clarification	Sampling instructions are made available upon request.
Section 23.2.1	Current Process	Added 'Compliance' designation in LIMS for SDWA work.

	Revision: 21	**Effective date:** 12-JAN-2024
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Section 1.1 and 1.3	Current Process	Removed remaining reference to "biological" testing
Section 2.1	Clarification	Updated Lab Director/Ops Director to Business Unit Manager.
Section 2.2	Clarification	Updated sub sections to separate the Technical Director and the Business Unit Manager, and re-numbered sub sections.
Section 3	Current Process	Updated section to include current title names
Section 4.2.1	Clarification	Added daily monitoring and annual calibration of meters.
Section 8.1	Clarification	Subcontract laboratories are external to Eurofins. Client approval is only required in some cases, while notification of subcontracting is always required.
Section 12.1 and 12.2	Current Process	Removed Jira terminology
Section 14.2	Clarification	Standard raw data retention time is 10 years
Section 19.1	Clarification	Added calibration schedule for Class 1 Weights from QA-SOP11880.
Section 23.2.1	Clarification	Added summary of QA-SOP11886

1) INTRODUCTION

This *Environmental Quality Policy Manual*, or EQPM, is based upon Eurofins Lancaster Laboratories Environment Testing, LLC's, (herein referred to as the laboratory) overall business and management philosophies, mission, and goals. This manual is written to present the policies employed by the laboratory as well as the support departments that serve the environmental laboratories and to comply with the requirements of the National Environmental Laboratory Accreditation Program (also referred to as NELAP or TNI), ISO 17025, the Department of Defense (DoD), Quebec Accreditation Program for Analytical Laboratories (PALA) as well as individual state agency requirements. These policies define the "what" we do with emphasis on management's responsibilities and commitment to quality.

Governing SOPs are in place within the organization to ensure the proper execution of this policy document (refer to *Appendix A*). This manual is required reading for laboratory personnel. The most recent and up-to-date EQPM and all referenced documents are available to all laboratory personnel who work in or support the laboratory. As described within this document, the laboratory actively strives for continuous improvement of its quality systems to better serve our clients.

1.1) Mission Statement

The laboratory offers analytical and consulting services in the chemical sciences with comprehensive expertise in environmental laboratory applications. The company mission statement describes the corporate philosophy:

At Eurofins Lancaster Laboratories Environment Testing, LLC, we are people working together to serve the health and environmental needs of society through science and technology. We strive to be the recognized leader in all that we do.

Our mission is to provide independent laboratory services in the chemical sciences with excellent quality and service. As a corporate community, we:

- Deliver quality by fully understanding and always meeting the requirements of those we serve.
- Live our values by relating to our clients, coworkers, shareholders, suppliers, and community in a fair and ethical manner.
- Manage our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders, and maintain our meaningful and enriching workplace.

1.2) Quality Policy Statement

The Executive Management Group recognizes quality as a key element of the laboratory's standard of service. The group supports the laboratory's commitment to quality as defined by NELAP, ISO 17025, DoD, PALA and other regulatory agencies (i.e. states) through the strict adherence to the Quality Policy Statement. The policy cannot be revised without the approval of Eurofins National Business Line Service Center (NBLSC) QA Directors.

The Quality Policy Statement gives employees clear requirements for the production of analytical data. Employees are trained on the components of the Quality Policy Statement during their first day of orientation. Each employee signs the statement upon hire as agreement to implement the policy in all aspects of their work. Employee agreement to any subsequent revisions of the statement is obtained by documented reading and understanding of an agreement to follow the Quality Manual, which contains the current version of the statement. The statement is as follows:

As an organization, all personnel are committed to high quality professional practice, testing and data, and service to our clients.

We strive to provide the highest quality data achievable by:

- Reading and understanding all of the quality documents applicable to each position and implementing the process in our work.
- Following all recordkeeping requirements; describing clearly and accurately all activities performed; recording "real time" as the task is carried out; understanding that it is never acceptable to "back date" entries and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Ensuring data integrity through the completeness, consistency, impartiality and accuracy of the data generated. Data is attributable, legible, contemporaneously recorded, original or a true copy, and accurate (ALCOA). This applies to manual paper documentation and electronic records.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/qualification/validation, analysis, and reporting; establishing an audit trail (the who, what, when, and why) that identifies date, time, analyst, instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.
- Emphasizing a total quality management process which provides impartiality, accuracy, and strict compliance with agency regulations and client requirements, giving the highest degree of confidence; understanding that meeting the requirements of the next employee in the work flow process is just as important as meeting the needs of the external client.
- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications, but is still of use to the client; understanding this occurs only after discussion with the client on the data limitations and acceptability of this approach.

- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems, with investigation and applicable corrective action; documenting these activities completely, including the reasons for the decisions made.

- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expression of concerns on quality issues to management. Eurofins recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff

- Continually improve systems and manage risk to support quality improvement efforts in laboratory, administrative and managerial activities

- We each take personal responsibility to provide this quality product while meeting the company's high standards of integrity and ethics, understanding that improprieties, such as failure to conduct the required test, manipulation of test procedures or data, or inaccurate documentation will not be tolerated. Intentional misrepresentation of the activities performed is considered fraud and is grounds for termination.

I understand the expectations and commit to implementation of all applicable policies and procedures and to providing quality data.

1.3) Value Statement

Eurofins Lancaster Laboratories Environment Testing, LLC, is a team of people who work together to serve the health and environmental needs of society through science and technology.

At Eurofins Lancaster Laboratories Environment Testing, our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. We fulfill our mission by incorporating our values into our work every day.

As a corporate community, we embrace our heritage of integrity and strive to live by the following principles:

- Fairness and honesty in all our relationships

- Mutual trust

- A respect for ourselves and others

- A sense of caring that leads us to act responsibly toward each other and society, now and in the future

- Loyalty to our clients and one another

- A spirit of open-mindedness as we deal with all

- Dedication to service

- Good stewardship of our resources

- A commitment to flexibility and continuous improvement

We are committed to:

- Delivering quality by fully understanding and always meeting the requirements of those we serve.

- Living our values by relating to our clients, coworkers, shareholders, suppliers and community in a fair and ethical manner.

- Managing our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders and maintain our meaningful and enriching workplace.

At Eurofins Lancaster Laboratories Environment Testing, LLC, we each take personal responsibility to live these values in all of our dealings, knowing full well that our pledge may involve difficult choices, hard work, and courage.

1.4) Scope

The laboratory analyzes a broad range of environmental and industrial samples. Sample matrices vary among air, drinking water, waste water, soil, hazardous waste, tissues, and wipes. The QA Program contains specific procedures and methods to test samples of differing matrices for chemical and physical parameters.
The QA Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients, and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The approach of the EQPM is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs), or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory President, Laboratory Vice-President, Director of Operations, Laboratory Director and/or Business Unit Manager, and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory President, Director of Operations, Laboratory Director and/or Business Unit Manager and the QA Manager must determine if it is in the lab’s best interest to follow the less stringent requirements.

1.5) Company History

The laboratory was founded in 1961 by Dr. Earl Hess in response to a need for high quality technical services by the agricultural and industrial communities in southeastern Pennsylvania. Nourished in a culture of quality and caring about all those associated with the business, the corporation became an industry leader known for innovative business practices and people-friendly policies. The company was independently owned until the retirement of Dr. Hess in 1995. At that time, the laboratory was acquired by a publicly held company, Thermo TerraTech, Inc., a Thermo Electron company. Ownership changed in September 2000 when the laboratory was acquired by Goldner, Hawn, Johnson, and Morrison, Inc. (GHJ&M), a private equity investment firm. In August 2005, the laboratory was acquired by Fisher Scientific under their BioPharma Division. On November 9, 2006, Thermo Electron and Fisher Scientific merged to form Thermo Fisher Scientific. In April 2011, Thermo Fisher Scientific sold the laboratory to Eurofins Scientific. In July 2013, the Pharmaceutical and Environmental Divisions were split into separate business entities and the company name became Eurofins Lancaster Laboratories Environmental, LLC. In November 2018, Eurofins Scientific acquired TestAmerica, adding a network of laboratories across the United States. In January 2022, the company's legal name was changed to Eurofins Lancaster Laboratories Environment Testing, LLC, a holding of Eurofins Environment Testing America Holdings, Inc. The laboratory continues to operate as an independent laboratory and is incorporated by the State of Delaware.

2) MANAGEMENT REQUIREMENTS

2.1) Organizational Structure

Although the laboratory is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and Quality Systems operations described in this manual are specific to the Lancaster Business Unit and associated service centers. The Lancaster Business Unit is an individual entity, which can be held legally responsible for providing accurate laboratory testing and results. The laboratory President, in conjunction with the Business Unit Manager and senior management staff, is responsible for the daily operations of the laboratory. Duane Luckenbill is designated as the laboratory's Technical Director relative to accreditations. The laboratory management staff includes directors, managers and group leaders. Organizational charts of the management staff are presented in *Appendix C*. Individual departmental staff lists are maintained in the company's internal intranet.

2.2) Roles and Responsibilities

In order for the QA Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The responsibility for quality resides with every employee of the laboratory. All employees have access to the QA Manual, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks impartially and in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs.

Deputies temporarily fill a role if the primary employee is absent for more than 15 consecutive calendar days. The Technical Director and Quality Assurance (QA) Manager have identified deputies for all key management personnel. The deputies must meet the same qualifications as the primary person should they be required to take on the responsibilities. Notification to agencies is performed by QA.

See Section 3 for the requirements for personnel qualifications, training, and business conduct.

2.2.1) Business Unit Manager (BUMA)

The Business Unit Manager (BUMa) is responsible for the laboratory budget and operations. The BUMa supervises all laboratory personnel and provides leadership and direction as needed. The BUMa ensures compliance and integration of the laboratory operation with both corporate and regulatory policies and procedures.

2.2.2) Technical Director - Laboratory Certifications

The Technical Director ensures that the laboratory's policies and objectives for quality of testing services are documented in this quality manual. The Technical Director must assure that the manual is communicated to, understood, and implemented by all personnel and reports directly to the Business Unit President. The Technical Director must have the regulatory requirements for chemistry education credits, and is authorized to certify the laboratory during certifications applications, renewal, and their name may appear on the laboratory's Certificates or Scopes of Accreditation.

2.2.3) Quality Assurance Manager

The Quality Assurance Manager ensures that the quality system is followed at all times. The QA Manager reports directly to the President thus ensuring corrective actions to quality issues are taken promptly and are separate from business decisions. The QA Manager has no direct supervisory responsibility for the generation of technical data to avoid any conflict of interest in administrating the QA program. The QA Manager has the final authority to stop work that compromises our integrity or data quality. The situation must be investigated and appropriate corrective action must be put in place before the QA Manager will authorize the resumption of work. The specific duties of the QA Manager are communicated in the position qualification description (PQD) and include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Have functions independent from laboratory operations for which he/she has quality assurance oversight.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QA Manual or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.

- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Review of external audit reports and data validation requests.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Have a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).

2.2.4) Quality Assurance Department

The QA Manager assigns tasks with input from the company President. The primary responsibilities of QA include, but are not limited to the following:

- Oversee the laboratories' internal audit program which consists of various audit types and applies to all laboratory activities (technical and administrative).
- Review and approve standard operating procedures and analytical methods.
- Review and approve validation documentation.
- Review non-conforming quality control data.
- Perform tracking and trending of quality measurements and report the status, effectiveness, and potential risk areas of the quality system to management.
- Review and approve investigation and corrective action reports (ICARs) and audit responses to ensure that they are completed in a timely manner, evaluated for root cause, that corrective actions are implemented as needed and to monitor corrective action for effectiveness.
- Host client and regulatory agencies during facility audits and follow-up to any cited deficiencies.
- Provide regulatory guidance to the laboratory and support areas.
- Communicate quality issues to management in a timely manner.
- Provide and/or coordinate on-going regulatory training (e.g., Ethics).
- Participate in the vendor and supplier approval process, including subcontractors.
- Review analytical data for compliance with our procedures.
- Prepare and review QA project plans (QAPPs) as required by EPA and client projects.
- Maintain and update this EQPM.
- Maintenance of the Laboratory's accreditations, including but not limited to, administration of the proficiency test sample programs.
- Communication to the relevant regulatory authorities is required when there are management or facility changes that impact the laboratory. Changes in the technical director must be communicated within a period of time and in the manner dictated by each regulatory authority.

2.2.5) Director - of Inorganics, Organics, and Specialty Departments

Director duties are outlined for supervisory personnel using a job plan format, which details each individual's responsibilities along with expected results. Directors report to the BUMa. Typically, management duties include, but are not limited to:

- Ensure that the quality policy and program is understood, implemented, and maintained for their technical departments
- Ensuring compliance with applicable laboratory SOPs, the TNI Standards, ISO 17025, Department of Defense Quality Systems Manual, regulatory programs, analytical methods, and client requirements.
- Assessing laboratory capacity and workload; ensuring holding times are met and any issues communicated to clients.
- Resource allocation.
- Ensuring quality of data produced.
- Contributing to the continuous improvement of the laboratory operation.
- Ensuring that corrective actions are carried out in an appropriate and agreed upon time-frame.
- Communicating problems, risks, and concerns to Senior and Executive Management to enlist a higher level of support for corrections and continuous improvements.
- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to department Managers in resolving problems in conjunction with the Laboratory Director and/or QA Manager. Each is responsible for data review and documentation, non-conformances, the timely and accurate completion of performance evaluation samples and MDLs, for departments that report to them.
- Maintaining awareness of technical developments and regulatory requirements.

2.2.6) Technical Managers

Laboratory management duties are outlined for supervisory personnel using a job plan format, which details each individual's responsibilities along with expected results. Department management report to a Director. Typically, management duties include, but are not limited to:

- Personnel hiring and training.
- Supervision of personnel.
- Providing resources to ensure a work environment free from commercial, financial, and other undue pressures that may adversely affect the quality of their work.
- Providing resources to ensure a safe work environment.
- Directing daily work operations, including scheduling of work.
- Ensuring compliance with applicable laboratory SOPs, the TNI Standards, ISO 17025, Department of Defense Quality Systems Manual, regulatory programs, analytical methods, and client requirements.
- Assessing laboratory capacity and workload; ensuring holding times are met and any issues communicated to clients
- Resource allocation.
- Ensuring quality of data produced.
- Contributing to the continuous improvement of the laboratory operation.
- Ensuring that corrective actions are carried out in an appropriate and agreed upon time-frame.

- Communicating problems, risks, and concerns to Senior and Executive Management to enlist a higher level of support for corrections and continuous improvements.
- Encourage the development of analysts to become cross-trained in various methods and/or operate multiple instruments efficiently while performing maintenance and documentation, self-supervise, and function as a department team.
- Provide guidance to analysts in resolving problems encountered daily during sample prep/analysis in conjunction with the Technical Manager, Operations Manager, and/or QA Manager. Each is responsible for 100% of the data review and documentation, non-conformances, the timely and accurate completion of performance evaluation samples and MDLs, for his department.
- Develop, implement, and enhance calibration programs.
- Ensure all logbooks are maintained, current, and properly labeled or archived.
- Ensure that preventive maintenance is performed on instrumentation as detailed in the QA Manual or SOPs. Responsible for developing and implementing a system for preventive maintenance, troubleshooting, and repairing or arranging for repair of instruments.
- Maintain adequate and valid inventory of reagents, standards, spare parts, and other relevant resources required to perform daily analysis.
- Maintaining awareness of technical developments and regulatory requirements.

2.2.7) Client Services/Project Management Department

Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager (a.k.a. “CSR” or "PM") who serves as their primary contact at the laboratory. It is the project manager’s responsibility to act as the client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements. While most communication occurs and is stored via email, all client verbal communications are documented by the project manager in a controlled notebook. In addition to information management, Project Management responsibilities include:

- Coordinating and preparing proposals in conjunction with technical staff.
- Confirming certification status.
- Assisting QA with hosting client visits and audits.
- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.
- Answering common technical questions, facilitating problem resolution.
- Providing clients with sample status report or results (partial reports) prior to receipt of the final Analysis Reports.
- Scheduling sample submissions, sample containers orders, and sample pick-up via the laboratory courier service.
- Informing the client of deviation from their contract.
- Documenting client concerns in the LIMS; directing priority or high risk concerns to QA when formal investigation is needed.

2.3) Business Continuity and Contingency Plans

The following business and contingency plans are in place to ensure continued operations or minimal disruption in operations should unplanned events occur (natural disasters, unexpected management changes, etc.):

- Deputies as defined in Section 2.2 are identified for all key management personnel. Notification to agencies is performed by QA as noted
- A disaster recovery plan - see Section 4.4.
- Computer security and backups - see Section 4.5
- Client record handling in the event of a change of company ownership or should the company go out of business - see Section 14.1.

3) PERSONNEL

3.1) Personnel Qualifications and Responsibilities

Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum preferred education and training requirements for laboratory employees are outlined in Position Qualification Descriptions, or PQDs. PQDs for all positions are maintained in the laboratory's document control system. Resumes or curricula vitae (CVs) are maintained on file for all staff in the training record system. Responsibilities are outlined in the PQD at the position level. Individual responsibilities and expectations are documented in each employee's job plan. The job plan is evaluated and discussed with each employee on an annual basis. The job plan is a confidential personnel record. The PQDs for senior staff (Business Unit Manager, Laboratory Technical Director, Scientific Officer, Technical Department Directors, Quality Assurance Manager, and Technical and Support Managers) are provided in Appendix D.

3.2) Personnel Training

The experience and training received by personnel is of great importance to our company, our clients, and regulatory agencies. Curricula Vitae (CVs) and on-going training documentation are available to demonstrate how personnel have been prepared for the tasks they routinely perform. To ensure the highest quality of services at the laboratory, training programs and plans are developed to match skills with job functions. Accurate training documentation is the responsibility of both the employee and their supervisor. On a routine basis, the supervisor reviews and approves training documentation to verify that it is complete and current.

Training requirements can be met through education, prior job experience, internal and external training classes, on-the-job training, training modules, procedure reading, or any combination thereof, to enable the person to perform assigned job functions and meet regulatory compliance.

Each analyst training to perform a new analysis is required to perform an initial demonstration of capability and meet the requirements for accuracy and precision before working independently on the test method. Typically, this is accomplished by the successful analysis of four known samples (i.e. a quad study). However, there are certain tests performed that are not required by the mandated test method or regulation to perform the above procedure since they are not conducive to spiking. In this case, the analyst’s documentation of proficiency is achieved by documentation of having read, understood, and agreed to follow the SOP as written, on-the-job training and observation by a senior analyst.

Management personnel are responsible for planning ongoing professional growth and development activities for an employee through on-the–job training and/or internal and external training courses so an employee can maintain a current skill set to match job responsibilities.

An annual performance review based on job responsibilities, accountabilities, objective measures, and pre-defined standards is completed by management personnel for each employee. This assessment is documented and maintained. Input is obtained from other managerial personnel as needed. Performance reviews are maintained in the employee's personnel file and are confidential.

The QA Department is responsible for coordinating and conducting initial and ongoing regulatory training (e.g., Ethics) for all applicable laboratory and support personnel. It is the responsibility of management within each department to ensure that personnel attend the required training sessions.

The choice of training format and topics covered for ongoing regulatory training is left to the discretion of QA and the trainer. All training sessions reinforce the concepts in the regulations as they are relevant to the laboratory.

Whenever possible, after training is completed, a demonstration of proficiency of the training topic is given. The demonstration of proficiency is generally in the form of a quiz although other demonstrations of proficiency are acceptable depending on the scope and content of the training. If necessary, training is presented and/or repeated one-on-one with individuals who do not demonstrate proficiency in the training topic. This is performed by QA in conjunction with applicable laboratory management personnel.

New employees are oriented as part of a year-long process that is designed to make the employee feel welcome and comfortable by defining our culture, traditions, philosophies, and work practices. During the orientation process an employee learns about personnel and safety policies and business strategies in addition to quality, ethics, and customer satisfaction expectations through a formal process administered by collaboration of our Human Resources staff, QA, and the management of the employee's assigned department.

New employees are required to attend “core” technical orientation, as applicable, which can entail the participation in training module exercises, short session attendance, and/or other skill training specific to their assigned department or job function. Additional job-specific training required for an employee is based upon their assigned duties and is identified by their supervisor. Technical orientation occurs during the first few weeks of employment.

Note: Seasonal and temporary employees have reduced “core” training requirements based on the assigned tasks and as defined by QA, Safety, and the assigned department management.

The orientation process is designed to enable employees to initiate and take responsibility for their personal and professional career growth at the laboratory. The orientation process is conducted without regard to employee race, color, creed, national origin, sex, age, or disability in accordance with the laboratory’s Employee Equal Opportunity (EEO) policy.

Refresher and ongoing training occurs through various means, which include but are not limited to, training in or independent review of new/updated standard operating procedures and work instructions; on-going regulatory training; in-house or off-site classes or seminars. The goal of this training is to ensure that employees remain current with changes to laboratory systems and practices, as applicable to their job function. Retraining and re-qualification activities occur as directed by procedures or regulations. Employees are retrained if an issue or investigation warrants that retraining is a necessary corrective action. Management directs when employee re-training is required, and the extent of the re-training.

3.3) Business Conduct

Our business conduct policy applies to all operations of the company. All employees must avoid involvement in any activities that would diminish confidence in their competence, impartiality, judgment, or operational integrity. All employees must further avoid any relationship with other individuals or organizations that might impair, or even appear to impair, the proper performance of their company-related responsibilities. Employees must avoid any situation that might affect their independence of judgment with respect to any business dealings between the company and any other organization or individual. Any employee who believes that they have such a conflict, whether actual or potential, or who is aware of any conflict involving any other employee must report all pertinent details to the President, QA Manager, and/or Operations Director of the company. The company’s management vigorously enforces this policy and takes prompt and appropriate action, including termination, against any employee found to be in violation.

4) BUILDING, FACILITIES, AND ENVIRONMENTAL CONDITIONS

4.1) Physical Facilities

The laboratory is located at 2425 New Holland Pike, Lancaster, PA. The facility consists of two campuses with multiple buildings located on the North and South sides of Route 23. The two campuses are connected by a pedestrian bridge that spans Route 23.

Building A resides on a commercial plot measuring 13.6 acres on the north side of Route 23. It is a three-story building of concrete and steel construction which houses both laboratory space and administrative offices. It is approximately 108,000 square feet and consists of approximately 47,000 square feet of laboratory space; 29,000 square feet of office space; and 32,000 square feet of storage, mechanical, and common areas. On this parcel, adjacent to Building A, sit two chemical storage buildings (Buildings I and L) with a total space of 2500 square feet. In addition, a 10,500 square foot storage building houses stability chambers (Building J). The bottles packing area, which includes preservation of bottles being sent to clients for sampling, is located in a separate 3100 square foot building (Building K). In addition, there are two other buildings (Buildings G and H) with a total square footage of 20,000 square feet that host recycling, storage, workshop and facilities maintenance areas.

The remaining buildings reside on a commercial plot measuring 36.48 acres on the south side of Route 23. These building are connected to the north campus buildings via a pedestrian walkway over the highway.

Building B is a three-story building of steel and concrete construction. It is approximately 56,000 square feet and consists of approximately 17,000 square feet of laboratory space; 14,000 square feet of office space; and 25,000 square feet of storage, mechanical, and common areas.

Building C resides between buildings B and D and consists of a three-story building of steel and concrete construction. It is approximately 47,000 square feet and consists of approximately 25,000 square feet of laboratory space; 6,900 square feet of office space; and 15,100 square feet of storage, mechanical, and common areas. The first floor houses the main lobby and visitor’s entrance.

Building D is connected to building C. It is a 78,000 square foot, four-story building of steel and concrete construction and provides approximately 43,000 square feet of laboratory space, 10,000 square feet of office space, and 25,000 square feet of storage, mechanical, common area.

Building M is a five-story building constructed of steel and concrete connected to Building D by a pedestrian bridge on the third floor. The building is 168,000 square feet, 33,000 square feet of laboratory space, 27,000 square feet of office space, and 108,000 square feet of support area including conference rooms, restrooms, hallways, cafeteria, dining, shipping dock, and mechanical spaces. There is also 24,000 square feet of parking located on the first floor north side.

Building E is a 400 square foot structure designed for solvent storage and solvent waste. Building F is a 200 square foot medical waste storage building. Building U is approximately 17,000 square feet, a free standing building, and is used for sample storage. Building R is a single-story 920 square-foot masonry building adjacent to building “M” that housed chilled water pumps and cooling towers. Buildings V,W, and X are storage buildings adjacent to building “M” that support new chemical storage and waste.

Building N is a two-story, masonry, 18,800 square-foot building that houses administrative services for Eurofins US operations. This building is located in a nearby condominium complex. Services provided include accounting, purchasing and human resource operations.

Building S is a two-story stone, masonry, and wood-frame barn consisting of approximately 13,700 square feet. This building is used for storage of facility materials and equipment.

Building T, located on an adjacent parcel, consists of a single-story, 21,000 square-foot, pre-engineered metal building hosting storage, pharmaceutical medical device testing, and training facilities.

There is an automatic fire alarm and security system hooked up at the facility. This system is monitored off-site by Choice Security. The entire campus and all exterior doors are monitored by video surveillance. All laboratory operations and support buildings have electronic access control. Sub-areas within the larger building may have further access restriction for security or safety reasons.

All facilities are serviced by public sewer. Drinking water and the facility sprinkler system is fed by the public water supply. Laboratory process water is supplied via on-site wells. The closest surface water is the Conestoga River.

4.2) Environmental Monitoring

The air handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors to ensure that samples are not contaminated. The Physical Services/Maintenance Group is responsible for maintaining the HVAC and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive pressure system is maintained.

Most refrigerators, freezers, incubators, and ovens used for analysis are monitored by a computerized system equipped with stationary thermometer temperature probes linked to a master panel that is accessed through a computer. If a unit is outside of a predefined temperature range for a specified period of time, the system alarms. Units not on the computerized system must be monitored manually by recording thermometer temperature readings once daily.

The laboratory is set up so that there is effective separation between neighboring areas in which there is potential for contamination. Laboratory storage blanks are also used to evaluate conditions under which samples for volatile analysis are stored to monitor for cross-contamination potential. QA provides oversight of the environmental monitoring system.

QA and technical management, in consultation with facilities management as needed, evaluate any issues with environmental conditions that could have adverse effects on data to determine if alternative operational plans (moving testing to alternate laboratories, temporary shutdowns, etc.) need to be employed.

4.2.1) Water Systems

Well water and the public sewer system service the facility. The water system is monitored to meet the permit requirements of the Pennsylvania Department of Environmental Protection.

Reagent water is available to analysts for sample preparation (including dilution) and glassware cleaning. Two reverse-osmosis deionized water systems deliver highly purified water to a sealed fiberglass storage tank. From the storage tank the water is delivered to an ion-exchange-carbon filter system for further polishing. The water is also exposed to an in-line ultraviolet sterilization lamp before being circulated to taps throughout the laboratory.

Daily monitoring of resistivity and conductivity, annual calibration of meters, and preventive maintenance for the system is the responsibility of the Physical Services Department. Monthly and annual testing is performed as required by regulatory guidance. QA provides oversight of the water system monitoring. In addition, method blanks are tested with each batch (less than or equal to 20) of samples.

4.2.2) Housekeeping/Cleaning

The laboratory is dedicated to providing a clean workplace. A third party professional cleaning service provides routine cleaning of “common areas” that include lavatories, drinking fountains, floors, and windows. Technical staff are responsible for the cleaning (or the contract of cleaning) of specific laboratory work areas.

Detergents used for cleaning contain no to very low levels of metals, pesticides/herbicides/fungicides, or volatile solvents.

4.2.3) Insect & Rodent Control

Steps are taken to prevent, monitor, and control insect and rodent infestation. The coordination of this program is the responsibility of the Physical Services Department under the direction of QA. An outside service firm is contracted to perform routine and ongoing monitoring of the facility to ensure that preventive measures which are in place are effective and are working as intended.

No insect or rodent control chemical agents in a liquid or vapor form are applied or sprayed in any laboratory building, unless there is no other option, in which case department management must be contacted for approval.

4.2.4) Facility Changes

Procedures are in place to manage change, ensure communication, and to minimize negative consequences through active participation of personnel involved in a facility change. The goal is to ensure that physical and environmental condition changes are adequately evaluated for impact and reduction of risk to quality, safety, health, employee, environment, property, analytical services, and business operations before and after the change is implemented.

4.2.5) Labware Cleaning

Dedicated washroom personnel support the laboratory operations in regard to labware preparation, washing, rinsing, and drying. Labware can include, but is not limited to glassware, plastic ware, utensils, and pipettes. Procedures are in place to outline the washing process for each type of labware. Most labware is cleaned using a Miele glass washing machine. Some labware is still washed by hand and either air-dried or dried in specifically designed ovens.

Most of the labware used in the laboratory is "common or non-dedicated" labware (common to a department), but some of the labware used in the laboratory may be identified as "dedicated" labware and exclusively used for certain analyses. This labware is isolated and cleaned only with "like" labware.

All glassware is class A and 100% visually inspected for breakage (e.g., cracks, chips), cleanliness, and dryness before being returned to the laboratory for use. Generally, each test has controls in place to ensure that results are not adversely affected by unclean labware. These controls include blanks to detect positive interferences and recovery controls to detect negative interferences.

4.3) Employee Safety

The laboratory, being mindful of its responsibilities as an employer and active corporate citizen, has established the following objectives of its safety program:

- Provide a safe environment for its employees, visitors, and the community surrounding its place of business.
- Provide ongoing safety training for employees.
- Provide all necessary facilities and equipment to ensure the safety of its employees and to minimize all chemical exposure during the normal performance of their required tasks, and to take all necessary precautions to safeguard the surrounding environment.
- Provide periodic health physicals for employees.
- Foster and encourage safe operations and a proper safety attitude on the part of our employees through general operations and systems, training, and the *Chemical Hygiene Plan* (CHP).

The CHP addresses various aspects of our safety program in greater detail.

A Safety Committee works to enhance our overall safety program. The committee meets on a routine and ongoing basis and its specific responsibilities are detailed below:

- Review accident and incident reports. Make recommendations for methods of prevention to eliminate further accidents.
- Promote safety awareness and distribute safety information by various means (e.g., posters, videotapes, pamphlets, and books). Use internal communication channels to promote safety awareness.

- Enhance and recommend safety-training programs for all employees, as necessary.
- Maintain up-to-date information on employee concerns that are safety related. Offer input and information to the Chemical Hygiene Officer and/or Safety Officer, as needed.

4.4) Emergencies

A disaster recovery plan is in place to provide direction for situations where normal operations of the laboratory are not possible. In the event that the building or information technology (IT) systems would be severely challenged, a designated disaster recovery team, which includes Physical Services, Maintenance, Safety, Corporate Management, Public Relations, IT, QA and other applicable personnel depending on the scope of the disaster, would assemble at a designated area to assess the situation and formulate a plan.

The plan addresses, in general terms, how to approach the following issues: electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, and stability chamber failures.

The laboratory is located at the junction of two power grids that supply electrical service to the facility. If one of the power grids fails, we have the ability to work with the power company to have service switched to the other grid. Various types of diesel and natural gas generators are also available on a standby basis to supply power to selected areas of the laboratory in case of a power outage.

To reduce spikes and spurious line voltage changes to laboratory instruments that can affect results or damage electronic equipment, "conditional power" is fed to these sensitive instruments. All essential computer systems are on uninterrupted power supply (UPS) which is a battery system that provides continuous conditional power for a limited time period in the event of a short power outage.

4.5) Security and Building Access

The laboratory is considered a secure facility. All outside doors (except the main lobby entrance) are locked during normal business hours to prevent unauthorized entry. (An attendant monitors this entrance at all times.) Video cameras are utilized by Security personnel to monitor the facility grounds.
Building keys and alarm codes are distributed to employees as necessary. Employees wear photographic identification name cards while on the premises.

All visitors must register with the lobby attendant and are issued a visitor badge. A staff person must accompany visitors while in the facility. Additional visitor rules are outlined in the *Visitor Security and Safety Rules* pamphlet which is provided to all guests.

Building access cards are issued on a temporary basis to contractors or service technicians (e.g., electricians and plumbers) who need access to the building to work on a project. These cards provide the contractor with limited access during the normal workday and must be returned when the work is complete.

4.6) Computer System Security and Access

In order to protect computer hardware from misuse, theft, unauthorized access, and environmental hazards, the corporate computer area and computer "Hot-Site" is locked and requires identification/building card access. All vendors, contractors, or other visitors must be escorted into this area.

The e-mail system is used primarily for the laboratory's business purposes. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to system usage. Employee access to the internet is restricted to those employees who have a business need for it. All employees have access to e-mail. Access to the internet is configured through a user's Windows network account. All internet and e-mail activity is subject to monitoring. All messages created, sent or received over the internet are company property and can be regarded as public information. E-mail and website filtering software is utilized.

Designated employees are able to remotely connect to the laboratory computer systems through an encrypted (SSL) login. When logging in, users are authenticated with their Windows Active Directory account and password.

4.6.1) Passwords

Passwords are important for the security of company data and resources. The laboratory's primary network operating system is Windows and each employee must have a user ID and password combination to access the system. Other computer systems also require a user ID password combination for access. The following procedures apply regardless of which system(s) is being utilized:

- Passwords must be created as strong passwords in accordance with Eurofins Password Policy and must be kept confidential.
- Users must log-out of a system when not in use to prevent unauthorized access. In addition, the network access will automatically timeout after a set period of inactivity, requiring a user to log-in to access the system.
- Forgotten passwords can only be reset by the IT Department or by an appropriate System Administrator.
- Network and LIMS passwords automatically expire at designated intervals. The computer prompts a user to change the password when the expiration date nears. If the password is not changed, the user will be locked out of the system.

4.6.2) Viruses

The laboratory centrally and continuously monitors the computer network for computer viruses. Employees are prohibited from using the company's computer equipment to propagate any virus. Anti-virus software is employed to detect viruses on the Windows network. A notification is sent when there is a particularly dangerous or virulent data destructive program that employees need to be aware of. However, employees are instructed to always be cautious and observant even if there are no current warnings. Employees must report any virus concerns to the anti-virus administrator or IT Management as soon as possible. Employees who share files between their home computer and the laboratory should install anti-virus software on their home computer. If an employee does not have such software, the laboratory can suggest various no-cost anti-virus software products.

4.6.3) Software Policy

Copyright laws protect software, and the laboratory's intent is to abide by all software agreements.

Software purchases must be formally requested and approved by management and/or validation personnel, as necessary.

All software is used in accordance with applicable license agreements.

Employees are not to install any software on computer(s) unless authorized by the IT Department.

Software upgrades must occur in accordance with applicable change control procedures.

Employees must not give software to outsiders (e.g., clients, contractors), unless approval is granted by management.

Users must not make copies of any licensed software or related documentation without permission. Any user that illegally reproduces software is subject to civil and criminal penalties including fines and imprisonment.

5) QUALITY SYSTEM
5.1) Quality System Overview

In addition to this *Quality Policy Manual*, aspects of the QA program are documented in a series of standard operating procedures that support the proper execution of this document. Technical operation procedures with required quality components are also in place. A list of the titles of relevant SOPs is provided in *Appendix E*. There are a variety of mechanisms used to communicate requirements and verify compliance with the QA program, including:

- Management requires that all employees read and be trained in the policies and SOPs that are pertinent to their jobs.
- Employee job plans define individual responsibilities. All job plans include data quality aspects, and performance is reviewed annually.
- Laboratory audit findings are communicated to management and require a response and follow-up to items needing corrective action.
- Cross-functional meetings, including representatives from QA, Client Services, Business Development, management, and technical operations are held as needed to review specific projects and quality issues.
- The Quality Policy Statement is in Section 1.2.
- The Ethics and Data Integrity Policy is in Section 5.2.
- The Quality System Documentation is explained in Section 5.3.

5.2) Ethics and Data Integrity

All employees review and sign the Employee Ethics Statement on their first day of employment and annually thereafter. All employees are instructed in regard to how ethics and data integrity are relevant to every position in the company. Employees responsible for generating, handling, or reviewing laboratory data understand that the laboratory mission is to perform all sample processing and testing with the highest level of integrity. Under no circumstances are shortcuts or generating results to suit a client's purpose rather than good scientific practice considered acceptable. Any violation of the laboratory ethics policy results in a detailed investigation that could lead to termination, debarment or civil/criminal prosecution.

All levels of management consider the following activities unacceptable:

- Knowingly recording inaccurate data.
- Fabrication of data without performing the work needed to generate the information. This includes creating any type of fictitious data or documentation.
- Time travel or adjusting clocks on computerized systems to make it appear that data was acquired at some time other than the actual time.
- Manipulation of data for the express purpose of passing system suitability or quality control criteria.
- Selective use of data generated, or not using data that was legitimately generated and has an impact on the outcome of the test.
- Executing significant deviations from approved test methods and procedures without prior approval from the laboratory management, QA, and/or the client.

If an issue does arise which could compromise data integrity, personnel are instructed to perform the following activities:

- Clearly document the situation and maintain all data generated. There is a big difference between poor judgment and fraud. Fraud usually involves intent to conceal an action taken. Therefore, the more documentation that is maintained, the less likely an action is considered fraudulent if further scrutinized.

- When out-of-specification results or quality type issues are detected, all supporting data and relative background information must be documented and presented for management review. Problem resolution and client contact, as applicable, must also be documented.
- Review any questionable situations and decisions with a supervisor.
- Bring a questionable or uncomfortable issue directly to the QA Director or a member of the QA Department as part of our QA open door policy.
- Utilize the company's anonymous Ethics hotline service at www.lighthouse-services.com/eurofinsus, via email at reports@lighthouse-services.com (include company name), or calling 855-910-0005 (Spanish Speaking 800-216-12888).

5.3) Quality System Documents

The laboratory's Quality System is communicated through a variety of documents.

The order of precedence is as follows:

1. NBLSC Guidance Documents
2. The Environmental Quality Policy Manual QA-QM11872
3. Document Levels are defined in sections 5.3.1 through 5.3.4 of this document. The development of new procedures and the review and updating of current procedures is ongoing based on laboratory changes, new method development and regular review cycles.

5.3.1) Level 1 - Quality Policy Manual and Company Policies

The intent of these documents is to define "what" we do with emphasis on Executive and Management's responsibility for quality.

The purpose of the Quality Policy Manual is to provide a framework to outline the quality systems at the laboratory. Information on key quality system processes is described within the manual. Organizational charts, list of SOPs, a list of equipment, instrumentation, and PQDs for senior personnel are included as attachments to this manual.

- Executive Management is responsible for ensuring that adequate personnel, resources, and support are available to carry out the requirements of this Quality Policy Manual.
- Management is responsible for ensuring that SOPs, Work Instructions, or other appropriate documents are written and available to personnel to define the practices and systems which support these policies.
- All employees are responsible for conducting business in a manner which is compliant with quality and company policies and associated SOPs, Work Instructions, or other appropriate documents. Review of these policies and procedures must be documented.

Additional company policies are written to support and expand upon this Quality Policy Manual. These policies contain more detailed information about a subject with approval signatures executed at the Executive and/or Management level.

5.3.2) Level 2 - Standard Operating Procedures

The intent of these standard operating procedures is to define "who, what, where, and when." These procedures provide specific information for a process or topic so that the requirements outlined in this *Quality Policy Manual* and company policies can be achieved. The review and approval of these SOPs is performed at

the director/manager/group leader level, including QA review and signoff, and the responsibility of these SOPs lies with the area or person directing the operation.

SOPs can apply to site-wide operations, the entire company, across multiple departments, or a specific operating area.

5.3.3) Level 3 - Work Instructions (at a department level)

The intent of these procedures or documents is to define in greater detail the specific "how to". The level of detail in these documents must be sufficient so any appropriately trained person can perform the task accurately. Examples include, but are not limited to departmental standard operating procedures (SOPs); maintenance and calibration procedures; and the laboratory analytical methods. Departmental level procedures/documents are reviewed and approved at the manager or group leader level including QA review and signoff.

5.3.4) Level 4 - Quality Records

The intent of these documents is to provide documented evidence to support our quality systems and operations. Examples include but are not limited to, data notebooks/logbooks, and preformatted data recording forms.

5.4) Overview of the Quality Assurance Program

Quality Assurance (QA) is responsible for developing planned activities whose purpose is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of NELAP, ISO 17025, DoD, PALA, and any other regulatory agencies (i.e. states) in which we hold accreditation. Although the laboratory is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and Quality Systems operations described in this manual are specific to the Lancaster Business Unit and associated service centers.

The administration of the QA program is the responsibility of the QA Manager in cooperation with all levels of management.

The QA program, as directed by executive management, was established to:

- Ensure accountability, accuracy, traceability, and impartiality for all analytical data generated.
- Ensure that current regulatory, agency, and client requirements are being met.
- Ensure that operating procedures are in place to minimize risk, the possible loss, damage, and tampering with data, in addition to ensuring that raw data is stored in a secured area and is maintained by designated archivists and/or system administrators.
- Ensure that curriculum vitae (CVs) and training records are maintained to document that staff members have the necessary education, training, and experience to perform their job responsibilities and functions.
- Ensure that regulatory training is provided to applicable employees on a routine and ongoing basis.
- Ensure that all procedures are available, controlled, and current.
- Ensure that documentation demonstrates that procedures are carried out in a compliant and effective manner.
- Ensure that all equipment and instrumentation is qualified, maintained, and calibrated, as appropriate, in accordance with written standard operating procedures.

- Ensure that all significant laboratory problems are investigated, evaluated for root cause and corrective action is put in place as documented
- Ensure that an internal audit program is in place to provide on-going monitoring, evaluate areas of risk, and confirm that laboratory personnel are adhering to standard operating procedures and applicable regulations.
- Ensure that quality issues are brought to the attention of management in a timely manner.

5.5) Quality Control Charts for Quality Indicators

The LIMS quality control system is used to report QC data to clients, to collect data for assessment of precision and accuracy statistical limits, and to generate control charts. Control charts are accessible to all employees through the LIMS interface. The system charts results from blanks, surrogates, matrix spike/matrix spike duplicates, duplicates, and laboratory control samples/laboratory control sample duplicates. These charts provide a graphical method for monitoring precision and bias over time. They can be used to detect quality problems by observation of patterns. The QA staff uses the charts to evaluate potential data trends.

5.6) Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846). The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts use the current limits entered into LIMS. The QA department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be re-analyzed, re-extracted and re-analyzed, or if a comment should be added to the report explaining the reason for the QC outlier.

5.7) Quality Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics. These metrics are used to drive continuous improvement in the laboratory’s Quality System. See Section 16.1.

6) DOCUMENT CONTROL

6.1) Overview

The administration of the document control system including tracking, filing, updating, and archiving of inactive copies is managed by the laboratory and QA staff using an electronic record keeping system. All documents are maintained and accessed through the electronic system. If an employee or department uses hardcopy versions of the documents, they are responsible to ensure that they are using the active version of the document.

It is laboratory policy to restrict the distribution of our internal procedures to clients, the distribution of company confidential documents outside of the facility is discouraged. Clients are permitted to review our procedures while on-site as part of an audit or visit. Any documents that are distributed are only sent with the approval of QA and are marked with the "Uncontrolled Copy" watermark before sending.

The laboratory maintains SOPs for all aspects of its testing and quality procedures. The document control process ensures that documents are approved by qualified personnel and adequate for use. It ensures that documents are readily available to personnel and at locations where essential operations are performed through the electronic system.

6.2) Document Approval, Issue, Control, and Maintenance

Controlled policies, procedures, and work instructions are reviewed and approved by qualified individuals and are formally issued and administered through the electronic document management system. The editor, reviewer and approval personnel are recorded within the document as through the document control interface. The recording of these steps is through the employee's secure network log-in and password. Designated personnel are assigned the editor, reviewer, and approval roles. Administration of the role assignments is managed by QA.

Analytical Work Instructions undergo scheduled annual review to ensure that they are accurate, current, and compliant. QA is the final approver and publisher on SOPs and Work Instructions, which gives QA the authority to implement the procedure. Forms may be approved and published by department management. Upon the effective date of new or updated documents, all copies of obsolete documents are removed from service.

Each procedure is uniquely identified and includes effective date, version identification, designated user groups, and the "approved by" employee. Document editors and reviewers are recorded in the electronic system for each version of a document. All documents are searchable and uniquely identified in the document management system. Procedures can be printed from this system for reference by employees as the corresponding task is being performed. Prior to using a printed document, the employee **must** ensure that it is the current version.

Interim amendments to procedures are not allowed. Any needed changes require a revision to the document. The document management system has a feedback function which enables information to be given to the assigned document editors. If minor edits (e.g. typos) are identified that can wait until the next review cycle, these can be communicated through the feedback function.

6.3) Client-Supplied Methods and Documentation

Client documentation to support environmental testing at the laboratory is maintained in a centralized area. This information is organized by client/project in the Client Services/Project Management Group. Client documentation includes the following information depending on project size and scope:

- Client supplied analyte lists
- Client supplied project plans
- Client contract quality manuals with specified limits, QC criteria, etc.
- Communication/correspondence records which relate to testing requirements, interpretation of results, or reporting formats

6.4) Control of External Documents

Hard copy versions of external documents are controlled using an inventory form in the document management system. Any external document that is maintained in the laboratory are inventoried and listed on a department specific controlled form.

External documents such as copies of the 40 CFR and ASTM methods are stored exclusively in the QA Department. QA also keeps applicable agency documents on file, these include, but are not limited to, the TNI (The NELAC Institute) and ISO 17025 Standards.

Environmental methods from the EPA or Standard Methods are available in the QA Department, but the technical areas also have copies that pertain to the tests that they perform. Some methods are available on-

line and are accessed through the Internet.

It is the laboratory's understanding that the need to control external documents is to ensure that the most current version of a method is referenced or appropriate manual is being used. Regulatory methods are used as references by the laboratory and testing is performed as per written SOPs that fall under our existing document control system and have scheduled reviews. The scheduled review of SOPs is used to ensure that the proper version of a method is referenced. While using the most current version of an analytical method is our typical practice, there are specific client needs and accreditation rules that require previous versions of a method to be used.

The technical areas are responsible for ensuring that all manufacturers' manuals are current and available to analysts. The vendor provides instrument manuals when new equipment is purchased or existing instruments are updated. These manuals are kept with the instruments to which they are associated.

7) SERVICE TO CLIENTS

7.1) Overview

We value our client relationships and support these partnerships through the following principles:

- Honesty and Fairness – Our corporate culture is founded on the principles of professionalism and high ethical standards in dealing with our clients. This may mean declining to provide the service requested (if we are convinced that to do so would be meaningless) or it may mean referring clients outside of our laboratory if we believe that another company can better meet their needs.

- Complete Service – We will give our clients full value on every service provided. We will provide detailed information on our methods, procedures, and QA programs if requested, and take a personal interest and initiative in helping solve our client's problems within the area of our professional expertise.

- Trustworthiness – All data and information developed for a client will be held confidential and not disclosed to a third party except on written request of the client. If information is subpoenaed, we must, by law, release it, but the client will be informed of the release.

- Commitment to Quality – We constantly strive to improve our service in quality, flexibility, and dependability, to keep our competitive edge. We will achieve this through: meeting the requirements of those we serve, staying apprised of regulatory and industry expectations, and providing prompt responses to client concerns.

- Basics of Superlative Service – Our focus is on our client's success. Through proactive collaborative communication, our leadership ensures we understand our client's expectations and strives to exceed them. We foster a service culture in our training, reward and recognition, and performance management process so each employee takes ownership to deliver superlative service to our clients. Feedback from clients, whether positive or negative, is an important part of our continuous improvement system. Ways in which feedback is gathered can include, but is not limited to, customer satisfaction surveys, client audits, and the customer complaint system.

We also view our fellow employees as our clients since they frequently receive the results of our labor. Meeting the requirements of the next employee in the workflow process is just as important as meeting the needs of an external client.

7.2) Review of Work Requests, Tenders, and Contracts

The laboratory places great importance on understanding and meeting client requirements for a project. We ensure, to the best of our ability, that client/project requirements are identified and communicated throughout the laboratory. Project evaluation can be achieved in various ways, including the review of analytical methods, protocols, business contracts, and quality project plans (QAPPs). The project review encompasses our Project Cycle process and individual topics to be evaluated for a project include, but are not limited to: scope of testing; required accreditations (i.e. individual state agencies, PALA, NELAP, DoD, and ISO 17025) held by the laboratory; appropriate and current testing methods; ability to meet project required reporting limits and QC (if applicable); inconsistencies clarified; and nonstandard work requests.

Project kick-off meetings can be arranged through the PM or Business Development Group. These meetings allow the client and key technical personnel to discuss project issues and requirements prior to project initiation. Any differences between laboratory processes and the project requirements are discussed and addressed with the client and the laboratory staff before the project is accepted and samples arrive. Project-specific requirements are communicated to the laboratory through use of Project Notes or Method Comments. Accreditation-specific requirements (i.e. NJ DKQP, MA MCP, CT RCP, PALA, NELAP, DoD, and ISO 17025) have template PNs maintained by QA, and these are used to add to the project's PNs. Testing that cannot be performed at the laboratory may be subcontracted to another laboratory (see Section 8).

A key client contact, the PM is assigned to oversee the project. Communication between the client and laboratory staff is available and is coordinated through the PM. As a project continues, the PMs provide continuous communication and status reports (if requested) about the project to the client. The PM relays any project changes or modifications to the technical groups. If the client submits revised project documents (QAPPs, etc.) then the Project Cycle review process is repeated. The PM also communicates any issues encountered by the technical laboratories back to the client and vice-versa.

7.3) Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the laboratory Operations Director, in conjunction with the President, and management team. Input from business development, sample registration, and client services management is also evaluated. These responsibilities are documented in the individual job plans for these positions.

The laboratory facilities and staff size are very large compared to other laboratories serving the environmental industry. Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in case of malfunctions. This minimizes the need to evaluate small and medium size projects against capacity available to complete them. Large projects are reviewed against capacity estimates before bids are submitted to ensure that the client’s analysis schedule is met.

Regularly scheduled meetings are held with upper management, laboratory middle management, Client Services and QA personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory. Laboratory capacity and backlog is tracked on a continuous basis using information from the Laboratory Information Management System (LIMS) including turnaround time, and work in progress.

7.4) Communication and Documentation

Documentation is maintained on the Environmental Project Management network folder and, if necessary, the LIMS. A key client contact, the PM is assigned to oversee the project. Communication between the client and laboratory staff is available and is coordinated through the PM. As a project continues, the PMs provide continuous communication and status reports (if requested) about the project to the client. The PM relays any project changes or modifications to the technical groups. If the client submits revised project documents (QAPPs, etc.) then the Project Cycle review process is repeated. The PM also communicates any issues encountered by the technical laboratories back to the client and vice-versa.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel. All stages of the contract review process are documented and include records of any significant changes.

PMs are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project. Records are maintained of pertinent discussions with a client relating to the client’s requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client. Technical Managers are available to discuss any technical questions or concerns that the client may have.

7.5) Client Feedback

The laboratory is in the business of providing high quality analytical testing services. The data that we supply to our clients must be technically complete, accurate, and compliant with applicable regulations. Complaints can be received via letter, phone call, e-mail, or face-to-face meeting.

When a complaint is received, it is our responsibility to determine, to the best of our ability, the extent of the issue and what data is in question. The person receiving the complaint documents this information and promptly forwards it to the appropriate management personnel where the work in question was performed. If a data reporting error is discovered, the final report and/or data must be regenerated with the correct value(s).

The PM is responsible for entering client concerns into the LIMS. QA reviews these issues on a monthly basis to evaluate for trends and potential risks to laboratory data/systems. In some cases, an ICAR is initiated to address and document the situation. While an individual issue may not warrant a formal investigation, QA monitors these issues for potential trends and will issue an ICAR if a trend is evident. If the client requires a formal investigation, then the PM notifies QA so the ICAR can be initiated.

The laboratory sends out automated surveys through Relationwise periodically to client who have received their report(s) and had no received a client satisfaction survey in a set amount of time. An example question on our survey is "how likely is it that you would recommend Eurofins to a peer or colleague?" Survey feedback is scored out of 10. There is a timeframe of 24 hours for PMs to follow-up with client whose feedback scored 7 or below. The results of these surveys are compiled, routed to the laboratory executive management and the QA Director, and used to identify areas of improvement for the laboratory.

8) SUBCONTRACTING

8.1) Overview

For the purpose of this quality manual, the phrase "subcontract laboratory" refers to a laboratory external to Eurofins Environment Testing. The phrase "work sharing" refers to internal transfers of samples between the Eurofins laboratories.

The client must be notified if their sample must be sent to a subcontract or workshare laboratory. Some clients reserve the right to approve the subcontract or workshare laboratory before samples are subcontracted.

When subcontracting our clients' work, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity, or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client.

When subcontracting analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a quality program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025, and/or the client’s Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client’s analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

8.2) Qualifying and Monitoring Subcontractors

Subcontracting laboratory(s) shall be selected based on the following:

- Subcontractors specified by the client - In these circumstances, the client assumes responsibility for the quality of the data generated from the use of a subcontractor.

- Subcontractors reviewed by Eurofins – Firms which have been reviewed by the company were confirmed to meet accreditation and technical requirements for the project and are appropriately insured.

A listing of vendors is available on the LIMS. All Eurofins laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations and can adhere to the project/program requirements. Client approval is not necessary unless specifically required by the contract.

When the potential subcontract laboratory has not been previously approved, the PM may nominate a laboratory as a subcontractor based on need. QA requests that the PM begin the process of approving the subcontract laboratory.

8.3) Responsibilties

- Client - the client assumes responsibility for the quality of the data generated when they specify the subcontractor to be used
- ELLE - the laboratory assumes responsibility for the review and approval of the subcontracted laboratory's credentials.
- Project Manager - informs the client, preferably in writing, of the need to subcontract work. Email notification is acceptable.

  Note: Subcontracted laboratories must receive project-specific approval from the customer where required (i.e., any DoD clients) **before** any samples are analyzed.

- Project Manager/Sales - requests information from potential subcontract laboratory (via the Laboratory Analytical Services Subcontract Form)
- Quality Assurance - ensures the subcontracted laboratory complies with ELLE's overall management system

8.4) Use of NELAP and A2LA Logo

It is not laboratory policy to use these logos on any company letterhead, including analytical reports.

9) PURCHASING SERVICES AND SUPPLIES

9.1) Supplier Evaluation

Procedures are in place to evaluate vendors who supply us with: new equipment, instrumentation, computerized systems and computer software; commercially purchased glassware, including sample bottleware, reagents, chemicals, solvents, gases, media, and standards; and contracted and subcontracted services.

The laboratory strives to ensure that our suppliers continually improve their quality systems and we reserve the right to purchase from suppliers of our choice in order to best fulfill the needs of our clients and our business. When directed by a client to purchase from a specific supplier, we will do so. In this instance it is the client’s responsibility to “qualify” the specified supplier. We attempt to purchase from businesses that we have an established purchase history or have previously acquired information regarding the supplier’s quality programs.

The laboratory does not evaluate every supplier. Risk assessment is taken into consideration when making this decision. The risk assessment analysis includes system, material, services, and number of samples or operations the purchase may affect or support. Evaluations are not required for computer operating systems, utilities, toolsets, or systems software. They also are not required for any off-the-shelf configurable software package that has an extensive market performance history (e.g., Microsoft Word, Excel, Access).

Additional quality systems are also in place within the laboratory to further verify and support the materials used:

- Certificate of Analysis (COA) for every lot of purchased chemicals, where available, are reviewed and maintained on file.
- For most chemical analyses a blank and a recovery check are routinely analyzed and serve as real time suitability testing of the reagent being used.
- Whenever possible, the laboratory will use Class A, Pyrex glassware.
- Purchasing guidelines for equipment, consumables and reagents must meet the requirements of the specific method and testing procedures for which they are purchased. Solvents and acids are pre-tested in accordance with laboratory criteria.

9.2) Procurement

It is the responsibility of management personnel within each department to ensure that the appropriate supplies are available and/or ordered with sufficient lead-time to perform analytical testing or to provide support to the testing areas. The individual technical departments have trained personnel who enter the supply order into the company's purchasing system. The selection of these products is based on technical input at the analyst level and authorized by technical departmental management. The Purchasing Department maintains an ordering system in which purchase requisitions are managed. Common laboratory items (e.g., beakers, flasks, reagents) are ordered directly through the purchasing system. Purchase orders over a specified dollar amount require approval from the appropriate member(s) of the Executive Management Group before an order can be placed.

Upon receipt of an order, the Shipping and Receiving Department checks the order to ensure that all items were received as specified. Products that have specific storage requirements are taken to the technical area upon receipt. It is the technical area's responsibility to ensure that the product is stored in the appropriate manner. Any checks on the quality of the materials received for use in a specific test are the responsibility of the laboratory using them. This is based upon the experience of the laboratory with the usability of the product. Generally, each test has controls in place to ensure that test results are not adversely affected by the materials.

Any problems encountered when using a material in the laboratory must be brought to the attention of the Purchasing Department and/or Quality Assurance, as applicable, to ensure that follow-up and corrective action occur.

10) COMPLAINTS

10.1) Receipt and Investigation of Complaints

The laboratory considers an effective client complaint handling process to be of significant business and strategic value. Listening to and documenting client concerns captures client knowledge that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints, or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner. The nature of the complaint is identified, documented and investigated, and appropriate actions are determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department follows the Investigation and Root Cause Analysis procedure as described in Section 11 and 12. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

11) CONTROL OF NON-CONFORMING WORK

11.1) Evaluation of Significance and Actions Taken

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately as appropriate. First, the laboratory evaluates the significance of the nonconforming work and the response is based on the outcome of the evaluation. The action could be as simple as addition of a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, an investigation and root cause analysis is performed (see Section 12).

The following list provides examples of the type of issues that warrant investigation:

- Noncompliant QC results*
- Failed PT samples
- Reporting incorrect results
- Contamination issues
- Client complaints resulting from an established policy or procedure that was not followed
- Procedural errors
- A trend of missed holding times
- Systematic problems that compromise the accuracy or compliance of the data generated
- Problems with instrumentation and equipment which could compromise the data generated

These investigations must include the following:

- Identification of the problem
- Determination of samples or systems affected by the problem
- Steps taken to investigate the problem
- Explanation of probable root cause(s) of the problem
- Identification and timeline for implementation of corrective action(s)

The information is tracked through our Investigation and Corrective Action Report (ICAR) process.

*Note: individual QC noncompliance does not require in depth investigation. Actions are taken as defined in the corresponding method and documented in the data. An adverse trend with noncompliance would be investigated. All results from quality control (QC) samples are logged into the LIMS quality control system, which is programmed to alert analysts to unacceptable results. Analysts are required to review the results and determine the source of the problem. The source of the problem and proposed action must be documented. Action for QC outliers may include, but is not limited to, re-analysis, re-extraction or re-digestion, instrument maintenance, or re-calibration. If these actions do not yield compliant data within the required hold time, a Nonconformance Memo (NCM) is created to document actions and communication with the client. The NCM is archived with the associated raw data in LIMS. NCMs are reviewed by the technical department’s management, or designee. A copy of the form is reviewed by QA.

11.2) Responsibilities

Any member of laboratory staff can contact QA for initiation of an investigation. The QA staff initiate the investigation in the electronic tracking system. The QA staff track documentation and investigative process, evaluates investigations for completeness and appropriateness, monitors corrective action(s) for effectiveness, and follows up if needed. Department personnel complete the investigation with the oversight of the Department Manager. Technical management and/or QA may issue a stop work notice if issues indicate the potential for problems on a broad scale or present a critical concern regarding the validity of the laboratory methods. The investigation would need to be completed, authorized by the QA Manager in consultation with Lab Management, and the issue resolved before work could continue. Project Management handles the communications with the client(s) if necessary.

Tracking and trending of laboratory issues is performed by QA staff and reported to management on a monthly basis or immediately upon detection of a trend with potential for putting the laboratory or our clients at risk. The QA Department is responsible for preparing reports to Management to keep them apprised of

outstanding quality issues. Reports to management foster communication, review, and refinement of QA activities to ensure that the QA program is adequate to meet regulatory and the laboratory's quality objectives.

11.3) Prevention of Nonconforming Work

See Section 13.1 for description of preventative actions that the laboratory employs. In addition to this, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

12) CORRECTIVE ACTION

12.1) Investigation Process

The laboratory has established procedures for determining the root cause(s) and implementing corrective action(s). Problems having potential impact on data quality or involving deviations to ELLE processes are investigated and documented using an Investigation and Corrective Action Report (ICAR). The process ensures documentation of the investigation, root cause evaluation, identification and implementation of corrective action(s), and laboratory management review and QA approval. Follow-up to ensure effective corrective action is managed by QA staff.

These investigations are initiated and managed through the Deviation tracking database. QA initiates an ICAR through this system to document a laboratory problem. The investigation must be completed by designated members of management and approved/closed by QA. Each investigation has a unique tracking number.

If a laboratory error is identified from the outcome of the investigation that impacts validity of client data, the client must be notified in writing of the situation and corrected data provided as soon as possible. If the root cause of the problem has affected any other client sample results, all affected clients are notified of the problem. Every effort must be made to notify the clients within 2 business days of confirmation of the problem.

12.2) Root Cause Analysis

A major component of the laboratory's QA Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence.

Cause Analysis

- The event is defined and documented in the Deviation tracking database. Department Management works with QA and a team of relevant staff to investigate
- Good cause analysis is the key to implementing effective, long-term corrective action(s).

Implementation of Corrective Action(s)

- The laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented.
- Corrective actions are proportional to the magnitude of the problem.
- The results of the corrective action(s) are documented in the database.

Monitoring Effectiveness

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective. Ineffective actions are documented and re-evaluated until acceptable resolution is achieved

- Follow-up audits may be scheduled if QA or the Technical Department deems necessary, or compliance with standards/procedures have come into question.

13) PREVENTATIVE ACTION AND RISK ASSESSMENT

13.1) Preventative Actions

All employees are empowered and encouraged to use the concept of Preventive Action to avoid a problematic situation. The company supports, embraces and drives the process for continuous quality improvement by several means, such as: Ethics Hotline and training classes that include new hire orientation and Ethics. If an employee identifies a potential problem or an area of concern or it should be brought to the attention of his/her supervisor, Human Resources, QA Manager or the Ethics Hotline.

The laboratory also utilizes a formal program to encourage preventive action through development of Lean processes. The goal of this program is to optimize processes to ensure efficiency and operational improvements while maintaining compliance. The efficiency gains are inherently coupled with minimizing errors and rework. Teams of employees learn the tools and techniques to evaluate a process, identify potential sources of errors, delays or problems in an operation, determine system changes that will minimize these and work to implement the improvements. Each project includes thorough documentation of the evaluation, measurement, and implementation phases. The process is continually monitored to ensure that the anticipated results are sustained.

Employees are also encouraged to communicate to their supervisor any area(s) or operation(s) that they believe could be streamlined, make their job easier, would provide a quality improvement, or could provide a cost savings to the company.

Described below are some of the systems available to employees to assist with building quality and efficiency into their daily jobs. They stress a proactive approach/environment to problem solving and to review quality systems and operational efficiencies.

- "Ethics" is a course required for all employees to teach the laboratory's Statement of Values by examining how it translates to our everyday jobs and ethical decision making. Topics discussed include: Statement of Values, data integrity, ethics, confidentiality, etc.. Mandatory ethics training refresher is scheduled on an annual basis.

- The laboratory has contracted with an Ethics Hotline to provide an anonymous means of reporting ethics concerns or issues. The issue is forwarded by the service to the NBLSC QA Director who notify the appropriate business unit personnel who need to address the issue. All communication and actions are documented in a secure web interface managed by the hotline service company.

- The QA staff prepares monthly program status reports for management (section 16.1). The reports include a variety of metrics and graphs which are used to evaluate trends in laboratory performance across all quality and compliance areas. Management responds to any negative trends by developing a corrective action plan.

- The laboratory uses a Project Cycle process (further described in section 7.2) to proactively review and prepare for client projects in an effort to ensure full understanding by all laboratory staff of the client's needs and resolve any concerns in advance of receiving the work.

13.2) Change Control

Procedures are in place to define how to maintain facilities, processes, instrumentation, equipment, computerized systems, and computer software in a validated or controlled state through a plan of change control. Successful changes require a thorough evaluation and testing for potential consequences prior to implementation. Planning, authorizing, testing, and reviewing of proposed changes are documented throughout the change process. Changes are planned or could be made in response to an emergency situation. The following "general" elements apply to changes, as appropriate:

- Request to perform a change

- Evaluation of a change
- Authorization of a change request
- Preparation for an authorized change
- Execution and testing of the change
- Documentation of the change
- Approval of the change
- Change implementation and follow-up (Formal approval of the change is performed by designated responsible individuals and QA.)

Note: The DoD will be notified in advance of the migration to a new LIMS platform and/or relocation of any data center(s) from the Lancaster Business Unit.

14) CONTROL OF RECORDS

14.1) Data Documentation Requirements

Most data are acquired, documented, and stored in the LIMS. In some cases, data are documented in bound notebooks. Analysts review data as it is generated to determine that the instruments/systems are performing within specifications. If any problems are observed during an analytical run or the testing process, corrective action is taken and documented.

Procedures are in place to ensure that all data is traceable, authentic, and complete. Electronic data records are maintained and tracked through the LIMS, requiring authorized, password protected user access. The following general requirements outline our system for notebook, logbook, and electronic documentation recording:

- Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task.
- Entries must be legible, signed, and dated. The signature may be a wet or electronic signature.
- Errors are corrected in a manner that does not obliterate the original entry, initialed and dated, and coded with an explanatory identifier. Changes to electronic data are tracked through audit trail functions.
- Blank pages or substantial portions of pages which are left blank are crossed-out to eliminate the possibility of data entry at a later date.
- Notebook pages and instrument printouts are signed/dated to indicate second party data review; this may be a wet or electronic signature.
- At periodic intervals a supervisor or data reviewer checks equipment/instrument logbook entries and temperature recordings for completeness, legibility, and conformance to procedures.
- At a minimum, the following information is recorded as part of data documentation:
    - Date of analysis/operation
    - Signature/date of analyst performing test/operation
    - Identification of client sample(s) and material(s) analyzed
    - Materials, reagents, standards used to perform the testing/operation
    - Method used to perform testing/operation (including version number and/or effective date)

- Equipment/instrumentation used to perform testing/operation
- Calculations and how they were derived
- Departures, planned or unplanned, from the analytical method
- Signature/date of person reviewing data documentation

- For computer generated data, the following information is recorded:
  - Sample(s) analyzed/operations performed
  - Date of analysis/operation
  - Unique instrument identification
  - Name/date of person operating the instrument
  - Name/date of person reviewing data
  - Any manual notations made on instrument printouts are signed, dated, and reviewed

14.1.2) Laboratory Notebooks, Logbooks, and Forms
Procedures are in place to ensure that all data is traceable, authentic, complete, and retrievable. Most documentation and records are maintained within the LIMS. The laboratory has a procedure in place for data that requires a physical log.

The following general requirements outline our system for the issuing, control, and archival of physical laboratory notebook and logbooks.

- The administration of notebooks and logbooks is controlled by the Office Services Group. They maintain a master index to uniquely number and identify each book distributed.
- Notebooks and logbooks are bound, uniquely identified and have sequentially pre-numbered pages. In specific situations, records may be bound to create books at the time of archival (e.g., temperature charts).
- If notebooks or logbooks contain preprinted laboratory form pages, the form is managed as a Controlled Document in the laboratory's Document Control system.
- Completed notebooks are returned to an archivist. Incomplete books are returned to the Office Services group in accordance with the defined schedule. At that time any blank page(s) in the notebook or logbook are crossed-out, or a statement is written on the last page used to note that the book is complete to prevent data from being entered at a later date.

14.1.2) Electronic Data
Instrument software used for processing data must, when available, have password access and audit trails enabled. All data processed through the LIMS includes tracking features to document who and when data was entered and/or changed. Records shall be retained for equipment and/or instruments that can influence laboratory activities. The record shall include, where applicable: the identity of equipment, including software and firmware versions (*QA-FRM75405*).

14.2) Data Storage, Security, and Archival

The laboratory has documented procedures and instructions for the identification, collection, access, indexing, filing, storage, maintenance, and disposition of data records. Records are in the form of paper records or electronic data files.

All data records are maintained in a confidential manner in an environment to minimize deterioration or damage and to prevent loss. Some records are stored in off-site facilities, in such a way that they are readily retrievable. Retention time for records is in accordance with specific procedures or instructions and in compliance with relevant regulations, for a standard timeframe of 10 years. Prior to the destruction of data/records, and if requested by a client or agency, the laboratory will notify the client/agency that their data is scheduled for destruction so arrangements can be made to have the original data sent to the client.

If specified in client contract(s), archived records are transferred according to their instructions in the event of a change in laboratory ownership or if the laboratory goes out of business. If not specified by the client, the sale agreement must require that archived records be maintained as scheduled by the new owners. In the case of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed.

NOTE: For DOE-clients, the laboratory must obtain written approval from all affected customers before disposal of records relevant to testing performed for them.

The laboratory maintains all documentation which is necessary for historical reconstruction of data:

- Analysis reports
- Data notebooks
- Data logbooks
- Instrument output
- Correspondence and client files
- Instrument and equipment logbooks
- QA records
- Corporate documents
- Electronic records

14.2.1) Computer System Backup, Data Restoration, and Data Archival

Mission critical data is stored on several computers throughout the laboratory. These computers are connected through the local area network. Selected files on these computers are backed up using an enterprise-level backup software program. The objective of this backup is to have the ability to restore data after a total loss (e.g., theft, fire, natural disaster). Procedures are in place to perform data backups and restores.

15) AUDITS

15.1) Internal Audits

The QA Department, which is independent of laboratory activities, is responsible for periodic internal audits of the laboratory activities. Audit personnel are trained in accordance with *Q-EQA-FRM6851*. System, traceability, and observation audits are performed to objectively review current systems, operations, and procedures as well as automated data integrity audits of electronic data records. The goal of the audits is to ensure that the quality system activities are effective and in compliance with referenced methods, regulatory programs (including NELAP, ISO 17025, DoD, PALA, and state agencies), and internal policies and procedures. Audits are documented and tracked in a QA database. All records maintained as part of an audit are kept on file for ten years. The specific content and findings of internal audits are considered company confidential and are not shared with clients.

Audits are scheduled and conducted following a predefined schedule, based on criticality of operation and prior audit results, with the goal of evaluating systems and technologies across the operation to identify

issues or potential risks as well as best practices. If warranted, additional audits are performed to follow up on promised corrective action or areas of concern. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management. Results of an audit are distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an audit with root cause analysis and application of a corrective action plan. If any of the audit findings cast doubt on the validity of the results, the clients must be notified within one business day from confirmation of the issue. Should an audit issue present a major concern regarding validity of laboratory methods, QA personnel can issue a stop work notice.

15.2) Client Audits

Because clients place great importance on compliance with applicable regulations, data quality, and project requirements, they may audit our facility as assurance that their objectives are being met. QA, management staff, PMs, the analytical laboratories, and the support staff play a key role in these audits. Visits by clients can range anywhere from a tour (to verify laboratory facilities and instrumentation) to an intensive inspection of technical operations, procedures, regulatory compliance, and/or review of specific project(s). The option for a remote audit via MSTeams is available.

Audits are scheduled directly with the PM or QA. The request to audit is communicated to all applicable laboratory departments. An escort (designated laboratory employee) remains with an auditor at all times. In accordance with our policy on client confidentiality, a client is permitted to review only data and results that apply to their work, or which have been approved by laboratory management.

15.2.1) Confidentiality

Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are willingly provided.

All employees are required to protect company data, including client names and test results from disclosure to any third party. This policy, as described in the *Eurofins Lancaster Laboratories Employee Handbook*, is provided and presented to employees during their orientation period and whenever revisions are made.

Intellectual property associated with the testing that we perform under contract for a client is the property of the client.

In an attempt to ensure the confidentiality of our systems and procedures within our laboratory, it is our policy to restrict the distribution of our internal procedures to clients. Requests for copies of SOPs to be provided to clients must be approved through QA. Audit and investigation reports are considered company confidential. Audit or investigation summaries will be generated as needed for a client. Personnel files are strictly confidential and facility floor plans may only be viewed on site.

15.3) Agency Inspections

It is laboratory policy to cooperate to the fullest extent and maintain cordial relations with all government agencies. The QA Department is assigned the responsibility of hosting and working with agency representatives. The QA role includes, escorting the investigator(s); ensuring all questions are answered promptly and accurately; making note of all unresolved issues; informing management of the audit status and outcome; responding to the audit report and ensuring that appropriate corrective action is completed. PMs and laboratory staff responsibilities are similar to those noted above for client audits.

Inspections can be performed by investigators or auditors from the EPA, states, third-party accreditation bodies (i.e. A2LA, United States Department of Agriculture (USDA)), or other regulatory agencies. Government agencies have the right to investigate and inspect the laboratory during normal business hours and permission to inspect is granted by Executive Management. The option for a remote audit via MSTeams is available.

Designated members of the QA Department are primary contacts for announced inspections. The QA Manager is the primary contact for all unannounced agency inspections. If the QA Manager is unavailable, Executive Management is notified, in addition to a member of the QA Department. The QA Manager, or their designee, must obtain evidence of the investigator's authority either in the form of a letter or examination/explanation of credentials.

15.4) Proficiency Testing

Many of the organizations that certify the laboratory to perform various analyses require proof of competency. Laboratory performance is checked regularly by participation in a variety of proficiency testing (PT) programs. PT samples are obtained from TNI-accredited vendors. The matrices and analytes defined in the TNI Field of Proficiency Testing (FOPT) tables must be analyzed. In addition, some individual certification programs require analysis of specific sets of proficiency samples.

Generally, the PT programs consist of samples or ampulated spiking solutions used to fortify laboratory samples. The laboratories analyze the samples in the same manner as a client sample, and the data is sent to the agency or vendor for evaluation. After the study results are returned to the laboratory, any data falling outside the acceptance criteria is investigated, root cause is identified, and corrective action is implemented. Results are circulated to management. No PT samples or portion of a PT sample are sent to another laboratory for analysis.

Double blind samples may be submitted to the laboratories with some client projects so that the laboratory is not aware that the samples are PTs. The acceptance criteria for these double blind samples are developed statistically using data from participating laboratories, providing a source of inter-laboratory comparison. Investigations and corrective actions are implemented for these PTs as well. Additional blind PTs or QC check samples can be ordered for a specific test as corrective action if requested by the department or recommend by QA.

15.5) Good Laboratory Practice Critical Phase Inspections

The laboratory no longer performs formal GLP compliance testing.

16) MANAGEMENT SYSTEM REVIEW

16.1) Quality Reports

The QA Department is responsible for preparing a comprehensive monthly metrics report to Management to keep them apprised of current quality issues. This report fosters communication, review, and refinement of the QA system to evaluate the suitability of policies and procedures to meet both regulatory and laboratory quality objectives.

In addition, all levels of management are continually updated on the status of quality and compliance by circulation of pertinent documents. Management review is documented by signatures on the documents, electronic records of each person's review, along with any comments or request for additional follow-up. The types of documents circulated real-time include:

- Internal, client, and agency audit reports and responses
- Proficiency test results
- Monthly QA status reports

16.2) Annual Management Review

Executive management reviews the elements of the total quality program on an annual basis to ensure its continuing suitability and effectiveness in meeting the stated objectives outlined in Section 5.4 of this manual. The evaluation entails review of reports to management, all audit findings, client complaints, laboratory investigations, staff adequacy and training, and projected growth in workload. Patterns or trends in any of these areas are reviewed as a means to continually improve the quality system. This review also

includes an evaluation of any audit findings resulting from the audit of the QA Department. At the conclusion of this quality system review, executive management determines the need to introduce changes or improvements into the quality systems at the laboratory. The minutes from the meeting and any recommendations for improvement are documented and a copy is forwarded to the QA staff for review and follow-up. See *QA-QP38702* for more detail.

17) TEST METHODS AND METHOD VALIDATION

17.1) Scope of Testing

Samples are analyzed in accordance with official published methods, standard methods, client-supplied methodology, or validated in-house methods. We recognize the importance of providing verifiable results and, therefore, use methods accepted and approved by a broad range of federal and state regulatory agencies. The laboratory can also assist in developing and validating analytical methods for specific products and matrices. All methods submitted for our review, as well as all analytical results, are considered confidential.

The laboratory performs a wide variety of environmental testing in support of the Safe Drinking Water Act (SDWA); Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA/Superfund); and the Clean Air Act (CAA). Methods approved by ASTM are also used in testing. Potable water, wastewater, soil, sediment, sludge, oils, biota, tissue, soil gas, and air are among the matrices typically analyzed.

Our areas of expertise include:

Standard Services	**Specialty Services**
• Volatiles • Semivolatiles • Metals • Pesticides/PCBs/Herbicides • Petroleum Analysis • Waste Characterization • Non-potable Water Testing • Drinking Water • Soil and Surface Water Testing • Vapor and Air Analysis • Sediment and Tissue Testing • Method Development • Shale Oil & Gas Analysis	• Dioxins & Furans • Hydrazines • Perchlorate • 1,4-Dioxane • Pharmaceutical Manufacturing Industry (PMI) Wastewater • EPA Method 25D • PCB Congeners • Explosives • Alkyl PAHs, Alkanes, Biomarkers • PFAS • Organic Acids • Aldehydes

All current certificates and scopes of accreditation are available on the laboratory's website https://www.eurofinsus.com/environment-testing/resources/certifications/. A complete list of the tests routinely performed by the laboratory can be found in the *Schedule of Services*.

17.2) Analytical Test Methods

Each laboratory is required to establish and maintain analytical procedures for all the methods referenced in standard testing. The sources for these methods include the most recent versions of these compendia:

- Test Methods for Evaluating Solid Waste, SW-846
- Standard Methods for the Examination of Water and Waste
- Code of Federal Regulations, Chapter 40
- EPA 100 through 600 and 1600 series methods
- ASTM

The test methods used are re-written into a laboratory standard format, which provides consistency in content and allows the analysts to locate the information they need quickly. Procedures are in place to define the format, required approvals, and the control system for these method documents. Elements to address in SOPs are based on TNI and DoD required sections. The format requirements include, but are not limited to, the following:

- LIMS defined method designation, which is used extensively for scheduling and documentation purposes.
- Reference to the original source of the method (e.g. SW-846)
- Scope
- Basic Principles
- Apparatus and Reagents
- Personnel Training and Qualifications
- Safety and Waste Disposal
- Detailed procedure (including any method modifications)
- Calculations
- QA/Quality Control
- Revision Log
- Review and approval by technical management and QA personnel

Analytical methods are maintained as controlled documents to ensure that analysts are always working with the most current version and are reviewed annually for accuracy.

17.2.1) Procedural Deviation

Analysts are required to follow a documented method for all tests performed. Procedures are in place to ensure that deviations from analytical methods are documented, approved, and justified in an appropriate and consistent manner. We classify method deviations as either being a planned deviation or an unplanned deviation. In general, the following information is captured to document both types of situations:

- Description of the deviation
- Reason or justification for the deviation
- Impact the deviation had on the testing
- Electronic Signature/date of analyst performing the test
- Electronic Signature/date of Quality Assurance and Laboratory Management approving the deviation
- Electronic Signature/date of client approval, if necessary

Deviations to written procedures are documented in raw data records or through the ICAR (Investigation and Corrective Action Report) system. Both types of documentation require management and QA review and approval.

NOTE: Deviations to analytical methods are NOT permitted by PALA. If samples are analyzed for compliance to a regulatory program, deviations may be allowed with approval from the appropriate compliance officer and/or program.

17.2.2) Client Supplied Methods

Most of the client-supplied method requirements presented to us involve achieving specific quality control criteria, reporting limits (RL), and/or method detection limits (MDL) using standard EPA methods. These

requirements are communicated to the appropriate technical groups prior to the project start up. Each technical group evaluates the scope of work and the requirements to ensure the criteria can be met using the standard EPA method. The data is monitored to ensure the criteria are met throughout the project. The PM notifies the client if there is a more appropriate method available or if the client's criteria cannot be achieved on a certain sample matrix (i.e., due to matrix or dilutions).

Occasionally, we are asked to transfer a non-standardized method from a client into our lab or to develop a new method, when one is not available. In the case of a method transfer, we set up the client's method and perform some initial evaluation. After the initial evaluation, we may make recommendations on how to improve method performance. If the method appears to be adequate, we determine linearity, specificity, precision, accuracy, MDL, and RL by performing calibrations, analyzing method blanks, and carrying out method detection limit and quad studies.

In the case of method development, we work with the client and/or data user to determine the level of validation required ensuring that the method meets its intended purpose. In addition to the elements above, we also determine standard and sample stability and robustness depending on the scope of the project. Typically, a standard operating procedure is written and submitted to the client with the results of the validation. These steps are completed prior to analysis of field samples. Data related to the setup of the method are archived.

17.3) Method Validation

Before new or revised analytical methods are authorized for routine use in the laboratory, validation data is required to demonstrate that the method as performed in our laboratory and analysts performing it are capable of meeting data quality objectives for precision and accuracy. A procedure is in place to outline this process.

Many methods published by USEPA include instructions for performing an initial demonstration of capability, which typically consist of determining the method detection limit and analyzing fortified samples in quadruplicate (i.e. a quad study). This demonstration is performed and compared to acceptance limits for precision, accuracy, and detection limits, when available.

Methods that do not include specific validation requirements are validated by analyzing fortified samples or standard reference materials in replicate. The results of these analyses are used to assess accuracy and precision. Results of validation studies are documented and subject to review and approval by technical and QA management.

17.4) Reporting Limits

It is important to ascertain the reporting limit (RL), also referred to as the limit of quantitation (LOQ), that can be achieved by a given method, particularly when the method is commonly used to determine trace levels of an analyte. The Environmental Protection Agency has set forth one method for determining method detection limits (MDLs) from which RLs/LOQs can be extrapolated. This process is summarized in a laboratory procedure.

MDLs are determined annually using quarterly MDL analyses performed for each method across all instruments used for that method. The MDL is the basis for the RL/LOQ used in the default reporting format. Because MDLs change each time they are re-evaluated, they are not included in this manual, but are maintained in the LIMS and available to clients upon request.

The reporting limit used to determine whether a result is significant and reported as detectable is dependent upon agency and client requirements. A variety of formats are available and include use of the MDL, RL/LOQ, method specified limits, and project specific limits. The MDL and RL/LOQ for each analyte are programmed into the LIMS for reporting purposes. The reported value is adjusted to account for sample aliquots.

Under the DoD program, the laboratory must establish a Detection Limit (DL) and Limit of Detection (LOD). As defined by the DoD program, the DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. The laboratory determines the DL using the calculated value from the MDL Study. The DL can be derived from pooled MDL values obtained across instruments. The LOD is the smallest amount of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. It is established by spiking a quality system matrix at a

concentration of 2-4 times the DL and must be less than the RL/LOQ. The LOD must be verified on a quarterly basis or with each batch of samples.

17.5) Measurement Uncertainty

Per ISO 17025-2017 section 7.6.1 "Laboratories shall identify the contributions to measurement uncertainty. When evaluating measurement uncertainty, all contributions that are of significance, including those arising from sampling, shall be taken into account using appropriate methods of analysis." This means the laboratory must determine the uncertainty contribution of all steps in the testing process such as equipment, calibration, standards, reagents, preparation, cleanups, etc. Since, in most methods, the laboratory control sample (LCS) goes through the entire process of preparation to analysis; all factors that would contribute to uncertainty is evident through the LCS results. LCSs are performed with every batch of samples where appropriate for the method. Tests that do not have LCSs (i.e. TCLP; paint filter test), are evaluated on a case-by-case basis by taking into account the uncertainty of each of the steps taken to perform the test. Our laboratory does not perform field sampling so our ability to assess uncertainty is limited to the processes that we perform. Thoroughly mixing samples prior to taking the testing aliquot minimizes the uncertainty risk with our aliquot.

Measurement Uncertainty is calculated as two times the standard deviation of the LCS recoveries for the group and date range of data points selected for all applicable methods. This is reported as a percentage. It is not necessary to apply or report the uncertainty value with sample results. When a client requests the measurement uncertainty it is applied by multiplying the determined analyte concentration by the uncertainty percentage.

18) EQUIPMENT AND CALIBRATIONS

18.1) Laboratory Equipment Requirements

This document defines equipment as instrumentation used for the determination of analytical results, measurement equipment used for sample preparation and analysis, and support equipment used that may be outside of direct analysis.

The laboratory stocks all equipment required for testing the scope of work which it supports. Equipment is operated by authorized personnel. All equipment is maintained in proper working order and is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. A master list of laboratory equipment is maintained by our accounting department and includes the date received and the condition at receipt (new v. used). Major equipment and instrumentation capabilities are summarized in *Appendix F*. In addition to this list, the laboratory stocks support equipment such as pH meters, ovens, incubators, centrifuges, balances, etc.

Laboratory procedures include, a routine schedule for equipment preventive maintenance (where applicable), a calibration schedule, calibration acceptance criteria and remedial action to be taken in the event of failure. These procedures are maintained in the document control system and reviewed on a regular basis to verify they remain current and accurate. Vendor supplied manuals are also available to provide additional information in regard to operation and maintenance.

Equipment is assigned a unique designation. This unique number or system identification is used to track equipment in logbooks and in the LIMS.

A maintenance logbook is established in conjunction with installation and is readily available to document all incidents and/or routine maintenance processes that pertain to the equipment as they occur. The corrective action taken, the date that the equipment/instrument is returned to service, and performance checks performed is documented.

All equipment or instruments taken out of service are tagged "DO NOT USE". The following minimum information is documented on the tag:

- Date taken out of service

- Employee who took the equipment/instrument out of service
- Reason for tag-out

18.2) Calibration

Calibration is the establishment of, under specified conditions, the relationship between the values/response indicated by a measuring instrument or system and the corresponding known/certified values associated with the standards used. Before being placed into service, equipment must be calibrated or checked to establish that it meets the criteria in the applicable laboratory SOP. Some types of calibrations are performed with a set frequency (e.g. daily) while others provide intermediate checks to ensure that the instrument response has not changed significantly.

The calibration procedures, schedules, and acceptance criteria are defined in the corresponding SOPs and Work Instruction documents. Equipment requiring calibration shall be labeled or otherwise identified with the calibration date and status. (i.e. Analytical equipment calibrations dates are maintained within the instrument software.) All measuring and testing instruments and equipment having an effect on the accuracy, precision, validity, or measurement uncertainty of results are calibrated and/or verified at least annually.

Methods for calibration of instruments and equipment vary widely with the nature of the device and the direction given by analytical procedures, departmental procedures, manufacturer recommendations, or regulatory requirements. Frequency of calibration can also depend on additional factors including ruggedness of the instrument or equipment and the frequency of use. Calibrations must be compliant with TNI2016 V1M4, including a calculations of error (RSD for average curve fits, and Relative Error or Relative Standard Error for other curve types such as linear or quadratic).

Departmental management is responsible for developing or acquiring written calibration procedures for the types of instruments and equipment employed within their area, as applicable. Procedures address the following aspects: description of the calibration method, frequency/schedule for calibration, acceptance criteria, and corrective actions if failure occurs.

Calibrations data is generated and filed to document the activity and recorded either in the equipment logbook, the LIMS, and/or a calibration certificate is maintained.

Calibration failures are documented in the associated logbook and/or within the data generated from the instruments or equipment. Management personnel perform an evaluation and review of failures and assess any potential impact the failure might have on previously generated data. The laboratory utilizes “real-time” controls to ensure the accuracy of the data. These controls are used to assist in assessing the impact of the situation.

After repair, adjustments, or relocation that could affect instrument response, calibration/verification activities are performed, as applicable, before the unit is returned to service.

Analytical data is not reported from instrumentation or equipment with noncompliant calibration unless the client has agreed to receipt of the data and appropriate qualifiers or comments are applied to the final Analysis Report.

18.3) Maintenance

Instrument and equipment maintenance is performed as either a preventive or corrective operation. These processes and schedules are defined in the corresponding SOPs and Work Instruction documents.

Preventive maintenance procedures and schedules are developed for each instrument or piece of equipment, where applicable. Preventive maintenance operations are performed by an analyst, equipment maintenance specialist, or contracted (manufacturer’s representative or service firm personnel). Documentation is maintained in the associated maintenance log for the procedure(s) performed as part of the preventive maintenance operation. It is the responsibility of departmental management to ensure that a preventive maintenance schedule is addressed by a procedure where appropriate and is followed.

Corrective maintenance is performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel) in response to indications of equipment or instrument malfunctions. The unit must be clearly tagged as out of service. All corrective actions taken to bring the unit back into service are documented in the associated maintenance log. After repair, further notation is made in the log regarding the functional status. Calibration activities are performed, as applicable, and documented in the log before the unit is placed back into service.

A supply of commonly needed replacement parts is maintained by the laboratory.

19) MEASUREMENT TRACEABILITY

19.1) Reference Standards and Materials

The laboratory has procedures to ensure traceability of measurements with documentation of calibration activities via the analysis of reference standards, or certification through an accredited third party that performs ISO 17025-compliant calibrations.

Calibration measurements are traceable to national standards of measurement (e.g., NIST) where available. Physical standards, such as NIST certified weights or thermometers (if used by the laboratory), are re-certified on a routine basis by a vendor accredited to ISO 17025 according to the relevant accrediting body requirements as documented in the laboratory standard operating procedures. Calibration certificates are maintained on file, where applicable, to indicate the traceability to national standards of measurement. These physical standards are used for no other purpose than calibration. The required certification schedules for references standards are included in laboratory standard operating procedures and work instructions.

Standard calibrations schedules for reference standards are as follows:

- NIST-certified weights: every 5 years per ISO 17025 , or a 3 years per PALA
- NIST-certified thermometers: every 5 years

Laboratory support equipment whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. All equipment that has an effect on the accuracy, precision, or validity of an analysis or preparation must be calibrated and/or verified at least annually. The procedures must be listed in the department's Work Instructions.

19.2) Calibration Standards

The laboratory's ISO 17025 and DoD accreditations require calibration materials to be certified and purchased from a reference material producer accredited to ISO 17034 and ISO 17025, when available. A list of accredited suppliers is maintained by QA. This is applicable to the tests under these scopes of accreditation and can be met through the stock standards used for calibration; a standard processed under the calibration such as an ICV or LCS; or comparison to a separate reference material at a frequency defined by at the test level (i.e. annually).

Standards are usually purchased from commercial supply houses either as neat compounds or as solutions with certified concentrations. Upon receipt at the laboratory, the material must be labeled with the date of receipt. The accuracy and quality of these purchased standards is documented on a Certificates of Analysis (COAs) and maintained on file in the laboratory.

Records of all working standard preparations include the dilution(s) made and a reference to the original and any intermediate mixtures. Solutions are labeled according to laboratory procedures and assigned unique names or code numbers that provide traceability to the original components.

All standards are stored separately from samples and in conditions as stipulated by the method or vendor (refrigerator, freezer, room temperature, etc.).

Each new preparation of standard is tested for integrity by comparison to standards from another source or previously prepared solutions. Standards are not used for sample analyses in the laboratory past their expiration date. In some method development or research work, expired standards may be used. These must be labeled as such or stored in a designated location.

20) SAMPLING

20.1) Sample Collection

The laboratory does not provide sampling services. It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples for their collection event. The laboratory provides the appropriate sample containers, required preservative, chain of custody (COC) forms, shipping containers, labels, and custody seals. The laboratory also provides trip blanks and analyte-free water for field blanks.

If additional sample volume is necessary to complete testing or perform retesting, the laboratory contacts the client to submit additional volume to supplement current work being performed within our facility. Additional sample received is either assigned a new laboratory sample ID number and/or a comment noted on the final report to state that additional sample was received, depending on the situation. It is our goal to provide accurate traceability between sample submission and when testing is performed.

20.2) Sampling Instructions

The laboratory provides instructions with all bottle orders that define how to sample, preserve, store, and ship the samples prior to their delivery at the laboratory. Sampling instructions are made available upon request. These instructions inform the client of the importance of proper sampling and advise them that non-compliant samples are rejected or reported with a qualifier.

20.3) Sample Containers

Sample containers are purchased pre-cleaned by the supplier. For pre-preserved bottles, each lot of preservative is checked for contaminants before use. This also serves as a check on the associated containers. An annual bottle lot check is performed to evaluate the cleanliness of any containers not already covered by the preservative checks. The evaluation is to assess cleanliness to the laboratories' detection limits. These checks are processed through the LIMS as samples. Results are documented through the LIMS Analysis Report.

21) SAMPLE HANDLING

21.1) Chain of Custody

The Chain of Custody (COC) form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect.

21.1.1) Legal Chain of Custody

Samples being tested for litigation require locked storage and documentation of the time and personnel responsible when the sample was not in storage. This level of documentation is available upon client request and procedures to define these activities are in place and include the following:

- A legal internal COC is initiated for each bottle type submitted by the client.
- The legal internal COC is signed each time the sample is stored, removed from storage, or changes hands.
- Clients requesting legal internal COC documentation receive the completed forms after the analysis is complete.

21.2) Sample Receipt

Samples can be received at the laboratory 24 hours a day, 7 days a week, 365 days of the year. Receipt can occur in one of three ways:

- The laboratory courier services (i.e., Transportation Department)
- Personal delivery

- Commercial courier

All samples received for testing are delivered to the Sample Registration group immediately upon arrival. This group is responsible for the unpacking and organizing of the samples. This process includes checking custody seals if present, paperwork agreement, signing the COC, recording cooler temperatures, documenting the condition of containers, accounting for all sample bottles, and observing any safety hazards, and reporting any problems to Client Services for communication to the client. This receipt process is documented in the LIMS.

21.2.1) Sample Acceptance / Rejection Policy

Regulated (e.g. drinking water, NPDES) samples are rejected if receipt requirements are not met. The laboratory's Sample Acceptance Policy *S-SA-FRM10734* is communicated to clients with each bottle order. Any time a sample is received in a condition that does not meet the method, regulatory, or client requirements, the condition of the sample is clearly documented through the LIMS using a sample registration receipt checklist and receipt comments. This information is communicated to the PM and the client is contacted to discuss the best course of action. The client is given the option to resample or have the sample analyzed and reported with a qualifying comment. Some regulatory programs do not allow qualification. Details are provided in the Sample Acceptance Policy.

21.2.2) Sample Preservation Check

Sample Registration personnel check and document preservation of non-volatile liquid samples after the samples have been entered into the LIMS and before they are released to the laboratory for testing or placed into storage. Any checks of volatile samples are performed and documented at the time of analysis.

21.3) Sample Entry

As soon as practical after sample receipt, all samples are entered into our LIMS. Samples awaiting log-in are stored in temporary holding areas, at appropriate storage conditions to maintain sample integrity. Samples scheduled for Volatile analysis are stored separately. If there is doubt about the suitability of items received or if items do not conform to the description provided or the testing required is not clear or specified, the client is contacted and the conversation documented.

At the time of entry, the LIMS assigns a unique laboratory job and sample number to each sample. This job number is sequentially assigned and a label is generated and is attached to the sample container. Each sample container is uniquely identified with a container descriptor and unique container designation. The sample number and container used are documented on laboratory data records to ensure traceability from the test data to the sample container that was used. The label includes a barcode that can be used to confirm/enter the sample identification information throughout sample processing.

Sample receipt processing is tracked and documented in the laboratory from arrival through receipt, unpacking, and entry.

A sample acknowledgement is generated from the LIMS per sample entry group. Upon request, a copy of the Acknowledgement may be sent to the client on the day following sample log-in to confirm sample receipt and entry. Internally, appropriate personnel audit all applicable sample entries against the client paperwork.

21.4) Sample Identification and Tracking

The sample label generated at time of entry contains the following information:

- A unique sample number
- A unique container identification
- Container type
- Storage location
- Client sample designation.
- Sample date and time
- A unique barcode that contains this information about the sample/container and tracks each container’s storage location, traceable within LIMS.

The unique sample number assigned is used to identify the sample in all laboratory data documentation, including notebooks, instrument printouts, and final reports. Each container for a sample is tracked through the sample number and container designator code when there are multiple containers of the same type received. This is used to identify which specific container was used for testing. Laboratory subsamples, extracts, and digests generate unique container identification in the LIMS.

Routine sample tracking is documented using the Laboratory Chronicle which captures the date, time and analyst for each sample preparation and analysis. The information is compiled in the LIMS using electronic record tracking from the data upload and entry functions. This displays, per sample, on each Analysis Report.

21.5) Sample Storage

After sample registration is complete, samples are placed in an assigned and identified storage location until needed for analysis. Room temperature, refrigerated, and frozen storage are available and samples are stored in accordance with regulatory, method, or client direction. The LIMS is used to assign storage locations, which assists in the orderly storage of samples. Sample storage locations are secured and monitored for accurate temperature control. Samples are stored separately from standards and reagents.

The central locked storage facility contains 3430 square feet of refrigerated space, including 2740 square feet equipped for automated sample retrieval. Samples are stored in the laboratory's automated storage and retrieval system (ASRS) or other assigned storage locations (separate volatiles areas) within the laboratory until completion of all analytical work.

When a sample is scheduled for analysis, the analyst requisitions it through the LIMS from the storage area. Barcode readers are used for LIMS documentation of the movement of the samples between storage and the laboratories. To maintain the integrity and security of the sample(s), the aliquot needed for analysis is removed and the sample(s) returned to storage as soon as possible.

21.6) Representativeness of Samples

Each analytical method provides specific procedures to ensure that a representative aliquot of the sample is used for testing. These procedures include shaking water samples and mixing solid samples prior to removing the aliquot for testing. Analysts are also instructed in sampling techniques that prevent contamination of samples and for handling volatile samples to minimize loss of volatiles.

It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples of the system from which they are drawn. The laboratory assumes that all multiple sample containers with the same designator/description and bottle type contain a homogeneous, representative sample. We also assume that it is acceptable to deplete one container and move to the next without implications unless otherwise indicated by the client.

21.7) Sample Return/Disposal

Samples remain in the storage area following analysis until the testing results have been verified and the Analysis Report has been generated. On a regular basis, a list is generated from the LIMS that summarizes samples that can be removed from the storage area. At a minimum, water samples are held for 1 week and soil samples for 2 weeks after reporting before they would be eligible for disposal. Samples are either returned to the client or disposed of in accordance with local, state, and federal regulations. Removal of the containers from storage for permanent discard is also documented in the LIMS using the barcode reader.

Due to the variety of waste generated at the laboratory, several general categories of wastes and waste streams have been identified. Identification of waste occurs through information provided by the client, historical information, and/or analytical testing. The laboratory uses a sophisticated, computerized LIMS, which includes programming to assist in the identification of hazardous wastes at time of discard.

For reasons of environmental liability, client confidentiality, proprietary product formulation protection, etc., wastes generated by the laboratory are disposed of via incineration at EPA licensed facilities. The three

exceptions include bulk neutralized acid waste, COD analysis waste, and lab pack waste containing mercury. None of these exceptions involve containers with client information.

22) ASSURING THE QUALITY OF TEST RESULTS

22.1) Ongoing Evaluation of Data Quality

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process using the following:

- Instrument calibration and evaluation as discussed in Section 18
- Routine process quality control sample (QC) analysis (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DU), surrogates, Internal Standards (IS)).
- Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance as discussed in Section 15.4.

22.2) Reagents and Solvents

The reliability of our analytical results can be directly affected by the quality of reagents used in the laboratory. Procedures are in place to address labeling, storage, and evaluation of these materials. Reagents and solvents include acids, bases, indicators, buffer solutions, colorimetric solutions (CS), test solutions (TS), and volumetric solutions (VS). The *Chemical Hygiene Plan* provides safety information in regard to the storage and handling of laboratory chemicals. All reagents are stored separately from samples.

Each analytical method includes a list of reagents needed to perform the test. Reagents/solvents are fully described, including chemical name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed. The laboratory is responsible for checking that new supplies meet the method requirements. These checks are documented and maintained.

Departmental management ensures that an adequate inventory of reagents needed to perform testing is maintained. Reagents received at the laboratory funnel through the Shipping and Receiving Department and deliveries are verified and labeled with the date of receipt. Large volume reagents (e.g., solvents, acids) are stored in a building outside of the laboratory until needed for use.

In addition to the name and concentration of the reagent, all reagents are labeled with the manufacturer/vendor, storage conditions, the date opened, and an expiration or re-evaluation date. Before using any reagent, the analyst must ensure that the material was properly stored and labeled. If a reagent has passed its expiration date or shows signs of deterioration, the material is not to be used in the laboratory and must be discarded or segregated as expired. In some method development or research work, expired reagents may be used. These must be labeled as such or stored in a designated location.

If a re-evaluation date is reached before a reagent is completely consumed, the reagent will be inspected by physical observation for signs of degradation. Physical signs include, but are not limited to, color changes, clumping or other texture changes for solids and formation of precipitate in solutions. This evaluation is performed by an experienced chemist.

Subsequent reagent solutions or mixtures prepared at the laboratory are fully documented in a log and labeled to include: unique name, concentration, date prepared, name of analyst who prepared the reagent, storage conditions or reference to the log containing these details, and expiration/re-evaluation date. The information recorded allows these solutions to be traced to the original stock solution. The reference to the log is intended for use on containers that are too small to clearly document all of the information. The "log" may be a LIMS identifier for reagents/standards with preparation tracked via the LIMS.

All reagent certificates and SDSs are retained by the laboratory.

22.3) Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Management is responsible for ensuring that QC is analyzed as required by the referenced method. Each analytical SOP specifies (or cross-

references another procedure) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptable range.

The laboratory provides additional bottleware to the client for matrix QC sampling as determined by the method or regulatory requirements.

QA staff, at the direction of the technical department, must program the LIMS with the acceptance criteria for each QC type (other than blanks). The acceptance criteria are based on statistically generated limits from historical laboratory data, on method defined limits, government agency recommendations, or on client/project specific limits.

These limits are used to flag samples that are out of specification.

The types of QC samples and the information each provides are discussed in the following paragraphs.

22.3.1) Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples and the corrective action required when a QC result fails to meet the acceptance criteria.

The QC acceptance criteria are available to analysts in the laboratory through their SOPs or Work Instructions and the LIMS. If the method reference requires the use of specific limits then the laboratory uses the published limits that are documented as part of the analytical method. Many methods require that each laboratory determine their own acceptance criteria based on statistical data obtained from performance of the method. In these cases, the limits are available to the analysts and are entered into the LIMS described below. Statistically determined acceptance criteria are subject to change as the laboratory recalculates its control limits. Due to their dynamic nature, acceptance criteria are not included in this manual.

The results of all quality control samples are entered into the LIMS in the same way as the results of client samples. The LIMS compares the individual values with the acceptance limits and identifies quality control sample results that are out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This includes, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a flag and/or comment stating the observed deviation, and actions applied to the samples in the batch (e.g. reprep, reanalysis).

Qualifiers are applied to the data report, but additional comments are **not** needed for the following scenarios:

- QC with high bias and nondetects in the associated samples.
- Matrix QC outliers
- Surrogate outliers due to dilution effects or where confirmatory analysis supports the original result
- Blank detections where the associated sample is nondetect or has the analyte detected at >10x the blank level

The laboratory allows for marginal exceedances based on the number of analytes in the LCS. The exceedances are carefully monitored so that any systemic problems would be identified and corrective action taken. If the LCS is being reported based on the marginal exceedance allowance, a comment is added to the analytical report.

22.4) Negative Controls

Negative controls are used to monitor for possible contamination. The following are examples of negative controls used by the laboratory:

22.4.1) Method Blanks (MB)

A method blank is a designated sample designed to monitor for sample contamination during the laboratory testing processes. The method blank consists of a clean matrix (i.e. reagent water, Ottawa sand, glass beads, Teflon chips) taken through the entire sample preparation and analysis process. The method blank and field samples are treated with the same reagents, internal standards, and surrogate standards. Ideally, method blanks demonstrate that no artifacts were introduced during the testing processes. The specific acceptance criteria for each test are usually based on the required reporting limit (MDL or RL).

22.4.2) Instrument Blanks
Instrument blanks are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. Instrument blanks differentiate between contamination caused by the analytical system and that caused by the sample handling or sample preparation process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

22.4.3) Trip and Field Reagent Blanks
Trip blanks (TB) are provided by the laboratory, pre-filled with clean reagent water. Field reagent blanks (FRB) are filled at time of sample collection by the sample collector.

TBs or FRBs are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles and PFAS analyses (or as specified in the client's project plan). Additionally, TBs may be prepared and analyzed for volatile analysis of air samples, when required by the client. A TB may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The TB is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the TB in the cooler with the field samples.

22.4.4) Storage Blanks
Storage blanks are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory.

22.5) Positive Controls
Positive controls are reference materials with a known amount of analyte (see Section 19) that are used to demonstrate accuracy and precision.

22.5.1) Laboratory Control Samples (LCS)
Laboratory control samples (LCS) are samples of known composition that are analyzed with each batch of samples to demonstrate laboratory accuracy. Laboratory fortified blank (LFB) is another term used to describe a LCS. The samples are a clean matrix fortified with known concentrations of the analyte. Percent recovery is calculated and compared to acceptance limits.

22.5.2) Second Source Check
A second source check is analyzed using either the LCS and/or an Initial Calibration Verification (ICV). The second source is a standard that is made from a solution or neat purchased from a different vendor than that used for the calibration standards. For some custom mixes, the same vendor but a different lot and preparation is used. This ensures that potential problems with a vendor supply would be evident in the analysis. Some tests use the continuing calibration verification standards as a second source from the initial calibration.

22.5.3) Duplicates, Matrix Spike Duplicates and Laboratory Control Sample Duplicates (DU, MSD, LCSD)
A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. To compare the values for each analyte, the relative percent difference (RPD) is calculated by dividing the difference between the numbers by their average. Precision for analytes that are not typically found in environmental samples (i.e., organic contaminants) is determined by analyzing a pair of matrix spike duplicates, defined as two spiked samples and comparing the RPD for the spiked compounds. The acceptance criteria are described as a maximum for the RPD value.

22.6) Sample Matrix Controls

The following are examples of controls used by the laboratory to identify the impact of potential sample matrix interferences:

22.6.1) Matrix Spikes (MS)

A matrix spike sample is created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. Blanks are not used for matrix spike QC. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the potential matrix effects on the data relative to the parent sample. Matrix effects can cause results to be outside of the acceptance criteria. Matrix QC is reported only on the Analysis Report for the job that includes the parent sample. Batch acceptance is not dependent on matrix QC. Unless stipulated in a method or by the client, corrective actions are not applied to matrix QC outliers.

22.6.2) Surrogates

Surrogates are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the analytical method, surrogates are spiked into all the field and QC samples to monitor analytical efficiency by measuring recovery on an individual sample basis. The percent recovery is determined and compared to the acceptance criteria.

Isotope dilutions analyses use labeled isotopes, not surrogates, in each field and QC sample.

22.6.3) Internal Standards

Internal standards are compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the method, internal standards are added to every field and QC sample after extraction but prior to analysis. Comparison of the peak areas of the internal standards is used for quantitation of target analytes. Internal standard peak area and retention time also provide a check for changes in the instrument response. The acceptance criteria are stipulated in the analytical method.

23) REPORTING RESULTS

23.1) Sample and Data Flow

At a minimum, data management is initiated when the laboratory receives the samples from the client. More often the process begins with client communication of their needs and requirements for a specific project and/or testing. When requested, bottle orders for the client's sampling efforts are generated through the LIMS by the PM. The PMs are responsible for entering the information in the sample set up function of the LIMS. Upon receipt of the samples a unique tracking number for the sample group and the samples within the group is generated based on this information. At this point, the LIMS becomes an integral part of tracking the samples through laboratory operations. The flow of data from the time samples enter the laboratory until the data is reported is summarized in the following table:

Sample and Data Flow

Action	Personnel Involved
Bottle orders generated upon request · Bottles packed and shipped to the client under chain of custody documentation	PM Bottles Preparation
Sample received at Lancaster Labs · Unpacked and reconciled against the client paper work or COC · Sample Entry Documentation log completed	Sample Registration
Sample is entered into the LIMS · Lab ID number assigned · Analyses entered · Storage location assigned	Sample Registration

Action	Personnel Involved
· Electronic record of sample number · Labels generated · Acknowledgement generated (record of samples received and analyses entered)	
Preservation checks performed Sample stored in assigned location (refrigerator, freezer, etc.) · Electronic record of sample #, container type, and location	Sample Registration
Acknowledgment sent to client (when requested)	PM
Samples requisitioned and removed from storage for analysis · Electronic requisition of sample number by container type · Necessary aliquot taken · Remaining sample returned to storage	Sample Registration Technical Personnel
Analysis is performed according to selected analytical method and applicable Project Notes* · Raw data recorded · Data Reviewed · Data uploaded to the LIMS from the instrument or manually entered by the analyst* (This is tracked by the unique sample number and batch number.)	Technical Personnel
LIMS performs calculations as programmed according to methods	Data Processing
Designated analyst or supervisor verifies raw data	Technical Personnel
Generation/release of reports	PM or designee
Data package deliverables are assembled, reviewed and released to client Electronic copy saved in the LIMS	PM or desginee
Electronic Data Deliverables (EDDs) are generated in LIMS	EDD staff
Designated Data packages are overchecked by QA prior to release	QA
Hard copy of raw data is archived Electronic data files and records are backed up and archived	Technical Personnel, Office Services, IT

*Project Notes contain client- and agency-specific requirements (i.e. DoD, PALA, NJ DKQP, CT RCP, MA MCP)
**Analyses requiring the analyst's interpretation may involve manual data reduction before entry into the LIMS.

23.1.1) Identification of Approved Signatories

All data is reviewed and verified by a second level reviewer at the department level prior to release to the client. The signature of the assigned project manager (PM) is applied to the Analysis Report. The PM performs a basic content check of the report. The authorization of the data is stipulated by the technical reviews performed and documented in the LIMS (1st and 2nd level reviews).

Based on complexity or regulatory needs, some projects are designated for additional QA review of the Analysis Reports and/or data deliverables. Designated QA staff are the "approved signatories" for these secondary reviews. Completion of the QA review is documented in the LIMS job tasks.

Note: "signatures" are attached through the LIMS interface and employee login.

23.1.2) Timely Delivery

Evaluating laboratory capacity and ability to perform specific projects is a joint responsibility between the laboratory President, Operations Director, Business Development, and the laboratory managers. We recognize that one of the most important aspects of the service we offer is turnaround time.

Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in the laboratory area creating operation flexibility for routine work. Larger projects are reviewed against capacity estimates before bids are submitted to ensure that the client's schedule is met. Turnaround time is continually measured.

Regularly scheduled meetings are held with technical and support management, and project management personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Management receives a daily report of the status of all samples in the lab, including those with priority status or those that have exceeded a preset turnaround time. This enables the planning and organizing of the workload through efficient scheduling.

Any changes to the established timeline by the client or the laboratory must be communicated to the client or laboratory as soon as possible. Upon communication of changes, a new timeline is established and agreed upon by both parties. If a client requires a change in the scope of the project (e.g., number of samples submitted, change in analyses, revised protocol) the laboratory must be informed in writing and a new timeline and cost estimate is be provided.

23.2) Data Reporting

When all analyses are completed and overchecked, the Analysis Report is generated and released from the LIMS. The client receives a copy of the report containing the results of the analysis and, where necessary, qualifier flags and/or explanatory comments to address non-conformances.

Copies of reports and associated supporting raw data are retained in our archives. The report contains the signature of the assigned client service representative who is the key contact for any questions concerning the results. Data release authorization is managed and tracked through the individual analysis first and second level reviews documented in the LIMS.

Standard Level 2 Analysis Report Sections

Section	Description
1. Cover Page	Report signatory and reporting laboratory Revision date and time Laboratory Job ID
2. Table of Contents	
3. Definitions/Glossary	Explanation of all symbols and abbreviations used in the report
4. Case Narrative	
5. Detection Summary	
6. Client Sample Results	Lab Sample ID Client Sample ID Date and time Collected Date and time Received Matrix Method Analyte Result Qualifier Reporting Limits

Section	Description
	Units Dilution Factor Date and Time of Analysis Surrogate recoveries
7. Surrogate Summary	
8. QC Sample Results	Analysis Batch Analyte Result Qualifier Reporting Limits Unit Dilution Factor Date and Time of analysis %Recovery Acceptance Criteria
9. QC Association Summary	Analysis Batch Prep Batch Lab Sample ID Client Sample ID Prep Type Matrix Method
10. Lab Chronicle	Date and Time of analysis and preparation Identification of laboratory analyst
11. Certification Summary	Authority, Program, Certification ID and Expiration Date List of analytes reported by the laboratory that do not come under the certification scope
12. Method Summary	
13. Sample Summary	
14. Chain of Custody	
15. Receipt Checklists	

The laboratory offers a variety of data reporting levels and formats, from a basic report of sample and QC results only, to a comprehensive data package of QC/calibration information and raw data. The client and any agency involved direct the selection of report type. Various electronic formats are also available formatted to client-specified file structure and sent via e-mail, direct upload, secure web-site access, or common courier. The secure web-site access is used for clients that require secure transfer of electronic data.

Client confidentiality of web-site data is ensured by the use of a secured firewall internet environment coupled with the use of a user ID and password to gain login access to the system. User accounts are configured to only allow access to specific data associated with the user’s business account number.

Amendments to a final report after issue are in the form of an additional document or data transfer and include a reference to the original report. When a completely new final report is required, it is uniquely identified and includes a reference to the original report it replaces.

Analytical reports are generated with a cover page that identifies the laboratory contact person’s name and phone number if there is a question about the report. Within this package, each page is uniquely identified and paginated. Analytical test results for methods listed on the laboratory's accreditation scope meet all requirements of the relevant regulatory body accreditation, NELAP accreditation, and ISO 17025 unless noted otherwise.

23.2.1) Safe Drinking Water Regulatory Compliance Reporting (SDWA)

Of all the testing performed at the laboratory, work that is submitted for compliance to the Safe Drinking Water Act (SDWA) must be considered the most critical to public health. The laboratory maintains QA-SOP11886 detailing state-specific acceptance, analysis, and reporting criteria for the most common submissions to the laboratory. The Project Manager must also designate SDWA Projects as "Compliance" in LIMS, to ensure that all requirements are met.

A summary of these requirements is as follows:

- **Sample acceptance** - while some clients may want data reported regardless of the acceptability of the samples, SDWA samples should not be accepted or analyzed by the laboratory unless all sample collection and preservation requirements are met.
- **Sample analysis** - some industry-standard accepted qualifications to the data, such as high-biased QC associated with non-detect samples, are **not** acceptable for SDWA compliance reporting in many cases. Past holding time analysis is **not** acceptable. If the sample is used for Matrix QC (DU, MS, MSD, etc.), matrix failures are **not** acceptable without additional testing, such as dilution of the sample and re-analysis.
- **Maximum Contaminant Limit (MCL) Exceedance Notifications** - MCLs are the concentrations at which the EPA has deemed that the water is **unsafe to drink**. Most states notification timelines that must be met - examples are within 24 hours of analysis, or within 1 hour of the data being 2nd level reviewed (see section 23.4 of this document). Some states have additional, state-specific MCLs for certain parameters (for example, Fluoride has a state-specific MCL of 2 mg/L in PA).
- **Analysis Reports** - some states require that the MCLs be included on analysis reports. This is an available format in the LIMS.
- **Reporting through Agency Portals -** all SDWA compliance data is reported to the relevant agency, either by the testing laboratory, by a laboratory that is given written permission to report the testing laboratory's data, or submitted by the client to the agency. These requirements are state-specific

23.3) Data Calculations

Most instruments either include or are connected to a data system programmed to perform calculations to reduce the raw data to a reportable form. All calculations are maintained in the instrument manuals and/or as part of the analytical method.

In many cases, the data from the local instrument system are uploaded directly to the LIMS for review and reporting. This direct upload eliminates the need to retype data and an associated source of transcription errors from the analytical scheme.

Some instruments report data that require application of additional factors before the data is in final form. For example, an extract concentration may be reported by the instrumental data system, but additional dilution and preparation factors may be needed before the result represents the concentration of analyte in the sample. Analysts input these additional factors into the LIMS, where final calculations are performed.

Analysts manually enter collected data, such as titration data, into the LIMS, which is programmed to perform calculations for final reporting. Documentation of the programming for each calculation performed by the LIMS is maintained.

23.4) Data Review

Final review and verification of the data are performed by designated employees using the sample results, quality control information, method criteria and Project Notes entered into the LIMS. Data are initially evaluated by the analyst and then a second designated employee knowledgeable in the test, other than the employee responsible for performing the test, reviews the data. The reviews include checks for correct transcription, calculations, passing calibrations, compliant quality control results, holding time compliance, and project specific requirements. Any issues or errors identified during this stage are addressed, corrected, and reviewed with the responsible person.

After determining that all necessary requirements for valid data and for the project are met, the reviewer electronically approves the data by changing the LIMS status of the data from “1st level reviewed” to “2nd

level reviewed". The lab has designated personnel to perform 2nd level review. The system is password protected to ensure traceability.

Designated projects require further review by QA prior to release of the Analysis Report and/or data package to the client. These projects are identified in the LIMS through QA review task assignment.

23.5) Data Qualification

Data qualifiers are used to provide additional information about the results reported. The most typical use for data qualifiers is for results that fall below the quantitation limit, in the region where it becomes more difficult to distinguish a positive result from the background instrument signal. The data systems used to generate and report results are programmed to flag values in this range as estimates.

Other qualifiers are applied to advise data users of any validation issues associated with the data. The laboratory makes every effort to meet all of the requirements for generation of data. Occasionally, generation of data that does not meet all the method requirements occurs due to sample matrix or other analytical problems. If the test cannot be repeated or reanalysis would not yield better quality data, qualified data is reported. Qualifiers can be in the form of comments on the analytical report or flags applied to the results.

Qualifications for regulated samples (e.g. drinking water, NPDES) may not be permissible.

23.6) Client and Data Confidentiality

The laboratory will ensure the highest standards of quality and integrity of the data and services provided to our clients. The laboratory is responsible for maintaining in confidence all client information obtained or created. In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

The laboratory will not intentionally divulge to any person (other than the client or any other person designated by the client in writing) any information regarding the services provided by the laboratory or any information disclosed to the laboratory by the client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released. Information about the client obtained from sources other than the client (e.g., complainant, regulators) shall be confidential between client and the laboratory. The source of this information shall be confidential to the laboratory and shall not be shared with the client, unless agreed by the source.

Note: This applies to the scope of testing performed by the laboratory and to all personnel acting on the laboratory's behalf.

Attachment:
Appendix A - Procedure Cross Reference (.pdf)
Appendix B – Certifications, Accreditations, Registrations, and Contracts (.pdf)
Appendix C - Organizational Chart (.pdf)
Appendix D - Personnel Qualifications and Responsibilities (.pdf)
Appendix E – SOPs and Analytical Methods (.pdf)
Appendix F – Instrument and Equipment List (.pdf)

IA-QP38702 Management Systems Review
Q-EQA-FRM6851 Training of ELLE QA Staff for Internal Audits
QA-FRM75405 Equipment List - Firmware and Software
S-SA-FRM10734 Sample Acceptance Policy
Attachment: Appendix A - Procedure Cross Reference (pdf)
Attachment: Appendix B – Certifications, Accreditations, Registrations, and Contracts (pdf)
Attachment: Appendix C - Organizational Chart (pdf)
Attachment: Appendix E – SOPs and Analytical Methods (pdf)
Attachment: Appendix F – Instrument and Equipment List (pdf)

End of document

Version history

Version	Approval	Revision information	
20	26.AUG.2022	Reviewed 9/14/2023 X6TJ	
21	11.JAN.2024		
22	06.JAN.2025		

NOTE: SOPs and Forms are indicated in the table with the unique D4 document number. The topic of the document is given in parentheses.

EQPM	EQPM Section Title	ISO 17025-17	TNI -2016	Procedure(s)
1	INTRODUCTION	5.3		
1.1	Mission Statement	NA	NA	11872 (Employee Handbook)*
1.2	Quality Policy	5.7	4.2.2	11177 (Ethics and Data Integrity Policy)** NBLSC SOP01-ETHC-QP5252
1.3	Statement of Values	NA	NA	11872 (Employee Handbook)*
1.4	Scope	NA	NA	
1.5	Company History		NA	
2.0	MANAGEMENT REQUIREMENTS			
2.1	Organizational Structure	5.1	4.1	Organizational Charts 11872
2.2	Roles and Responsibilities	5.5	4.1	PDQs and 11872 app D (Position Qualification Descriptions and Essential Job Functions)
2.3	Business Continuity and Contingency Plans		4.1	13101 (Incident Response Plan)* 14735 (Preparedness, Prevention, and Contingency Plans)* 12233 (Archiving SOP) Form 6843 (Deputies)
3	PERSONNEL			
3.1	Personnel Qualifications and Responsibilities		4.2.1	PDQs and 11872 app D (Position Qualification Descriptions and Essential Job Functions)
3.3	Personnel Training	5.6		16134 (Employee Training Program) 11178 (Demonstrations of Capability)
3.4	Business Conduct			
4	BUILDING, FACILTIES, AND ENVIRONMENTAL CONDITIONS			
4.1	Physical Facilities	NA	NA	15553 (Facility Operation Manual)*
4.2	Environmental Monitoring	NA	NA	11191 (Monitoring Temperatures) 11919 (VOA Storage Blanks) 11916 (Use and Maintenance of Reagent Water)* 19712 (Laboratory Housekeeping and Cleaning)* 16117 (Insect and Rodent Control)* 14744 (Facility Change Management)*
4.3	Employee Safety			11893 (Chemical Hygiene Plan)* 39542 (EHS Manual)* 14738 (Safety Glasses)* 28743 (Ergonomics Program)* 25567 (Fall Protection Plan)*
4.4	Emergencies			14735 (Preparedness, Prevention, and Contingency Plans)* 13101 (Incident Response Plan)* 14741 (Emergency Evacuation Plan)*
4.5	Security and Building Access			12733 (Building Security)*
4.6	Computer System Security and Access			
5	QUALITY SYSTEM			
5.1	Quality System Overview			
5.2	Ethics and Data Integrity		4.8.1	11176 (Manual Integration) NBLSC NDSC-ETHC-SOP43862 11177 (Laboratory Ethics and Data Integrity Policy) NBLSC SOP01-ETHC-QP5252 11197 (Conflict of Interest)
5.3	Quality System Documents			
5.4	Overview of the Quality Assurance Program			
5.5	Quality Control Charts for Quality Indicators			

EQPM	EQPM Section Title	ISO 17025-17	TNI -2016	Procedure(s)
5.6	Statistical Quality Control			11896 (Establishing Control Limits)
5.7	Quality Metrics			
6	DOCUMENT CONTROL			
6.1	Overview			16131 (Document Control)
6.2	Document Approval, Issue, Control, and Maintenance			12233 (Data and Record Storage) 16244 (Writing and Reviewing Procedures)
6.3	Client-Supplied Methods and Documentation			11193 (analytical Decision Making) 38538 (QA Review of QAPPs) 11895 (Project Cycle) 12039 (Login Review)
6.4	Control of External Documents			16131 (Document Control)
7	SERVICE TO THE CLIENT			
7.1	Overview			11895 (Project Cycle) 38538 (QAPP Review)
7.2	Review of Work Requests, Tenders, and Contracts			11160 (Scheduling Rush Samples) 11197 (Conflict of Interest) 12039 (Client Paperwork)
7.3	Balancing Laboratory Capacity and Workload			11895 (Project Cycle) 38538 (QAPP Review) 11160 (Scheduling Rush Samples) Departmental LIMS Backlogs
7.4	Communication and Documentation			11912 (ICARs, Nonconformances, Concerns) 12039 (Client Paperwork)
7.5	Client Feedback			10251 (Client Concerns)
8	SUBCONTRACTING			
8.1	Overview			11181 (Subcontracting)
8.2	Qualifying and Monitoring Subcontractors			11181 (Subcontracting)
8.3	Responsibilities			11181 (Subcontracting)
8.4	Use of NELAP and A2LA Logo	NA		NA
9	PURCHASING EQUIPMENT AND SUPPLIES			
9.1	Supplier Evaluation			11181 (Subcontracting) 6826 (Preservative Checks)
9.2	Procurement			11192 (Procurement)
10	COMPLAINTS			
10.1	Receipt and Investigation of Complaints			10251 (Client Concerns)
11	CONTROL OF NON-CONFORMING WORK			
11.1	Evaluation of Significance and Actions Taken			10251 (Client Concerns) 11912 (ICARs, Nonconformances, Concerns)
11.2	Responsibilities			
11.3	Prevention of Nonconforming Work			
12	CORRECTIVE ACTION			
12.1	Investigation Process			11912 (ICARs, Nonconformances, Concerns)
12.2	Root Cause Analysis			26968 (Root Cause and Corrective Actions)
13	PREVENTATIVE ACTION/RISK ASSESSMENT			
13.1	Preventative Actions			7547 (Internal Audit Program) 6822 (QA Reports to Management)
13.2	Change Control			11195 (Change Control)
14	CONTROL OF RECORDS			
14.1	Data Documentation Requirements			11913 (Notebooks)
14.2	Data Storage, Security, and Archival			12233 (Data and Record Storage)
15	AUDITS			
15.1	Internal Audits			7547 (Internal Audits)
15.2	Client Audits			6824 (Client and Agency Audits)
15.3	Agency Inspections			6824 (Client and Agency Audits)

EQPM	EQPM Section Title	ISO 17025-17	TNI -2016	Procedure(s)
15.4	Proficiency Testing			11185 (PT Program)
16	MANAGEMENT SYSTEM REVIEW			
16.1	Quality Reports			6822 (ELLE QA Reports to Management)
16.2	Annual Management Review			
17	TEST METHODS AND METHOD VALIDATION			
17.1	Scope of Testing			LIMS Certifications Analytical Work Instructions
17.2	Analytical Test Methods			6853 (Writing Procedure Guidance)
17.3	Method Validation			11189 (Method Validation)
17.4	Reporting Limits			11892 (MDL, LOD, RL Verifications)
17.5	Measurement Uncertainty			11896 (Establishing Control Limits)
18	EQUIPMENT AND CALIBRATIONS			
18.1	Laboratory Equipment Requirements			11880 (Laboratory Equipment Verifications - Balance, Syringe, Pipette, Weights, and Other Equipment)
18.2	Calibration			11901 (Instrument Maintenance and Calibration)
18.3	Maintenance			11901 (Instrument Maintenance and Calibration) Departmental Maintenance Work Instructions
19	MEASUREMENT TRACEABILITY			
19.1	Reference Standards and Materials			11188 (Reagents and Standards)
19.2	Calibration Standards			11188 (Reagents and Standards)
20	SAMPLING			
20.1	Sample Collection	NA	NA	
20.2	Sampling Instructions			6830 (Sampling Instructions Form)
20.3	Sample Containers			10641 (bottle prep)
21	SAMPLE HANDLING			
21.1	Chain of Custody			11914 (Legal COC)
21.2	Sample Receipt			10725 (Sample Receipt and Unpacking)
21.3	Sample Entry			10723 (Login)
21.4	Sample Identification and Tracking			11184 (Lab Chronicle)
21.5	Sample Storage			12042 (Storage, Retrieval, and Discarding of Samples)
21.6	Representativeness of Samples			Analytical Work Instructions 11190 (Representative Solid Samples)
21.7	Sample Return/Disposal			12042 (Sample Discard) 22000 (Hazardous Wastes – Lab) EtQ 9017756 (Hazardous Wastes – Storage) 11915 (Quarantine Soils) 75283 (Hazardous Waste Disposal)
22	ASSURING THE QUALITY OF RESULTS			
22.1	Ongoing Evaluation of Data Quality			
22.2	Reagents and Solvents			Analytical Work Instructions 11188 (Reagents and Standards)
22.3	Laboratory Quality Control Samples and Acceptance Criteria			Analytical Work Instructions
22.4	Negative Controls			Analytical Work Instructions
22.5	Positive Controls			Analytical Work Instructions
22.6	Sample Matrix Controls			Analytical Work Instructions
23	REPORTING RESULTS			
23.1	Sample and Data Flow			11186 (Data Entry, Verification and Reporting) 11895 (Project Cycle)
23.2	Data Reporting			11186 (Data Entry, Verification and Reporting)
23.3	Data Calculations			
23.4	Data Review			11186 (Data Entry, Verification and Reporting)

EQPM	EQPM Section Title	ISO 17025-17	TNI -2016	Procedure(s)
23.5	Data Qualification			Form 11133 (Standardized Report and Case Narrative Comments)
23.6	Client and Data Confidentiality	4.2		14499 (Employee Handbook) 11197 (Conflict of Interest Plan)

* = Campus-wide SOP
** = US Environment Testing document

This Appendix includes the Certifications, Accreditations, Registrations and Contracts maintained by ELLE. The current version of this form is maintained in ELLE's Document Control System.

Program	Authority	Parameter	Field of Accreditation Matrix	Lab ID. No or EPA Lab Code
Misc. Programs:				
A2LA	Wyoming (UST)(4)	Inorganics, Organics	Solid Hazardous Waste (Aqueous/Solid)	0001.01
PALA	Quebec Ministry of Environment and Fight against Climate Change	Dioxins/Furans and PCB Congeners	Water Chemistry; Sludge, Waste and Soil Chemistry	507
Dept. of Defense ELAC	American Association for Laboratory Accreditation (A2LA)	Inorganics, Organics, Dioxins/Furans, PFAS, PCB Congeners	Drinking Water, Non-Potable Water, and Solid Hazardous Waste (Aqueous/Solid)	0001.01
ISO/IEC 17025	American Association for Laboratory Accreditation (A2LA)	WHO 29 Dioxins and Dioxin-Like PCBs	Food and Feed	0001.01
US Federal Program	USDA Quarantine Soil Permit	All	Solid	525-22-298-19481
State Programs:				
State	State of Alabama, Department of Environmental Management	Inorganics, Organics and PFAS	Drinking Water	43200
State	State of Alaska, Department of Environmental Conservation: Drinking Water Program	Dioxin, Inorganics, Organics and PFAS	Drinking Water	PA00009
State	State of Alaska, Department of Environmental Conservation: Contaminated Sites Program	Dioxins/Furans, Inorganics, Organics and PFAS	Water, Soil, UST/LUST	17-027
State	State of Arizona, Department of Health Services	Dioxins/Furans, Inorganic and PFAS	Drinking Water (SDW), Wastewater and Solid Waste	AZ0780
State	State of Arkansas, Department of Environmental Quality	Dioxins/Furans, Inorganics and Organics	Non-Potable Water and Solid and Chemical Materials	88-0660
State	State of California, CA Waterboards ELAP	Dioxins/Furans, Inorganics, Organics and PFAS	Drinking Water, Non-Potable Water, Hazardous Waste (Solid) and Hazardous Waste (Matrix Aqueous)	2792
State	State of Colorado, Department of Health and Environment	Dioxin, Inorganics and Organics	Drinking Water	PA00009
State	State of Connecticut, Department of Public Health	Dioxins/Furans, Inorganics, Organics and PFAS	Drinking Water (SDWA), Non-Potable Water/Wastewater (CWA) and Solid Waste/Soil (RCRA)	PH-0746
State	State of Delaware, Department of Health and Social Services	Dioxin, Inorganics and Organics	Drinking Water	None
State	State of Delaware, Department of Natural Resources & Environmental Control	Dioxins, Inorganics and Organics	Non-Potable Water and Solid and Chemical Materials	None

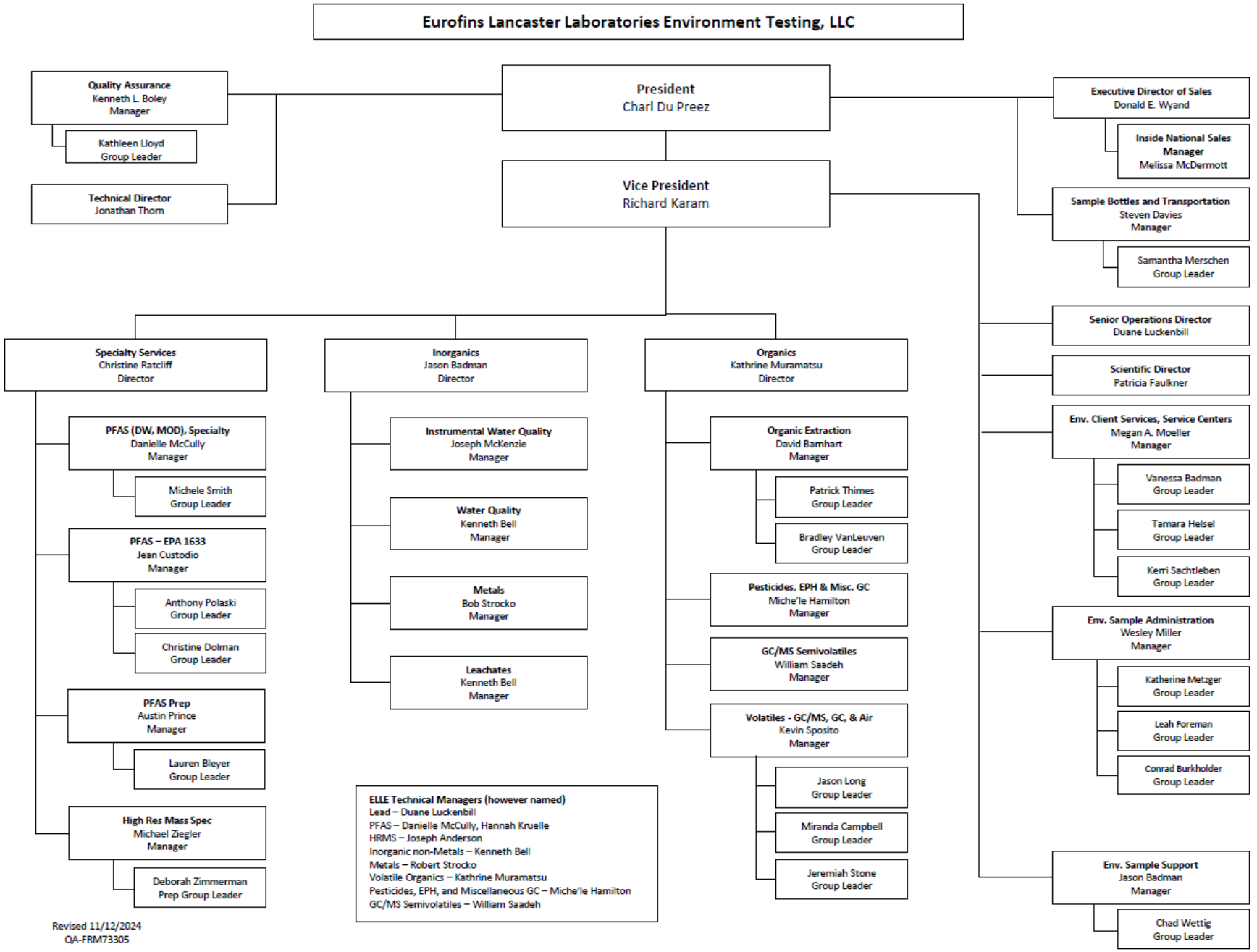
NELAP	State of Florida, Department of Health[3]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Air and Emissions, Drinking Water, Non-Potable Water, and Solid and Chemical Materials	E87997
State	State of Georgia, Department of Natural Resources	PFAS	Drinking Water	C048
State	State of Hawaii, Department of Health	Dioxin, Inorganics, Organics, and PFAS	Drinking Water	None
NELAP	State of Illinois, Environmental Protection Agency[3]	Dioxins/Furans, Inorganics, Organics and PFAS	SDWA (Potable Water), Non-Potable Water (CWA/RCRA) and Solid and Hazardous Material (RCRA)	200027
State	State of Iowa, Department of Natural Resources	Dioxin, Inorganics, Organics, PFAS and UST analysis	Drinking Water, Solid Waste Contaminated Sites (Water), Solid Waste Contaminated Sites (Soil & Sludge), UST Water and UST Soil and Sludge	361
NELAP	State of Kansas, Department of Health and Environment[3]	Dioxins/Furans, Inorganics, Organics and PFAS	Potable Water (SDWA), Non-Potable Water (CWA), Non-Potable Water (RCRA) and Solid and Hazardous Materials (RCRA)	E-10151
State	Commonwealth of Kentucky, Energy and Environment Cabinet, Drinking Water Laboratory Certification Program	Dioxin and PFAS	Drinking Water	KY90088
State	Commonwealth of Kentucky, Energy and Environment Cabinet, Wastewater Laboratory Certification Program	Dioxins/Furans, Inorganics and Organics	Wastewater	KY90088
State	Kentucky UST[4]	Inorganics and Organics	UST	108139
NELAP	State of Louisiana, Department of Environmental Quality [1,3]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Air Emissions, Biological Tissue, Non-Potable Water and Solid Chemical Materials	02055
State	State of Maine, Department of Health and Human Services	PFAS	Drinking Water	PA00009
State	State of Maryland, Department of the Environment	Dioxin, Inorganics and Organics	Drinking Water	100
State	Commonwealth of Massachusetts, Department of Environmental Protection	Inorganics, Organics and PFAS	Potable and Non-Potable Water	M-PA009
State	State of Michigan, Department of Environment, Great Lakes, and Energy	Dioxin, Inorganics, Organics and PFAS	Drinking Water	9930
NELAP	State of Minnesota, Department of Health[3]	Dioxins/Furans, PCB Congeners and PFAS	Drinking Water (SDW), Non-Potable Water (CWA/RCRA), Solid and Chemical Materials (RCRA)	042-999-487
State	State of Mississippi, Department of Health	PFAS	Drinking Water	None
State	State of Missouri, Department of Natural	Dioxin, Inorganics and Organics	Drinking Water	450

	Resources			
State	State of Montana, Department of Public Health and Human Services	Dioxin, Inorganics, Organics and PFAS	Drinking Water	0098
State	State of Montana, Department of Environmental Quality	Organics, UST analysis	Non-Potable Water and Solid and Chemical Materials	None
State	State of Nebraska, Department of Health and Human Services	Dioxin, Inorganics, Organics and PFAS	Drinking Water	NE-OS-32-17
NELAP	State of New Hampshire, Department of Environmental Services[3]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Drinking Water, Non-Potable Water and Solid and Chemical Materials	2730
NELAP	State of New Jersey, Department of Environmental Protection[3]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Air and Emissions, Biological Tissue, Drinking Water, Non-Potable Water and Solid and Chemical Materials	PA011
NELAP	State of New York, Department of Health [3]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Air and Emissions, Potable Water, Non-Potable Water and Solid and Chemical Materials	10670
State	State of North Carolina, Department of the Environmental Quality	Inorganics and Organics	Wastewater/Ground Water (Aqueous/Non-Aqueous)	521
State	State of North Carolina, Department of Health and Human Services	Dioxin, Inorganics and Organics	Potable (SDWA)	42705
State	State of North Dakota, Department of Environmental Quality	Dioxins/Furans, Inorganics and Organics	CWA (Non-Potable Water), Non-Potable Water, Potable Water (SDWA) and RCRA (Liquid, Sold and Water)	R-205
NELAP	State of Oklahoma, Department of Environmental Quality[3]	Dioxins/Furans, Inorganics, Organics, and PCB Congeners	Non-Potable Water and Solids	9804
NELAP	State of Oregon, Public Health Laboratory[3]	Dioxins/Furans, Inorganics, Organics and PFAS	Air, Drinking Water, Non-Potable Water and Solid and Chemical Waste	PA200001
NELAP	Commonwealth of Pennsylvania, Department of Environmental Protection [2]	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Drinking Water, Non-Potable Water and Solid and Chemical Materials	36-00037
State	State of Rhode Island, Department of Health	Inorganics and Organics	Potable Water and Non-Potable Water	LAO00338
State	State of South Carolina, Department of Health and Environmental Control	Dioxins/Furans, Inorganics and Organics	Non-Potable Water (CWA) and Solid and Hazardous Wastes (Aqueous/Solid)	89002
State	State of Tennessee, Department of Environment & Conservation	Dioxin, Inorganics and Organics	Drinking Water	02838
NELAP	State of Texas, Commission on Environmental Quality[3]	Dioxin, Dioxins/Furans Inorganics and Organics	Air and Emissions, Biological Tissues, Drinking Water, Non-Potable Water and Solid and Chemical Materials	T104704194
State	State of Vermont, Department of Health	Dioxin, Inorganics, Organics and	Drinking Water	VT 36037

		PFAS		
NELAP	Commonwealth of Virginia, Department of General Services[3]	Dioxins/Furans, Inorganics, Organics and PCB Congeners	Air, Drinking Water, Non-Potable Water and Solid and Chemical Materials	460182
State	State of Washington, Department of Ecology	Dioxin, Dioxins/Furans, Inorganics, Organics and PFAS	Air, Drinking Water, Non-Potable Water and Solid and Chemical Materials	C457
State	State of West Virginia, Department of Health and Human Resources	Dioxin, Inorganics and Organics	Drinking Water	9906C
State	State of West Virginia, Department of Environmental Protection	Dioxins/Furans, Inorganics, Organics, PCB Congeners and PFAS	Non-Potable Water and Solid and Chemical Materials	055
State	State of Wyoming and all Tribal Public Water Systems in Region 8	Dioxin, Inorganics and Organics	Drinking Water	8TMS-L

[1] NELAP Primary AB: Air and Emissions, Biological Tissue
[2] NELAP Primary AB: Drinking Water, Non-Potable Water, Solid and Chemical Materials
[3] NELAP Secondary AB
[4] Approval for UST work by A2LA

NOTE: This list accurately reflects the certifications, accreditations, registrations, and contracts held at the time of publication and is subject to change. Check with your account manager on the status of any certification needed for a specific project. Our current scopes of accreditation can be viewed at https://www.eurofinsus.com/environment-testing/resources/certifications/.


Eurofins Lancaster Laboratories Environment Testing, LLC
Quality Assurance
Kenneth L. Boley
Manager
Kathleen Lloyd
Group Leader
Technical Director
Jonathan Thom
President
Charl Du Preez
Vice President
Richard Karam
Executive Director of Sales
Donald E. Wyand
Inside National Sales Manager
Melissa McDermott
Sample Bottles and Transportation
Steven Davies
Manager
Samantha Merschen
Group Leader
Senior Operations Director
Duane Luckenbill
Scientific Director
Patricia Faulkner
Env. Client Services, Service Centers
Megan A. Moeller
Manager
Vanessa Badman
Group Leader
Tamara Helsel
Group Leader
Kerri Sachtleben
Group Leader
Env. Sample Administration
Wesley Miller
Manager
Katherine Metzger
Group Leader
Leah Foreman
Group Leader
Conrad Burkholder
Group Leader
Env. Sample Support
Jason Badman
Manager
Chad Wettig
Group Leader
Specialty Services
Christine Ratcliff
Director
PFAS (DW, MOD), Specialty
Danielle McCully
Manager
Michele Smith
Group Leader
PFAS – EPA 1633
Jean Custodio
Manager
Anthony Polaski
Group Leader
Christine Dolman
Group Leader
PFAS Prep
Austin Prince
Manager
Lauren Bleyer
Group Leader
High Res Mass Spec
Michael Ziegler
Manager
Deborah Zimmerman
Prep Group Leader
Inorganics
Jason Badman
Director
Instrumental Water Quality
Joseph McKenzie
Manager
Water Quality
Kenneth Bell
Manager
Metals
Bob Strocko
Manager
Leachates
Kenneth Bell
Manager
Organics
Kathrine Muramatsu
Director
Organic Extraction
David Bamhart
Manager
Patrick Thimes
Group Leader
Bradley VanLeuven
Group Leader
Pesticides, EPH & Misc. GC
Miche'le Hamilton
Manager
GC/MS Semivolatiles
William Saadeh
Manager
Volatiles - GC/MS, GC, & Air
Kevin Sposito
Manager
Jason Long
Group Leader
Miranda Campbell
Group Leader
Jeremiah Stone
Group Leader
ELLE Technical Managers (however named)
Lead – Duane Luckenbill
PFAS – Danielle McCully, Hannah Kruelle
HRMS – Joseph Anderson
Inorganic non-Metals – Kenneth Bell
Metals – Robert Strocko
Volatile Organics – Kathrine Muramatsu
Pesticides, EPH, and Miscellaneous GC – Miche'le Hamilton
GC/MS Semivolatiles – William Saadeh
Revised 11/12/2024
QA-FRM73305

This Appendix includes Position Qualifications Descriptions (PQDs) for key personnel. Current versions of PQDs are maintained in ELLE's Document Control System.

Personnel Qualifications and Responsibilities

President 2
Business Unit Manager 5
Laboratory Technical Director 7
Scientific Director 9
Technical Department Director (Inorganics, Organics, and Specialty Departments) 11
Quality Assurance Manager 13
Department Manager (Technical) 15
Department Manager (Support) 17

Job Title:	President	
Reports To:	None	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	The President is responsible for leading and expanding Eurofins Environment Testing America along the agreed upon strategy and to exceed business expansion and profitability goals.

Essential Duties and Responsibilities:

- Develop Eurofins Environment Testing America activities through organic growth and while
- meeting agreed EBIT growth objectives.
- Improve operations efficiency at laboratories. Streamline the operational processes and make good use of IT so as to achieve high efficiency. Support the development, implementation and optimal use of the Company's Laboratory Information Management System and ensure its efficient usage at all levels of the laboratory to improve productivity and profitability.
- Increase cost effectiveness and profitability to meet best industry standards in all activities.
- Lead / take part in the marketing and sales process and ensure that the relations with the clients are good and efficient. Attend and lead meetings with key clients, at all levels and develop an in depth knowledge of customer requirements through regular meetings.
- Make sure that cross-selling synergies with other Eurofins Environment Testing America laboratories are being developed.
- Take appropriate measures to improve economic profit, including hands-on personal commitment in addressing situations where profit levels are too low or payment terms not adhered to by clients.
- Hire, motivate, develop and retain excellent Business
- With the Business Unit Managers ensure goals are defined and communicated to their respective teams. Set up customer centric Key Performance Indicators (KPIs) to monitor progress. Follow up as appropriate and become hands on if required to ensure achievement of goals.
- Improve the technical and scientific aspects of the business units by ensuring the appropriate development and application of new techniques and business processes.
- Ensure that all companies he/she is in charge of have appropriate systems, work ethics and
- policies in place to guarantee high quality of service to clients. Maintain Customer satisfaction, including of internal customers.
- Guarantee and control that all relevant legal and Health & Safety requirements are being abided to, in all companies or Business Units under his/her direct or indirect responsibility, that the companies accreditations are being maintained and regularly expanded and that all employees act according to Eurofins values.
- Ensure adherence to highest quality and efficiency standards in laboratory operations.
- Ensure coverage and performance.
- Foster morale and teamwork.

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	• Bachelor's degree in environmental science, biology, chemistry, or other related degree concentration, or equivalent directly-related experience (two years of directly related industry experience is equivalent to one full-time year of college in related major) • Approximately 7 years of professional experience. At least 3 years of these with full responsibility for operations (of a business with at least 10 direct staff) and proven operational and financial success, preferably in the business services sector or in a small / mid-size company operating in a very competitive / low margin sector.
Additional preferences:	N/A
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	N/A
Ability and/or Skills (BMQ):	• Strong computer, scientific, and organizational skills • Excellent communication (oral and written) and attention to detail • Ability to work independently and as part of a team, self-motivation, • adaptability, and a positive attitude • Ability to learn new techniques, perform multiple tasks simultaneously, • keep accurate records, follow instructions, and comply with company • policies • Strong leadership, initiative, and teambuilding skill • Operations experience • Project Management experience • Profit and Loss responsibilities • Financial Management • Working knowledge of Chemistry and Business Finance • Managing multiple locations/departments • Problem-solving skills • Ability to develop and enforce policies and operating practices • Strong decision-making abilities • Ability to communicate at all levels of the organization • Leadership • Team Building • Ability to influence others • Ability to multitask • Ability to function under high stress and/or tense environments
Additional preferences:	N/A
Other Factors:	N/A

Equal Employment Opportunity and Affirmative Action Employer

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Vice President (Business Unit Manager)	
Reports To:	President	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Oversee operations in accordance with policies set forth in the Key Group Documents
- Develop efficient and effective operations and systems that support the strategic goals of the company
- Utilize management operating system to track key performance indicators and drive continuous improvement
- Coach and develop individual and team to maximize performance
- Interact with clients as necessary to maintain and grow the business
- Build strategic relationships within the organization to achieve company goals
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least fifteen years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Directors, Managers, and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Laboratory Technical Director	
Reports To:	Business Unit Manager	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Oversee operations in accordance with policies set forth in the Key Group Documents
- Develop efficient and effective operations and systems that support the strategic goals of the company
- Utilize management operating system to track key performance indicators and drive continuous improvement
- Coach and develop individual and team to maximize performance
- Interact with clients as necessary to maintain and grow the business
- Build strategic relationships within the organization to achieve company goals
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least fifteen years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Directors, Managers, and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Scientific Director	
Reports To:	Business Unit Manager	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Oversee and manage research and development efforts for new technologies and methodologies, assist with experimental design. Communicate effectively with the industry, scientific, and customer communities concerning laboratory capabilities, method improvements and developments.

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Coach and develop individual and team to maximize performance
- Interact with clients to maintain and grow the business
- Build strategic relationships within and outside of the organization to achieve company goals and drive technological development of the company
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least fifteen years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Directors, Managers, and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Technical Department Director (Inorganics, Organics, and Specialty Departments)	
Reports To:	Business Unit Manager	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Does everything reasonably possible to meet the annual budget
- Ensure that the quality policy/program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Oversee operations in accordance with policies set forth in the Key Group Documents
- Develop efficient and effective operations and systems that support the strategic goals of the company
- Utilize management operating system to track key performance indicators and drive continuous improvement
- Coach and develop individual and team to maximize performance
- Interact with clients as necessary to maintain and grow the business
- Build strategic relationships within the organization to achieve company goals
- Identify and evaluate issues and explore continuous improvement initiatives
- Perform administrative functions as needed, e.g., attend meetings and share information; prepare reports, job plans, and performance reviews
- Stay technologically current in field; attend seminars and/or training courses; publicize technical expertise through writing an article, presenting a poster session, or speaking at a seminar or technical meeting
- Perform other duties as requested by President or designee
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least five years related experience at ELLE or equivalent experience elsewhere
Additional preferences:	Bachelor's degree in appropriate field or equivalent experience; graduate courses are recommended; experience in a variety of technical areas
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of Directors, Managers, and other leadership employees
Ability and/or Skills (BMQ):	Demonstrated expertise in laboratory operations and leadership skills; communicate effectively and to relate well to people in direct communication, as well as formal presentation; manage the work of other personnel; understand and promote company policy; excellent business sense; motivation to excel, both in technical matters and in management; professional appearance and conduct; consciousness of and a positive attitude toward quality, service, and safety procedures; sound reasoning and decision making; technical expertise; organization and problem-solving skills; good judgement, versatility and flexibility in dealing with people; ability to coordinate multiple priorities; foresight and planning; ability to synthesize and retain information; computer skills; ability to communicate effectively in written and oral forms; leadership skills
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Quality Assurance Manager	
Reports To:	Business Unit Manager and/or designee	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:

Overseeing all managerial and quality operations of the company; providing leadership and mentoring/coaching to QA staff; participating in short-term and long-term planning and goal setting for the company; facilitating adherence to government regulations; sustaining quality improvement and providing quality policy development; providing sound consultation to laboratories and clients on problems or interpretation of quality/compliance issues; keeping abreast of evolving regulatory and industry quality assurance requirements

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Ensure that corrective action is appropriate; ensure that follow-up requirements are completed
- Encourage employee participation in process improvement initiatives
- Interview and make recommendations for new hires; train and develop staff; maintain job plans; handle personnel issues
- Handle agency audits, client audits, visits, and phone calls; prepare letters to clients; attendance at some local and national industry meetings
- Keep abreast of regulatory climate; assist technical operations with interpretation; advise on adjustment of lab policy as appropriate
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Coach/mentor other members of the quality team
- Oversee regulatory training program; assist with, and present departmental and corporate training at a frequency to meet regulatory expectations and ensure compliance
- Work with operations and clients to drive challenging/complex resolutions and/or negotiate appropriate position or compromise; offer compliance options
- Identify and drive system improvements; diagnose complex issues
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least six years' experience with QA
Additional preferences:	Bachelor's degree in chemistry or biology
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Provide leadership and direct management of any Group Leaders (if applicable) and other non-management employees in the department
Ability and/or Skills (BMQ):	Exhibit self-confidence and leadership; expertise in laboratory quality operations and regulatory environment; sound reasoning, decision making and problem-solving skills; good judgment and flexibility in dealing with others; ability to coordinate multiple priorities; communicate effectively in written and oral form; ability to manage the work of others and see projects through to completion; translate government regulations into laboratory policy/processes; utilize planning, organization and work management tools; ability to manage stress in self and others; dedication to quality, ethics, and customer service
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information may not be used or duplicated by others without written consent.

Job Title:	Department Manager (Technical)	
Reports To:	Director or designee	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Performing a variety of technical and administrative tasks to develop, evaluate, and supervise staff; planning and monitoring work flow; designing, implementing, and utilizing departmental operations systems; promoting safety; remaining current on technical developments; communicating with clients; maintaining a strong commitment to quality

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Utilize the MOS to track key performance indicators and drive continuous improvement
- Produce motivated and satisfied employees
- Encourage employee participation in process improvement initiatives
- Oversee inventory, maintenance, and repair of departmental machines, tools, equipment, materials, and/or products
- Manage scheduling of personnel; evaluate personnel performance
- Participate in interview process, make recommendations for new hires; train and develop staff
- Review, prepare, and approve methods, data, and SOPs
- Communicate with clients on technical matters; meet with clients to discuss operations and conduct tours and audits
- Maintain client confidentiality
- Investigate and solve laboratory problems
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	At least five years related experience
Additional preferences:	Bachelor's degree in chemistry or related science; supervisory experience preferred
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of the departmental Group Leaders
Ability and/or Skills (BMQ):	Knowledge of departmental techniques; manage personnel, resolve conflicts, and correct poor performance; attention to detail; tolerance for stress; integrity; computer skills; communicate effectively (verbally and written); perform multiple tasks simultaneously; logical thought; make decisions for self and others; independently develop solutions to complex problems
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information is for exclusive use and may not be used or duplicated by others without written consent.

Job Title:	Department Manager (Support)	
Reports To:	Director	
Position Location:	Lancaster, PA	
Day/Shift:	Varies	
FLSA Status:	Exempt	(Exempt/Non-Exempt)

Position Summary:	Overseeing all managerial operations of the department, managing the department in an efficient and financially sound manner; providing leadership and coaching to assigned individuals; participating in long- and short-term planning and goal-setting for the group; coordinating functions and responsibilities of assigned department members to provide consistent service; coordinating internal efforts between departments; relaying corporate information appropriately

Essential Duties and Responsibilities:

- Demonstrates and promotes the company vision
- Regular attendance and punctuality
- Ensure that the quality policy program is understood, implemented, and maintained at all levels of the organization; identify, prevent, or correct any departures from the quality system
- Administrative including human resource interviews, job plans, performance reviews, personnel issues, group meetings, and sharing of corporate information
- Training of and delegation to members of the department to provide consistent service to internal and external clients
- Work with other departments to set goals, develop pricing strategies, manage workload, and resolve problems
- Create, implement, and oversee budgets and goals for the department in the context of corporate philosophy
- Evaluate, plan for, and provide adequate staffing, equipment, consumables, etc., for the department to function in an effective manner
- Communicate verbally, in writing, and face-to-face with clients to discuss and resolve problems, build strong relationships, and increase sales
- Perform all functions in support of and in compliance with all state and federal employment regulations
- Administrative activities (photocopying, word processing, paperwork delivery, etc.)
- Assist with financial and purchase order issues as needed
- Help coordinate interdepartmental cross-training and/or assistance as needed to balance workload
- Conducts all activities in a safe and efficient manner
- Performs other duties as assigned

Basic Minimum Qualifications (BMQ):	To perform this job successfully, the individual must be able to perform each essential duty satisfactorily. The requirements below are representative of the knowledge, skill or ability required. (List three to five key quantifiable skills or position requirements that the candidate must have to be considered for this position.)
Education/Experience (BMQ):	Five years of related experience at LL or demonstrated equivalent experience elsewhere; computer skills in a variety of software; supervisory experience
Additional preferences:	Bachelor's degree in science (chemistry preferred)
Certificates and/or Licenses (BMQ):	N/A
Additional preferences:	
Supervisory Responsibility:	Responsible for the direct management of the Group Leaders of the department
Ability and/or Skills (BMQ):	Self confidence and leadership, ability to reason, make sound decisions, and delegate; empathy and sensitivity towards others; motivation to excel and inspire excellence in others; ability to develop strong relationships with clients resulting in client satisfaction and additional sales; ability to manage the work of others and see projects through to completion; strong communication including verbal, writing, and presentation skills; ability to communicate effectively and relate well to people; mental and emotional stability and maturity, ability to handle personal stress and diffuse stress in others; strong organizational and financial skills, ability to handle multiple priorities; good judgement and tact recognizing and solving problems; recognized as understanding, interpreting, and following company policy; sets example for others; dedication to quality, ethics, and customer service; pride in appearance, conduct, and company; sound persuasion and negotiation abilities; ability to view situations from a variety of perspectives; foresight and planning ability
Additional preferences:	
Other Factors:	N/A

Disclaimer:

This position description is written as a guideline to inform employees of what is generally expected of them at each job level. The description is not intended to be all encompassing or limiting in any manner; rather, it is hoped it will add understanding and better reflect the work performed at all levels of employment. Duties and responsibilities other than those listed may be included as needed within the work group or the company as a whole.

The above information is for exclusive use and may not be used or duplicated by others without written consent.

Document ID	Document name	Document Responsible
1 Lancaster Campus		
1.01 EHS		
Policies		
G-EHS-QP12356	Chemical Hygiene Plan	Env Quality Assurance Manager
G-EHS-QP14735	Preparedness, Prevention, and Contingency Plan	Env Quality Assurance Manager
G-EHS-QP28711	Exposure Control Plan for Bloodborne Pathogens	Env Quality Assurance Manager
G-EHS-QP39542	EHS Manual	Env Quality Assurance Manager
G-EHS-QP47636	Space Utilization SOP	Env Quality Assurance Manager
G-EHS-QP78030	Campus Safety Policy	Env Quality Assurance Manager
Standard Operating Procedure		
G-EHS-SOP11893	Environmental Hazardous Sample Communication Procedure	Env Quality Assurance
G-EHS-SOP13101	Incident Response Plan	Env Quality Assurance Manager
G-EHS-SOP14738	Safety Glasses	Env Quality Assurance Manager
G-EHS-SOP14739	Reporting Work Related Incidents	Env Quality Assurance Manager
G-EHS-SOP14740	Lockout/Tagout	Env Quality Assurance Manager
G-EHS-SOP14741	Emergency Evacuation Plan	Env Quality Assurance Manager
G-EHS-SOP22000	Management of Hazardous Wastes in the Laboratory	Env Quality Assurance Manager
G-EHS-SOP25567	Fall Protection Plan	Env Quality Assurance Manager
G-EHS-SOP28741	Environmental, Health, and Safety (EHS) Assessments	Env Quality Assurance Manager
G-EHS-SOP28743	Ergonomics Program	Env Quality Assurance Manager
G-EHS-SOP33477	Radiation Safety Program	Env Quality Assurance Manager
G-EHS-SOP46418	Rave Mobile Operating Procedures	Env Quality Assurance Manager
Work Instruction		
G-EHS-WI55382	Powered Industrial Truck Training and Safety	Env Quality Assurance
G-EHS-WI60988	Bulk Solvent Testing at ELLE	Env Quality Assurance
1.02 Facilities		
Standard Operating Procedure		
G-FAC-SOP12733	Building Security	Env Quality Assurance Manager
G-FAC-SOP14744	Facility Change Management	Env Quality Assurance Manager
G-FAC-SOP15553	Facilities Operation Manual	Env Quality Assurance Manager
G-FAC-SOP16117	Insect and Rodent Control	Env Quality Assurance Manager

G-FAC-SOP16118	Maintenance Connection Service Requestor Guidelines	Env Quality Assurance Manager
G-FAC-SOP19712	Laboratory Housekeeping and Cleaning	Env Quality Assurance Manager

1.03 Human Resources

2 Technical Resources

3 Training

4 Management

5 Document Control

Standard Operation Procedure

G-DC-SOP12233	Data and Record Storage, Security, Retention, Archival, and Disposal	Env Quality Assurance Manager
G-DC-SOP16131	Document Control	Env Quality Assurance Manager
G-DC-SOP16244	Writing and Reviewing ELLE Policies and Operating Procedures	Env Quality Assurance Manager

6 Quality System

Policies

QA-QP11176	Manual Integration for ELLE	Env Quality Assurance
QA-QP11177	Laboratory Ethics and Data Integrity Policy	Env Quality Assurance
QA-QP37583	Electronic Reporting and Signature Policy	Env Quality Assurance Manager

Quality Manual

QA-QM11872	Environmental Quality Policy Manual	Env Quality Assurance

Standard Operating Procedure

QA-SOP11178	Demonstrations of Capability	Env Quality Assurance
QA-SOP11180	Guidelines for Writing Technical Reports	Env Quality Assurance
QA-SOP11181	Subcontracting Analytical Testing	Env Quality Assurance
QA-SOP11182	Sample Requisition	Env Quality Assurance
QA-SOP11184	Lab Chronicle Documentation	Env Quality Assurance
QA-SOP11185	Proficiency Test Samples	Env Quality Assurance
QA-SOP11186	Data Entry, Data Review, and Reporting	Env Quality Assurance
QA-SOP11188	Reagents and Standards	Env Quality Assurance
QA-SOP11189	Validation and Authorization of Analytical Methods	Env Quality Assurance
QA-SOP11190	Obtaining a Representative Environmental Solid Sample Aliquot	Env Quality Assurance
QA-SOP11191	Monitoring Temperatures in Refrigerators, Freezers, Incubators, and Ovens Using the ETM	Env Quality Assurance
QA-SOP11192	Procurement of Environmental Laboratory Supplies	Env Quality Assurance
QA-SOP11193	Guidelines for Analytical Decision Making in Environmental Testing	Env Quality Assurance
QA-SOP11195	Change Control Procedures for ELLE	Env Quality Assurance
QA-SOP11196	Laboratory/Quality Systems Procedures Summary	Env Quality Assurance Manager
QA-SOP11197	Conflict of Interest Plan	Env Quality Assurance
QA-SOP11880	Laboratory Support Equipment - Calibrations, Verifications, and Maintenance	Env Quality Assurance
QA-SOP11882	Chromatography Integration and Documentation	Env Quality Assurance
QA-SOP11886	Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples	Env Quality Assurance
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation	Env Quality Assurance
QA-SOP11895	Environmental Project Cycle	Env Quality Assurance
QA-SOP11896	Establishing Control Limits	Env Quality Assurance
QA-SOP11901	Instrument Maintenance and Calibration	Env Quality Assurance

QA-SOP11912	Investigation and Corrective Action for Client Complaints, Noncompliant Data, and Laboratory Problems	Env Quality Assurance
QA-SOP11913	Laboratory Notebooks, Logbooks, and Documentation	Env Quality Assurance
QA-SOP11914	Legal Chain-of-Custody Documentation	Env Quality Assurance
QA-SOP11915	Quarantine Soils Procedures	Env Quality Assurance
QA-SOP11916	Use and Maintenance of Reagent Water Supply	Env Quality Assurance
QA-SOP11919	Monitoring of the Volatile Organics Analysis (VOA) Storage Areas for Contamination	Env Quality Assurance
QA-SOP16134	Employee Training Program	Env Quality Assurance Manager
QA-SOP26968	Root Cause, Investigation, and Corrective Action Processes	Env Quality Assurance
QA-SOP67098	Position Qualification Descriptions (PDQs)/Essential Job Functions (EJFs) – Reviewing, Writing, Revising, and Finalizing	Env Quality Assurance
QA-SOP70107	Sample Handling and Chain of Custody Procedures	Env Quality Assurance
QA-SOP70877	Internal Ethics and Data Integrity Investigations	Env Quality Assurance
QA-SOP74085	Management of Opportunities and Risk	Env Quality Assurance
QA-SOP7547	Laboratory Internal Audit Program	Env Quality Assurance

Work Instruction

QA-WI63804	Change Plan - D4 Deviation Recording System Implementation	Env Quality Assurance Manager

6.01 Environmental Quality Assurance

Work Instruction

Q-EQA-WI14754	Performing Administration and Handbook Editor Tasks in D4	Env Quality Assurance Manager
Q-EQA-WI66855	D4 DRS – Entry and Evaluation of Deviations (ICARs, Planned Deviations, Audits)	Env Quality Assurance
Q-EQA-WI6816	Proficiency Test Samples	Env Quality Assurance Manager
Q-EQA-WI6820	Maintenance of Environmental Certifications and Accreditations	Env Quality Assurance Manager
Q-EQA-WI6822	ELLE QA Reports to Management	Env Quality Assurance
Q-EQA-WI6823	Approval of Work Instructions and Standard Operating Procedures	Env Quality Assurance
Q-EQA-WI6824	Hosting of Environmental Client and Agency Audits	Env Quality Assurance
Q-EQA-WI6826	QA Processing for Bottle Lot and Preservative Checks	Env Quality Assurance
Q-EQA-WI6890	Trending Chart Alert Tracking, Review and Run Rules	Env Quality Assurance

7 Support Department

7.01 D40 Business Development

Work Instruction

S-BD-WI10787	Proposal Preparation	Env Sciences Manager
S-BD-WI10788	Review of Client Contracts, Terms and Conditions and other non-technical documents	Env Sciences Manager
S-BD-WI11156	Preparing Quotations	Env Sciences Manager
S-BD-WI26410	Project Win Cycle	Env Sciences Manager

7.01 D40 IT/Software Development

Policies

R-SD-QP74471	Remote Network Access via VPN/Citrix	Env Quality Assurance Director

Standard Operating Procedure

R-SD-SOP20940	Computer Backup, Recovery, and Archive Procedure Resources	Env Quality Assurance Director

7.01 D4039 Bay Area Service Center

Work Instruction

S-SC-BA-WI11332	Sample Receipt for the Bay Area Service Center	Sample Bottles Manager

7.01 D4039 Client Services

Work Instruction

S-CS-WI10251	Client Concerns	Client Services Manager
S-CS-WI11141	Creating Bottle Orders	Client Services Manager
S-CS-WI11152	Monthly and Quarterly DEP Reporting	Client Services Manager
S-CS-WI11155	Phone Log and Email Documentation	Client Services Manager
S-CS-WI11159	Project Creation Guide	Client Services Manager
S-CS-WI11160	Scheduling and Pricing of Rush Samples	Client Services Manager
S-CS-WI12039	Login Review	Client Services Manager
S-CS-WI59868	Generating the Shipping Order for Subcontracted and Workshare Samples	Client Services Manager

7.01 D6041 Transportation

Work Instruction

R-TR-WI11288	Sample Pick-Up, Transportation, and Delivery	Transportation Manager
R-TR-WI11297	What to Do in Case of Vehicular Accident or Breakdown	Transportation Manager

7.01 D6042 Sample Administration

Work Instruction

S-SA-WI10717	Entry of Environmental Samples Requiring Subcontracting/Workshare	Sample Administration Manager
S-SA-WI10695	Liquid Sample Preservation Checks, Turbidity Checks, and Sample Splitting	Sample Administration Manager
S-SA-WI10723	Environmental Sample Entry	Sample Administration Manager
S-SA-WI10725	Environmental Sample Receipt and Unpacking	Sample Administration Manager
S-SA-WI10743	Taking the Temperature of Environmental Samples Upon Arrival at the Lab	Sample Administration Manager
S-SA-WI11260	Preservation and Bottles Room Preservative Traceability	Sample Administration Manager
S-SA-WI12043	Sample Receipt at the Sample Receipt Desk	Sample Administration Manager
S-SA-WI7963	Maintenance and Calibration of HACH Model 2100AN Laboratory Turbidimeter	Sample Administration Manager

7.01 D6055 Sample Support

Work Instruction

S-SS-WI10666	ASRS Emergency Failure Procedure	Sample Support Manager
S-SS-WI10668	Automated Storage and Retrieval System (ASRS) Lockout/Tagout Procedure	Sample Support Manager
S-SS-WI10683	Glassware Cleaning	Sample Support Manager
S-SS-WI10685	Hardware Procedures for ASRS	Sample Support Manager
S-SS-WI10686	Homogenization, Sample Splitting, and Subsampling of Solid Waste Samples from Environmental Sources	Sample Support Manager
S-SS-WI10696	Maintenance of Dessicators	Sample Support Manager
S-SS-WI10697	% Moisture Calculation and % Solids Calculation (Gravimetric)	Sample Support Manager
S-SS-WI11220	Sample Support Ovens	Sample Support Manager

S-SS-WI11225	Subsampling for Subcontracted Analyses	Sample Support Manager
S-SS-WI11268	Incremental Sampling Methodology (ISM) and Drying and Sieving of Solids for Extraction and Analysis	Sample Support Manager
S-SS-WI12042	Automated Storage, Retrieval, and Discarding of Samples	Sample Support Manager
S-SS-75283	Hazardous Waste Disposal	Sample Support Manager

7.01 D6059 Sample Bottles

Work Instruction

S-BOT-WI10641	Bottle Preparation	Sample Bottles Manager
S-BOT-WI10642	Packing Bottle Orders	Sample Bottles Manager
S-BOT-WI10643	Preparation of Acid Dilutions	Sample Bottles Manager
S-BOT-WI10644	Preparation of Trip Blanks	Sample Bottles Manager
S-BOT-WI10645	Processing Bottle Orders	Sample Bottles Manager

8 Technical Section

8.02 D4021 Volatiles

Work Instruction

T-VOA-WI10682	GC/MS – Bulk Solids Matrix Sample Preparation	GC/MS Volatiles Manager
T-VOA-WI11168	Pipette Dispenser Calibration Procedure	GC/MS Volatiles Manager
T-VOA-WI11169	Preparation of Soil and Solid Samples for GC Volatile Analyses by methods SW-846-5030A and SW-846-5035A Modified	GC/MS Volatiles Manager
T-VOA-WI11170	Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035 and Method 5035A	GC/MS Volatiles Manager
T-VOA-WI11242	Preparation of Vials for Field Preservation of Soils for Volatile Analysis	GC/MS Volatiles Manager
T-VOA-WI11259	Prescreening Water and Soil Samples for Volatile Organic Compounds	GC/MS Volatiles Manager
T-VOA-WI18576	Waters for Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry using EPA Method 624.1	GC/MS Volatiles Manager
T-VOA-WI7605	Preparation and Testing of Trip Blanks for GC/MS Volatile Analyses	GC/MS Volatiles Manager
T-VOA-WI7606	Use of 40-mL Vials for Volatile Organic Analyses	GC/MS Volatiles Manager
T-VOA-WI7607	Statistical Calculations Used in the Analysis of Samples by EPA Methodology	GC/MS Volatiles Manager
T-VOA-WI7613	Calibrating the 1-µL Standard Delivery Groove on the Archon Model 5100A and O.I 4660 Autosampler Systems	GC/MS Volatiles Manager
T-VOA-WI7619	GC and GC/MS Instrumentation Maintenance	GC/MS Volatiles Manager
T-VOA-WI7627	Client Specific – Client Specific Target Compounds by GC/MS in Soils	GC/MS Volatiles Manager
T-VOA-WI7629	GC/MS Volatile Standards Traceability	GC/MS Volatiles Manager
T-VOA-WI7675	GRO in Soils by GC by SW-846, Methods 8015B, 8015C, 8015D	GC/MS Volatiles Manager
T-VOA-WI7690	GRO in Waters and Wastewaters by GC by SW-846, Methods 8015B, 8015C, 8015D	GC/MS Volatiles Manager
T-VOA-WI7691	Glassware Washing	GC/MS Volatiles Manager
T-VOA-WI7692	Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles	GC/MS Volatiles Manager
T-VOA-WI7706	GRO by GC in Waters and Wastewaters by Method AK101	GC/MS Volatiles Manager

T-VOA-WI7711	Client-specific Determination of Client Specific Target Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) in Waters	GC/MS Volatiles Manager
T-VOA-WI7717	Targeted Library Search by GC/MS	GC/MS Volatiles Manager
T-VOA-WI7869	Preservation and Residual Chlorine Checks of Samples for GC/MS Volatile Water Analysis	GC/MS Volatiles Manager
T-VOA-WI7870	Preparation and Testing of Storage Blanks for GC/MS Volatile Analysis	GC/MS Volatiles Manager
T-VOA-WI8194	VOCs and GRO by GC/MS in Waters and Wastewaters by EPA 8260C/D	GC/MS Volatiles Manager
T-VOA-WI8196	Preparation of Oil Samples by EPA 5035/5035A	GC/MS Volatiles Manager
T-VOA-WI8220	GC/MS Determination of 1,2,3-Trichloropropane in Waters Using Isotope Dilution and Selective Ion Monitoring (SIM) by EPA Method 524.2, Modified	GC/MS Volatiles Manager
T-VOA-WI8221	GRO by GC in Soils by Method AK101	GC/MS Volatiles Manager
T-VOA-WI8224	GRO in Soil and Water by GC using Northwest GX Method	GC/MS Volatiles Manager
T-VOA-WI8225	VOCs and GRO by GC/MS in Soils and Solids by EPA 8260B	GC/MS Volatiles Manager
T-VOA-WI8236	VOCs and GRO by GC/MS in Soils and Solids by EPA 8260C/D	GC/MS Volatiles Manager
T-VOA-WI8265	Volatile Organic Compounds in Wastewater by Isotope Dilution and GC/MS by EPA Method 1666/1666A	GC/MS Volatiles Manager
T-VOA-WI8373	GC/MS Volatiles Audit Process	GC/MS Volatiles Manager
T-VOA-WI8480	Purgeable Organic Compounds in Water by GC/MS Using EPA Method 524.2	GC/MS Volatiles Manager
T-VOA-WI8515	1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8260B/C/D in Waters and Soils	GC/MS Volatiles Manager
T-VOA-WI8544	Toxicity Characteristic Leachate Procedure (TCLP) and Synthetic Precipitate Leaching Procedure (SPLP); VOCs by GCMS in Zero Headspace Extraction (ZHE) by 8260B/C/D	GC/MS Volatiles Manager
T-VOA-WI8584	Volatile Target Compounds by GC/MS in Waters and Wastewaters by Method 6200B	GC/MS Volatiles Manager
T-VOA-WI8614	Determination of Target Compounds by GC/MS using Selective Ion Monitoring (SIM) by Method 8260C/D	GC/MS Volatiles Manager
T-VOA-WI9679	GC Routine and Nonroutine Maintenance for Instrumentation Used for VPH Analysis	GC/MS Volatiles Manager
T-VOA-WI9685	VPH in Waters and Solids Using GC/FID/PID	GC/MS Volatiles Manager
T-VOA-WI74313	Client Specific Determination of 1,1,3,3-Tetrachloropropene by GC/MS using Selective Ion Monitoring (SIM) by Method 8260C/D	GC/MS Volatiles Manager

8.03 D4022 Metals

Work Instruction

T-MET-WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A	Metals Manager
T-MET-WI11925	Client Specific - 3030 C. Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples	Metals Manager
T-MET-WI11926	Digestion of Oils by EPA 3050B for ICP Analysis	Metals Manager

T-MET-WI11931	Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)	Metals Manager
T-MET-WI11933	Metals by ICPMS by Methods SW-846 6020/6020A/6020B(waters, solid, tissue) and EPA 200.8 (waters)	Metals Manager
T-MET-WI11938	Digestion of Waters by EPA 200.7/200.8 for Analysis of Metals by ICP/ICPMS	Metals Manager
T-MET-WI11941	Digestion of Water and Leachates by EPA 3010A for Metals	Metals Manager
T-MET-WI11948	Preparation of Solids by EPA 7471A or B for Mercury Analysis	Metals Manager
T-MET-WI12063	Preparation of ICP Solutions and Standards	Metals Manager
T-MET-WI12065	Preparation of ICP-MS Solutions and Standards	Metals Manager
T-MET-WI21590	Instrument Maintenance for Agilent 7900	Metals Manager
T-MET-WI26740	Digestion of Aqueous Samples for Mercury by EPA 245.1	Metals Manager
T-MET-WI35797	Metals Data Verification Process	Metals Manager
T-MET-WI58243	Hardness by Calculation by Method SM 2340B-2011 or SM 2340B-1997	Metals Manager
T-MET-WI7562	Preparation of Solids for Cation Exchange Capacity (CEC) using Sodium Acetate by EPA 9081	Metals Manager
T-MET-WI76522	Preparation of Solids for Anion Exchange Capacity (AEC) and AEC Calculation	Metals Manager
T-MET-WI7886	Bottletop Dispensers	Metals Manager
T-MET-WI7920	Dilute/Run and AVS/SEM Sample Handling for Metals	Metals Manager
T-MET-WI7922	Glassware Cleaning	Metals Manager
T-MET-WI7943	Langelier Index in Water	Metals Manager
T-MET-WI7965	Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA	Metals Manager
T-MET-WI8636	Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS	Metals Manager
T-MET-WI8639	Digestion of Waters and Leachates by EPA 3005A for Analysis of Metals by ICP/ICPMS	Metals Manager
T-MET-WI8732	Lab and Field Filtered Waters and	Metals Manager
T-MET-WI9082	Working Instructions for Prep Solutions and Standards	Metals Manager
T-MET-WI9084	Preparation of Mercury Solutions and Standards	Metals Manager

8.04 D4024 Pesticides

Work Instruction

T-PEST-WI10004	Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI10006	Prescreening Water and Soil Samples for Pesticides and PCBs	Pesticide Residue Analysis Manager
T-PEST-WI10007	Preventative and Corrective GC Maintenance	Pesticide Residue Analysis Manager
T-PEST-WI10008	Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department	Pesticide Residue Analysis Manager
T-PEST-WI10011	QC Data Acceptability and Corrective Action	Pesticide Residue Analysis Manager
T-PEST-WI10018	Standards Preparation, Coding, and Storage	Pesticide Residue Analysis Manager
T-PEST-WI10019	Standards Traceability and Monitoring	Pesticide Residue Analysis Manager
T-PEST-WI11965	Formaldehyde and Other Aldehydes by Method 8315A in Aqueous and Solid Samples using HPLC	Pesticide Residue Analysis Manager

T-PEST-WI11967	Organic Acids in Water by Methods 8015B/D using HPLC/UV	Pesticide Residue Analysis Manager
T-PEST-WI17994	Pesticides in Aqueous Samples by Method 608.3	Pesticide Residue Analysis Manager
T-PEST-WI18000	Polychlorinated Biphenyls (PCBs) by Method 608.3	Pesticide Residue Analysis Manager
T-PEST-WI9202	Analysis of Chlorinated Herbicides by 8151A in Water	Pesticide Residue Analysis Manager
T-PEST-WI9232	Analysis of Pesticides by 8081B in Solid Samples using GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9238	Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9845	Chlorinated Herbicides by 8151A in Solids by GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses	Pesticide Residue Analysis Manager
T-PEST-WI9952	EDB/DBCP/and TCP by Method 8011 in Waters and Solids Using Microextraction and GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9954	Interpretation of Chromatographic Data	Pesticide Residue Analysis Manager
T-PEST-WI9961	Low Level PCBs in Water by Method 8082/8082A using GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9981	Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection	Pesticide Residue Analysis Manager
T-PEST-WI9983	N-Methylcarbamate Pesticides by Method 8318/8318A in Solids Using HPLC	Pesticide Residue Analysis Manager
T-PEST-WI9984	N-Methylcarbamates by Method 531.1 in Groundwater and Drinking Water using High Performance Liquid Chromatography (HPLC)	Pesticide Residue Analysis Manager
T-PEST-WI9987	PCBs in Oil by SW-846 Method 8082A	Pesticide Residue Analysis Manager
T-PEST-WI9998	Pesticides in Water by Method 8081A and 8081B using GC-ECD	Pesticide Residue Analysis Manager
T-PEST-WI9452	Determination of PCB Homologs in Waters and Solids by Method 680	Pesticide Residue Analysis Manager

8.05 D4026 GCMS Semivolatiles

Work Instruction

T-SVOA-WI11981	Client Specific Analysis of Chlorinated Herbicides in Water by 8270D/E SIM by GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI11997	Semivolatile Organics Tentatively Identified Compound Method	GC/MS Semivolatiles Manager
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards	GC/MS Semivolatiles Manager
T-SVOA-WI13634	The Determination of 1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8270C/D/E	GC/MS Semivolatiles Manager
T-SVOA-WI18565	Priority Pollutants by Method 625.1 in Water Using GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI31271	Client Specific Semivolatiles in Waters by Method 612 by SIM GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI31758	Client Specific Methylphenols by Method 8270D in Water Using GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI34439	Client Specific SAN Trimer by Method 525.3 in Water Using SIM by GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI34848	Client Specific Dinoseb by ATP in Water Using GC/MS	GC/MS Semivolatiles Manager

T-SVOA-WI68576	Semivolatile Organic Compounds in Water by Method 8270E using GC-MS/MS	GC/MS Semivolatiles Manager
T-SVOA-WI75083	Client Specific Determination of 1,1,3,3-Tetrachloropropene by Method 8270E Using Selective Ion Monitoring	GC/MS Semivolatiles Manager
T-SVOA-WI9252	Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270D/E SIM by GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI9587	Tetraethyl lead (TEL) in Water and Solids by 8270D/E by GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI9590	Dioxin Screening (2,3,7,8-TCDD) of Aqueous and Solid Matrices using GC/MS SIM	GC/MS Semivolatiles Manager
T-SVOA-WI9594	GC/MS Semivolatile Audit Process	GC/MS Semivolatiles Manager
T-SVOA-WI9596	GC/MS Electronic Data Management and Handling	GC/MS Semivolatiles Manager
T-SVOA-WI9598	GC/MS Preventative and Corrective Maintenance	GC/MS Semivolatiles Manager
T-SVOA-WI9604	Monitoring GC/MS Semivolatile QC Data Acceptance Limits	GC/MS Semivolatiles Manager
T-SVOA-WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS	GC/MS Semivolatiles Manager
T-SVOA-WI9626	THPA, THPI and PA by CELP 440 in Waters Using GC/MS	GC/MS Semivolatiles Manager
T-SVOA-WI9995	Semivolatiles in Waters and Soils by Methods 8270D/E SIM and 625.1 SIM by GC/MS	GC/MS Semivolatiles Manager

8.06 D4027 Instrumental Water Quality

Work Instruction

T-IWC-WI10024	Ammonia Nitrogen by EPA 350.1 in Waters Using Segmented Flow Analysis and Gas Diffusion	Instrumental Water Quality Manager
T-IWC-WI10037	Determination of Total Carbon in Water and Wastewater by SM-5310 C and EPA 415.1	Instrumental Water Quality Manager
T-IWC-WI10038	Total Organic Carbon in Water by SW-846 9060/9060A (Quadruplicate Studies)	Instrumental Water Quality Manager
T-IWC-WI10039	Digestion of Total and Soluble Phosphorus in Water, Wastewater, and Soils EPA 365.1, and SM 4500-P B-2011	Instrumental Water Quality Manager
T-IWC-WI10083	Reagent Water Extraction of Ions in soil, for analysis by method EPA 300.0 or SW 846 9056	Instrumental Water Quality Manager
T-IWC-WI10085	Cyanide (Total and Amenable) Distillation in Waters and Solids by SW-846 9012A/B, EPA 335.1/3/4, and SM 4500-CN G-1999/2011	Instrumental Water Quality Manager
T-IWC-WI10107	Total Kjedahl Nitrogen Digestion by EPA 351.2	Instrumental Water Quality Manager
T-IWC-WI10285	Weak Acid Dissociable Cyanide Distillation by Method 4500 CN-I 2016	Instrumental Water Quality Manager
T-IWC-WI11494	Dissolved Silica (Colormetric) in Water by SM4500SIO2 C-2011, SM4500SIO2 C-1997 or EPA 370.1	Instrumental Water Quality Manager
T-IWC-WI11495	Ferrous Iron (colorimetric) in Waters by Method 3500-Fe B-2011, Ferric Iron by Calculation	Instrumental Water Quality Manager
T-IWC-WI11619	Phenols in Water and Soils By Automated Flow Colorimetry EPA 420.4, SW-846, 9066	Instrumental Water Quality Manager
T-IWC-WI11625	Hexavalent Chromium by Ion Chromatography in Solids and Waters SW-846 7199 and Waters by EPA 218.6	Instrumental Water Quality Manager
T-IWC-WI11626	Anions by Ion Chromatography in Waters and Soil by EPA 300.0, SW 846 9056, and SW 846 9056A	Instrumental Water Quality Manager

T-IWC-WI11627	TOC and TC in Solids and Sludges by Combustion by SW-846 9060/9060A, Lloyd Kahn	Instrumental Water Quality Manager
T-IWC-WI11629	Cyanide (Total, Amenable, Free, WAD, Reactive) in Waters and Soils by Methods SW-846 9012A/B, EPA 335.4, and SM 4500-CN G/E/I-2016	Instrumental Water Quality Manager
T-IWC-WI11635	Total and Available Cyanide in Water using Amperometric Detection by ASTM D 7511-09e2, -12 and Method OIA-1677-09	Instrumental Water Quality Manager
T-IWC-WI11636	Total and Soluble Phosphorus in Water, Wastewater, and Soils (Colorimetric, Ascorbic Acid, Automated) by EPA 365.1 or SM 4500-P F-2011	Instrumental Water Quality Manager
T-IWC-WI11637	Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), and Total Inorganic Carbon (TIC) by SM 5310C or EPA 415.1 in Waters	Instrumental Water Quality Manager
T-IWC-WI11640	Maintenance of ICS 1100 and ICS-2000 Ion Chromatography Systems	Instrumental Water Quality Manager
T-IWC-WI11643	Maintenance of Continuous Flow Analyzers	Instrumental Water Quality Manager
T-IWC-WI11649	Nitrate Nitrogen in Water and Wastewater by EPA 353.2 (Colorimetric, Automated Cadmium Reduction)	Instrumental Water Quality Manager
T-IWC-WI11650	Nitrite Nitrogen in Water and Wastewater by EPA 353.2	Instrumental Water Quality Manager
T-IWC-WI11651	Phenol Distillation in Solids by EPA SW-846 9065	Instrumental Water Quality Manager
T-IWC-WI12055	Total Kjeldahl Nitrogen (TKN) by EPA 351.2 in Waters and Solids using Automated Flow Analysis or Discrete Analysis	Instrumental Water Quality Manager
T-IWC-WI55028	Maintenance of the Skalar-Primacs SC100 Total Organic Carbon Analyzer	Instrumental Water Quality Manager
T-IWC-WI59613	CLIENT SPECIFIC - Phosphate Buffer Extraction for analysis of Metals and Hexavalent Chromium	Instrumental Water Quality Manager
T-IWC-WI62444	Digestion of Hexavalent Chromium in Solids by SW-846 3060A (Client Requested)	Instrumental Water Quality Manager
T-IWC-WI74011	Low Level Hexavalent Chromium by Ion hromatography in Waters EPA 218.6	Instrumental Water Quality Manager
T-IWC-WI9861	Accusterilizer - Steam Sterilizer	Instrumental Water Quality Manager
T-IWC-WI9889	Maintenance and Calibration of A.I. Scientific AIM600 Digestor	Instrumental Water Quality Manager
T-IWC-WI9890	Maintenance of the OI Analytical Model 1030 Total Organic Carbon Analyzer	Instrumental Water Quality Manager
T-IWC-WI9891	pH Electrodes and Meters	Instrumental Water Quality Manager

8.07 D4028 Leachate Preparation

Work Instruction

T-TL-WI46585	PFAS Leaching Procedure (TCLP, SPLP) by EPA 1311-Modified and 1312-Modified in Solids and Wastes	Leachate Preparation Manager
T-TL-WI7141	pH Meters and Probes	Leachate Preparation Manager
T-TL-WI7142	Calibration of the Leachate Tumblers	Leachate Preparation Manager
T-TL-WI7143	Glassware Cleaning for Leachate Extractions	Leachate Preparation Manager
T-TL-WI7144	Leachate Blank Evaluations	Leachate Preparation Manager
T-TL-WI7145	Subsampling and Preservation of Leachates - ASTM D3987-12/85, EPA 1311, and EPA 1312	Leachate Preparation Manager

T-TL-WI7146	Manually Pressurized Zero Headspace Extractor (ZHE)	Leachate Preparation Manager
T-TL-WI7148	Shake Extraction of Solid Waste with Water by ASTM D3987-12, D3987-85	Leachate Preparation Manager
T-TL-WI7151	Nonvolatiles-Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312	Leachate Preparation Manager
T-TL-WI7257	Procedure for Calculating and Reporting Weighted Average Results for TCLP Extracts	Leachate Preparation Manager
T-TL-WI7258	Volatiles by Zero Headspace Extractor (ZHE) - Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312	Leachate Preparation Manager
T-TL-WI7563	Waste Extraction Test Leaching Procedure for Volatile and Non-Volatile Analytes	Leachate Preparation Manager

8.08 D4029 Water Quality

Work Instruction

T-WC-WI10348	Fixed Volume Hand-Held Pipettes	EUUSLA Water Quality Manager
T-WC-WI10349	SKALAR COD Robot Analyzer and COD Spectrophotometers	EUUSLA Water Quality Manager
T-WC-WI10350	Maintenance of Desiccators	EUUSLA Water Quality Manager
T-WC-WI10352	Genesys 30 Spectrophotometer	EUUSLA Water Quality Manager
T-WC-WI10358	Chemical Review	EUUSLA Water Quality Manager
T-WC-WI10360	Quality Control Data for Wet Chemistry	EUUSLA Water Quality Manager
T-WC-WI10362	Standardization of 0.02 and 0.1 Normal Sulfuric Acid	EUUSLA Water Quality Manager
T-WC-WI10364	Water Quality Washroom Procedures	EUUSLA Water Quality Manager
T-WC-WI10421	Specific Gravity by SM 2710F-1997, SM 2710F-2011 in Waters and Wastes, Bulk Density by ASTM E868-82 Sec 9.9 in Solids	EUUSLA Water Quality Manager
T-WC-WI10422	Acid Volatile Sulfide in Solids	EUUSLA Water Quality Manager
T-WC-WI10424	Ammonia-Nitrogen for Soils (Tritrimetric Distillation Procedure) by 4500-NH3 B/C - 2011, or EPA 350.2	EUUSLA Water Quality Manager
T-WC-WI10425	Distillation of Fluoride in Waters by SM 4500 F B-2011, EPA 340.1 Procedure 6.1 or SM 4500 F B-1997	EUUSLA Water Quality Manager
T-WC-WI10426	BOD and CBOD in Waters by SM 5210 B-2016 or 2011	EUUSLA Water Quality Manager
T-WC-WI10431	Chloride (Titration) in Water by SM 4500-CL C-2011/1997 or EPA 325.3	EUUSLA Water Quality Manager
T-WC-WI10437	Flash Point for Liquids and Solids by ASTM D93, EPA 1010A or EPA 1010B	EUUSLA Water Quality Manager
T-WC-WI10609	Dissolved Oxygen by 4500 O G-2011, EPA 360.1 or Hach Method 10360	EUUSLA Water Quality Manager
T-WC-WI10610	Fixed Suspended Solids (Gravimetric) Volatile Suspended Solids (Gravimetric)by SM 2540 E - 2011 or EPA 160.4 in Water	EUUSLA Water Quality Manager
T-WC-WI10618	Digestion of Hexavalent Chromium in Solids by SW-846 3060A	EUUSLA Water Quality Manager
T-WC-WI10627	Ignitability of Solids by 40 CFR, Part 261.21	EUUSLA Water Quality Manager

T-WC-WI10629	Methylene-Blue-Active Substances (MBAS) by 5540 C-2011 or EPA 425.1	EUUSLA Water Quality Manager
T-WC-WI11474	Ammonia-Nitrogen for Waters (Titrimetric Distillation Procedure) by 4500-NH3 B/C -2011, or EPA 350.2	EUUSLA Water Quality Manager
T-WC-WI11475	Multi-Parameters in Solids and Waters by ManTech Multi-Parameter System	EUUSLA Water Quality Manager
T-WC-WI11478	Chemical Oxygen Demand (Low-Level) by 410.4 in Waters	EUUSLA Water Quality Manager
T-WC-WI11480	Chlorine Residual for waters by 4500 Cl F-2011, or EPA 330.4	EUUSLA Water Quality Manager
T-WC-WI11482	Color by 2120 B-2011, or EPA 110.2	EUUSLA Water Quality Manager
T-WC-WI11483	Colorimetric Sulfide in Waters, Sulfide as H2S, Dissolved Sulfide in Waters by 4500-S2 D-2011, 4500-S2 H-2011, or EPA 376.2	EUUSLA Water Quality Manager
T-WC-WI11500	Hexane Extractable Material (HEM) and Silica Gel Treated Hexane Extractable materials (SGT-HEM) in Waters by EPA Method 1664A, 1664B, and 1664.	EUUSLA Water Quality Manager
T-WC-WI11501	Hexavalent Chromium in Waters and Soils (Colorimetric) by SW-846 7196A	EUUSLA Water Quality Manager
T-WC-WI11506	Low-Level Hexavalent Chromium in waters (Colorimetric) by 3500-Cr B-2011	EUUSLA Water Quality Manager
T-WC-WI11509	Moisture (Gravimetric), Total Residue, Volatile Residue, Total Fixed Residue/Ash by SM 2540 G-2011/1997 in Solids	EUUSLA Water Quality Manager
T-WC-WI11510	n-Hexane Extractable Material (HEM) and Silica Gel Treated HEM (SGT-HEM) in Solids by EPA 9071B	EUUSLA Water Quality Manager
T-WC-WI11511	Orthophosphate (Colorimetric) by EPA 365.3 in Waters	EUUSLA Water Quality Manager
T-WC-WI11512	Oxidation-Reduction Potential for Wastewaters and Soils by ASTM D1498, SM 2580 B-2011	EUUSLA Water Quality Manager
T-WC-WI11513	Paint Filter Liquids Test (Free Liquids Test) in Waste by SW-846 9095B	EUUSLA Water Quality Manager
T-WC-WI11515	Percent Solids for GC/MS by EPA 1666, Revision A - 1998	EUUSLA Water Quality Manager
T-WC-WI11518	pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometic Methods	EUUSLA Water Quality Manager
T-WC-WI11519	pH Probes and Meters	EUUSLA Water Quality Manager
T-WC-WI11572	Reactive Sulfide (titration) by SW-846 9034 (1996) Prepared by Chapter 7.3.4 (1996) in Waste	EUUSLA Water Quality Manager
T-WC-WI11574	Reactivity of Waste	EUUSLA Water Quality Manager
T-WC-WI11578	Settleable Solids in waters by 2540 F-2015, 2540 F-2011, or EPA 160.5	EUUSLA Water Quality Manager
T-WC-WI11584	Specific Conductance in Solids by SM 2510B-2011, SM 2510B-1997, SW-846 9050A, SW-846 9050, or EPA 120.1	EUUSLA Water Quality Manager
T-WC-WI11585	Standardization of 0.02 Normal Sodium Hydroxide	EUUSLA Water Quality Manager
T-WC-WI11586	Sulfate (turbidimetric) by EPA 375.4 in Waters	EUUSLA Water Quality Manager
T-WC-WI11587	Sulfide Titration for Waters by 4500 S2 F-2011, EPA 376.1, SW-846 Method 9034 or 4500 S2 F-2000	EUUSLA Water Quality Manager
T-WC-WI11589	Sulfite in waters by 4500-SO3 B-2011, or EPA 377.1	EUUSLA Water Quality Manager
T-WC-WI11598	Total Dissolved Solids (TDS)(Gravimetric) by SM 2540 C-2015, SM 2540 C-2011, SM 2540 C-1997 or EPA 160.1 in Waters and Wastewaters	EUUSLA Water Quality Manager

T-WC-WI11600	Total Fixed Solids (TFS), Total Volatile Solids (TVS) Gravimetric by SM 2540 E-2011, SM 2540 G-2011 or EPA 160.4 in Waters, Wastewaters and Sludges	EUUSLA Water Quality Manager
T-WC-WI11603	Total Solids (Gravimetric) by SM 2540 B-2011, SM 2540 G-2011, EPA 160.3, SM 2540 G-1991, SM 2540 B-1997, or SM 2540 G-1997 in Waters, Wastewaters and Sludges	EUUSLA Water Quality Manager
T-WC-WI11604	Total Suspended Solids (TSS)-Gravimetric by SM 2540 D-2011 or SM 2540 D-1997 and Total Filtered: Total Volume Test by NJDEP in Waters	EUUSLA Water Quality Manager
T-WC-WI11616	Dissolved Oxygen Meter Calibration	EUUSLA Water Quality Manager
T-WC-WI12050	Chemical Oxygen Demand (COD) in Water by EPA 410.4	EUUSLA Water Quality Manager
T-WC-WI15537	Orthophosphate in waters by Colorimetry SM 4500 P E-2011	EUUSLA Water Quality Manager
T-WC-WI15618	Turbidity by EPA 180.1 Rev. 2 or SM 2130 B-2011	EUUSLA Water Quality Manager
T-WC-WI46354	Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D422-63 (reapproved 2007) - Modified	EUUSLA Water Quality Manager
T-WC-WI53304	Total Suspended Solids (TSS Gravimetric) Prescreen for PFAS by EPA Draft Methods in Aqueous Samples	EUUSLA Water Quality Manager
T-WC-WI53655	Fluoride in Waters by Man-Tech ISE by SM4500-F C-1997/2011	EUUSLA Water Quality Manager
T-WC-WI58193	Acidity in Waters by Man-Tech ISE by 4500-F C	EUUSLA Water Quality Manager
T-WC-WI58195	Specific Conductance in Waters by Man-Tech ISE by SM 2510B, Sw-846 9050A, or EPA 120.1	EUUSLA Water Quality Manager
T-WC-WI58197	Alkalinity in Solids and Waters by Man-Tech ISE by SM 2320B-2011, SM 2320B-1997, or EPA 310.1	EUUSLA Water Quality Manager
T-WC-WI58199	pH in Waters by Man-Tech ISE by SM 4500-H+ B-2011, SM 4500-H+ B-2000, SW-846 9040B, or SW-846 9040C	EUUSLA Water Quality Manager
T-WC-WI58201	Unionized Ammonia in Waters by Calculation by SM 8010F-2011 (Table 8010:VI)	EUUSLA Water Quality Manager
T-WC-WI9898	Calibration of Hach 2100AN Turbidimeter	EUUSLA Water Quality Manager
T-WC-WI9900	Equipment Incubators and Refrigerators	EUUSLA Water Quality Manager
T-WC-WI9901	Equipment Muffle Furnaces and Ovens	EUUSLA Water Quality Manager

8.09 D4030 Air Quality

Work Instruction		
T-AQ-WI7163	Routine Instrument Maintenance for Volatiles in Air by GC and GC/MS	Volatiles in Air Manager
T-AQ-WI7164	Cleaning and Handling of Summa Canisters	Volatiles in Air Manager
T-AQ-WI7165	Cleaning and Handling of Flow Controllers	Volatiles in Air Manager
T-AQ-WI7168	Preparing Summa Can Order	Volatiles in Air Manager
T-AQ-WI7169	Standards Preparation, Validation, and Documentation Using EPA Method TO-15	Volatiles in Air Manager
T-AQ-WI7173	Volatiles in Air Tentatively Identified Compound Method	Volatiles in Air Manager
T-AQ-WI7174	Analysis of Air for Selected Volatile Organic Compounds by Gas Chromatography with Flame Ionization Detector Using EPA Method 18 and 25	Volatiles in Air Manager
T-AQ-WI7271	Volatiles in Air Audit Process	Volatiles in Air Manager
T-AQ-WI7275	Low-Level Volatiles in Air by EPA Method TO-15 Using GC/MSD in SIM Mode	Volatiles in Air Manager

T-AQ-WI7436	The Determination of Volatile Organic Compounds in Air by GC/MS Using EPA Method TO-15	Volatiles in Air Manager

8.10 D4032 EPH/Miscellaneous GC

Work Instruction

T-GC-WI24004	Volatile Hydrocarbons n Water by ASTM Standard Test Method D8028-17 Using Headspace Sampling Techniques and GC-FID	EPH/Misc GC Manager
T-GC-WI53958	Residual Volatile Organics Compounds in solids by GC	EPH/Misc GC Manager
T-GC-WI9253	Analysis of DRO/RRO by Alaska 102/103 in Waters and Soils by GC-FID	EPH/Misc GC Manager
T-GC-WI9644	Carbon Dioxide in Water Using Headspace Sampling Techniques and GC-TCD, Method RSK-175 or 8015	EPH/Misc GC Manager
T-GC-WI9656	Client Specific - Total Extractable Hydrocarbons (TEH) in Waters by Method 8015C Modified Using GC-FID	EPH/Misc GC Manager
T-GC-WI9657	Common Equations Used During Chromatographic Analyses	EPH/Misc GC Manager
T-GC-WI9672	EPH by Massachusetts Protocol (MA EPH), LA RECAP Ranges (LAEPH) and Montana DEQ (MT EPH) in Waters and Solids Using GC	EPH/Misc GC Manager
T-GC-WI9676	Extraction of Soils/Solids for Glycol Analysis by 8015B/C/D	EPH/Misc GC Manager
T-GC-WI9677	Extraction of Solids/Soils for Analysis of Alcohols by Method 8015B, C, or D	EPH/Misc GC Manager
T-GC-WI9678	Fractionated EPH using LA RECAP Ranges in Waters and Solids by GC-FID	EPH/Misc GC Manager
T-GC-WI9679	GC Routine and Nonroutine Maintenance for Instrumentation Used for VPH Analysis	EPH/Misc GC Manager
T-GC-WI9680	Glycols by Method 8015B/8015C/8015D in Water and Solid Matrices Using GC-FID	EPH/Misc GC Manager
T-GC-WI9689	Maintenance and Troubleshooting Procedures for GC-FID Instrumentation	EPH/Misc GC Manager
T-GC-WI9736	New Jersey Extractable Petroleum Hydrocarbons (NJEPH) in Solids using GC-FID	EPH/Misc GC Manager
T-GC-WI9740	PMI VOCs (Direct Injection) by Method 1671A in Waters Using GC/FID	EPH/Misc GC Manager
T-GC-WI9749	QC Data Acceptability and Corrective Action	EPH/Misc GC Manager
T-GC-WI9756	Qualitative/Quantitative GC Fingerprint in Petroleum Distillates, Fuels, and Oils by 8015B/C/D using GC-FID	EPH/Misc GC Manager
T-GC-WI9770	TNRCC TX Method 1005 - Total Petroleum Hydrocarbons (Gasoline Range, Diesel Range, and Extended Range Organics) in Waters and Solids	EPH/Misc GC Manager
T-GC-WI9771	Total Petroleum Hydrocarbons with Ranges by Methods 8015B/8015C/8015D in Waters and Solids by GC-FID	EPH/Misc GC Manager
T-GC-WI9772	Total Saturated Hydrocarbons by Method 8015C in Waters and Solids using GC/FID	EPH/Misc GC Manager
T-GC-WI9778	TPH and Quantitative Fuel Fingerprinting by Methods 8015B/C/D mod. in Waters and Solids Using GC-FID	EPH/Misc GC Manager
T-GC-WI9781	TPH by NWTPH-Dx (modified) in Soils using GC-FID	EPH/Misc GC Manager
T-GC-WI9783	TPH by NWTPH-Dx (modified) in Waters using GC-FID	EPH/Misc GC Manager
T-GC-WI9786	DRO and ORO by 8015C/D in Water using GC-FID	EPH/Misc GC Manager

T-GC-WI9788	DRO and ORO by 8015B/8015C/8015D in Solids using GC-FID	EPH/Misc GC Manager
T-GC-WI9791	Client Specific - TPH-DX with Fuel Identification in Waters by NWTPH-DX Using GC-FID	EPH/Misc GC Manager
T-GC-WI9796	Volatile Hydrocarbons in Water by Method RSK-175 and SW-846 8015B/C/D Using Headspace Sampling Techniques and GC-FID	EPH/Misc GC Manager
T-GC-WI9798	Volatile Organic Concentration of Waste Samples by Method 25D Using FID and ELCD	EPH/Misc GC Manager
T-GC-WI9824	Water Miscible Solvents by Method 8015B/8015C/8015D Using GC-FID	EPH/Misc GC Manager

8.11 D4033 PFAS by LC/MS/MS

Work Instruction

T-PFAS-WI12031	Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS	PFAS Manager
T-PFAS-WI13881	Standards Management in the PFAS Laboratory	PFAS Manager
T-PFAS-WI14355	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples Using Isotope Dilution Using LC/MS/MS	PFAS Manager
T-PFAS-WI18548	Total Oxidizable Precursors in Aqueous Samples by LC/MS/MS with Isotope Dilution	PFAS Manager
T-PFAS-WI20127	Client-Specific: Table 3 Compounds by Direct Injection Using LC/MS/MS	PFAS Manager
T-PFAS-WI21568	Manifold and N-EVAP Cleaning for PFAS Extractions	PFAS Manager
T-PFAS-WI23588	Preventative and Corrective Maintenance for the API 4000 and AB Sciex 4500, 5500, 5500+ Liquid Chromatograph Mass Spectrometers (LC/MS/MS)	PFAS Manager
T-PFAS-WI25232	Perfluorinated Alkyl Substances (PFASs) in Drinking Water by Method 537.1 Version 1.0 and Method 537.1 Version 2.0	PFAS Manager
T-PFAS-WI25971	Total Oxidizable Precursors in Solid Samples by LC/MS/MS with Isotope Dilution	PFAS Manager
T-PFAS-WI30676	Per- and Polyfluoalkyl Substances in Drinking Water Using Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry by Method 533	PFAS Manager
T-PFAS-WI34027	Client Specific: Determination of Mono-functional Surfactants (MFS) in Aqueous and Solid Samples by Extracted Internal Standard Quantitation using LC/MS/MS	PFAS Manager
T-PFAS-WI34886	Client Specific: Determination of Bi-functional Surfactants (BFS) in Aqueous and Solid Samples by Extracted Internal Standard Quantitation using LC/MS/MS	PFAS Manager
T-PFAS-WI35936	Minnesota - Polyfluorinated Alkyl Substances (PFAS) in Solids by Minnesota Pollution Control(MPCA) Guidance PFAS Method eao2-06, Using LC/MS/MS	PFAS Manager
T-PFAS-WI35937	Minnesota - Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Minnesota Pollution Control(MPCA) Guidance PFAS Method eao2-06, Using LC/MS/MS	PFAS Manager
T-PFAS-WI36458	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Version 1.1 Modified QSM5.4 Table B-15 Using LC/MS/MS	PFAS Manager
T-PFAS-WI36459	Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Version 1.1 Modified QSM 5.4 Table B-15 Using LC/MS/MS	PFAS Manager

T-PFAS-WI38299	Extraction and Analysis of Adsorbable Organic Fluorine (AOF) from Water by Carbon Adsorption coupled with Combustion Ion Chromatography (CIC). Determination of Total Fluorine (TF) in Water by Combustion Ion Chromatography	PFAS Manager
T-PFAS-WI39592	Client specific-Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples Using Isotope Dilution and LC/MS/MS	PFAS Manager
T-PFAS-WI43681	Determination of Total Fluorine (TF) and Extractable Organic Fluorine (EOF) from Solids/soil by Combustion Ion Chromatography (CIC)	PFAS Manager
T-PFAS-WI46412	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Aqueous Samples by LC-MS/MS Using Draft Method 1633/QSM5.4 Table B24	PFAS Manager
T-PFAS-WI48593	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Solid Samples by LC-MS/MS Using Draft Method 1633/QSM5.4 Table B24	PFAS Manager
T-PFAS-WI49209	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Aqueous Samples by LC-MS/MS Using Draft Method 1633	PFAS Manager
T-PFAS-WI49211	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Solid Samples by LC-MS/MS Using Draft Method 1633	PFAS Manager
T-PFAS-WI49212	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Tissue Samples by LC-MS/MS Using Draft Method 1633/QSM5.4 Table B24	PFAS Manager
T-PFAS-WI49214	Analysis of Per and Polyfluoroalkyl Substances (PFAS) in Tissue Samples by LC-MS/MS Using Draft Method 1633	PFAS Manager
T-PFAS-WI50447	PFAS Prescreen Method in Water Samples Requesting PFAS by Isotope Dilution	PFAS Manager
T-PFAS-WI53302	Extraction and Analysis of Adsorbable Organic Fluorine (AOF) from Water by Carbon Adsorption coupled with Combustion Ion Chromatography (CIC) using EPA Draft Method 1621	PFAS Manager
T-PFAS-WI58310	Non-targeted Acquisition With Suspect Screening for Per- and Polyfluoroalkyl Compounds	PFAS Manager
T-PFAS-WI59559	Preventative and Corrective Maintenance for the Promochrom Automated Extraction Unit	PFAS Manager
T-PFAS-WI62457	Polyfluorinated Alkyl Substances (PFAS) in Oil Samples Using Isotope Dilution and LC/MS/MS	PFAS Manager
T-PFAS-WI62538	Cryogrinding of Solid Materials for Targeted PFAS, Extractable Organic Fluorine, Total Fluorine and Non-Target/Suspect Screening Analysis	PFAS Manager
T-PFAS-WI65636	Determination of Per- and Polyfluoroalkyl Substances (PFAS) in Water by Direct Injection Analysis	PFAS Manager
T-PFAS-WI67009	Total Oxidizable Precursors in Aqueous Samples by L-MS/MS Using Draft Method 1633	PFAS Manager
T-PFAS-WI67289	Knifemill of Solid Materials for Targeted PFAS Extractable Organic Fluorine, Total Fluorine, and Non-Target/Suspect Screening Analysis	PFAS Manager
T-PFAS-WI67878	Client Specific: Determination of C6O4 in Aqueous and Solid Samples by Extracted Internal Standard Quantitation using LC/MS/MS	PFAS Manager
T-PFAS-WI68879	Determination of Per- and Polyfluoroalkyl Substances (PFAS) in Solids by Direct Injection Analysis (ASTM D8421 Mod)	PFAS Manager
T-PFAS–WI69608	Aqueous PFAS Prep by SPE and Analysis by LC-MS-MS by EPA 1633	PFAS Manager

T-PFAS-WI72213	Solid PFAS Prep by Sonication and Analysis by LC-MS-MS by EPA 1633	PFAS Manager
T-PFAS-WI72427	Aqueous PFAS Prep by SPE and Analysis by LC-MS-MS by EPA 1633/QSM 6.0 Table B-24	PFAS Manager
T-PFAS-WI72428	Solid PFAS Prep by SPE and Analysis by LC-MS-MS by EPA 1633/QSM 6.0 Table B-24	PFAS Manager
T-PFAS-WI73994	Determination of Selected Branched and Linear Isomers in Samples Submitted for PFAS by EPA 1633	PFAS Manager

8.12 D4034 Specialty Services

Work Instruction

T-SSG-WI10940	Extraction for Perchlorate by Method 6850 in Solids	Specialty Services Manager
T-SSG-WI33739	Client Specific Method- Extraction and Analysis of Chlorpyrifos in Wastewater by GC/MS/MS	Specialty Services Manager
T-SSG-WI35758	Client Method: Analysis of Indirect Precursors and Telomer Intermediates by GC/MS/MS	Specialty Services Manager
T-SSG-WI35928	(Client Specific) Analysis of FRD-920 in Wastewater by LC/MS/MS	Specialty Services Manager
T-SSG-WI36413	Preventative and Corrective Maintenance for the API 4000 and AB Sciex 4500/5500 Liquid Chromatograph Mass Spectrometers (LC/MS/MS)	Specialty Services Manager
T-SSG-WI41726	Extraction of Solid Samples for Fluorotelomer Alcohols by Method 3546	Specialty Services Manager
T-SSG-WI63786	Client Specific Method – Analysis of Pesticides in Solid Samples using GC-MS/MS and LC-MS/MS	Specialty Services Manager
T-SSG-WI69042	Determination of Dioxathion in Water and Solid Samples by LC/MS/Ms following SW-846 8321A Modified Method	Specialty Services Manager
T-SSG-WI7748	Thermo Scientific Trace 1310 Gas Chromatograph Tandem Mass Spectrometer (GC/MS/MS) Preventative and Corrective Maintenance	Specialty Services Manager
T-SSG-WI7750	Analysis of Fluorotelomer Alcohols in Water, Waste Water, and solids using GC/MS/MS	Specialty Services Manager
T-SSG-WI9093	Client Specific - Analysis of Glycerol Monolaurate and Propylene Glycol Monolaurate in BioPolySan by Gas Chromatography Mass Spectroscopy (GC/MS)	Specialty Services Manager
T-SSG-WI9431	Determination of Hydrazine, Monomethylhydrazine and 1,1-Dimethylhydrazine in Soil samples by LC/MS/MS	Specialty Services Manager
T-SSG-WI9448	Determination of Hydrazine Monomethylhydrazine and 1,1-Dimethylhydrazine in Aqueous Samples by LC/MS/MS Using SW-846 8315A Modified	Specialty Services Manager
T-SSG-WI9483	Extraction of Waters for Fluorotelomer Alcohols by Method 3510C	Specialty Services Manager
T-SSG-WI9989	Perchlorate by Method 6850 in Waters and Solids by LC/MS/MS	Specialty Services Manager
T-SSG-WI76033	Client Specific: Analysis of Neutral PFAS in AFFF/Dispersions/Liquid Product Samples using GC/MS/MS	Specialty Services Manager

8.13.01 D4036 Organic Extraction - Prep for Pesticides

Work Instruction

T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)	Organic Extraction Manager

T-OE-PEST-WI10907	Extraction By Method 8318/8318A for Carbamate and Urea Pesticides in Solids	Organic Extraction Manager
T-OE-PEST-WI10912	Ultrasonic Extraction of Chlorinated Herbicides by Method 3550B/C in a Solid Matrix	Organic Extraction Manager
T-OE-PEST-WI10918	Waste Dilution by EPA 3580A for PCBs in Oil	Organic Extraction Manager
T-OE-PEST-WI10919	Extraction of Chlorinated Herbicides in Water by SW-846 8151A	Organic Extraction Manager
T-OE-PEST-WI10920	Separatory Funnel Extraction by Method 3510C, 608, or 608.3 for Pesticides and PCBs in a Wastewater	Organic Extraction Manager
T-OE-PEST-WI10921	Waste Dilution by EPA 3580A for Pesticides in a Non-Water Soluble Leachate Matrix	Organic Extraction Manager
T-OE-PEST-WI10922	Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550B and 3550C	Organic Extraction Manager
T-OE-PEST-WI10926	Microwave Extraction Method 3546 for Pesticides in a Solid Matrix	Organic Extraction Manager
T-OE-PEST-WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix	Organic Extraction Manager
T-OE-PEST-WI10939	Ultrasonic Extraction for Pesticides in a Solid Matrix by Method 3550	Organic Extraction Manager
T-OE-PEST-WI10942	Extraction of Nitroaromatics and Nitroamines by Method 3535A in Water	Organic Extraction Manager
T-OE-PEST-WI10943	Ultrasonic Extraction of Nitroaromatics and Nitroamines by Method 8330B in Solids	Organic Extraction Manager
T-OE-PEST-WI10956	Microextraction of EDB and DBCP in Solids by Method 8011	Organic Extraction Manager
T-OE-PEST-WI11372	Extraction of Formaldehyde and Other Aldehydes in a Water Matrix by Method 8315A	Organic Extraction Manager
T-OE-PEST-WI11373	Extraction of Solid Samples for Formaldehyde and Aldehydes by Method 8315A	Organic Extraction Manager
T-OE-PEST-WI11381	Microextraction by Method 8011 for EDB, DBCP, and TCP in Water	Organic Extraction Manager
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by Method 3640A	Organic Extraction Manager
T-OE-PEST-WI55207	Ultrasonic Extraction of Nitroaromatics and Nitroamines by Method 8330B MOD in Solids - DOD	Organic Extraction Manager
T-OE-PEST-WI9480	Extraction of Water and Soil Samples by Method 680	Organic Extraction Manager

8.13.02 D4036 Organic Extraction - Prep for SVOA

Work Instruction

T-OE-SVOA-WI10280	Alumina Column Cleanup	Organic Extraction Manager
T-OE-SVOA-WI10554	Semivolatile Extract Cleanup Using GPC by Method 3640A	Organic Extraction Manager
T-OE-SVOA-WI10884	Solid Phase Extraction Procedure for the Determination of THPA, THPI, and PA in a Water Matrix	Organic Extraction Manager
T-OE-SVOA-WI10916	Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	Organic Extraction Manager
T-OE-SVOA-WI10917	Waste Dilution, EPA 3580A for Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	Organic Extraction Manager
T-OE-SVOA-WI10924	Separatory Funnel Extraction by Method 3510C for Tetraethyl Lead in Waters	Organic Extraction Manager
T-OE-SVOA-WI10928	Microwave Extraction by Method 3546 for Semivolatiles	Organic Extraction Manager
T-OE-SVOA-WI10935	Separatory Funnel Extraction (Method 3510C) of Base Neutrals and Acid Extractables in Leachates	Organic Extraction Manager

T-OE-SVOA-WI10936	Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix by Method 3580A	Organic Extraction Manager
T-OE-SVOA-WI10947	Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1	Organic Extraction Manager
T-OE-SVOA-WI11432	Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater	Organic Extraction Manager
T-OE-SVOA-WI18058	Separatory Funnel Extraction of Chlorinated Herbicides in Water by SW-846 Method 8151A	Organic Extraction Manager
T-OE-SVOA-WI34450	Extraction of SAN Trimer by Method 525.3 in Waters	Organic Extraction Manager
T-OE-SVOA-WI68732	Microextraction by Method 3511 for Semivolatile in Water	Organic Extraction Manager
T-OE-SVOA-WI75098	Client Specific Method – Microextraction by Method 3511 for 1,1,3,3-tetrachloropropene in Water	Organic Extraction Manager

8.13.03 D4036 Organic Extraction - Prep for GC

Work Instruction

T-OE-GC-WI10278	10g Silica Gel Cleanup by Method 3630C for Hydrocarbons by GC in Water and Solid Matrices	Organic Extraction Manager
T-OE-GC-WI10879	Silica Gel Fractionation by Method 3630C for Hydrocarbons by GC in Water and Solid Matrices	Organic Extraction Manager
T-OE-GC-WI10883	Microwave Extraction Method 3546 for NJ EPH in a Solid Matrix	Organic Extraction Manager
T-OE-GC-WI10892	Separatory Funnel Extraction for ETPH in Water or Wastewater Matrix by Connecticut Methodology	Organic Extraction Manager
T-OE-GC-WI10894	Separatory Funnel Extraction for DRO and RRO by AK 102/103 in a Water Matrix	Organic Extraction Manager
T-OE-GC-WI10897	Ultrasonic Extraction by Method 3550B/C for DRO and Fingerprint on Petroleum Products in Solids	Organic Extraction Manager
T-OE-GC-WI10899	Microwave Extraction for EPH in a Solid Matrix by Montana Protocol	Organic Extraction Manager
T-OE-GC-WI10901	Ultrasonic Extraction for ETPH in Solid Matrix by Connecticut Methodology	Organic Extraction Manager
T-OE-GC-WI10905	Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	Organic Extraction Manager
T-OE-GC-WI10906	Microextraction by Method 3511 for DRO in Water and Wastewater	Organic Extraction Manager
T-OE-GC-WI10908	Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	Organic Extraction Manager
T-OE-GC-WI10909	Microwave Extraction, Method 3546, for MA EPH in a Solid Matrix	Organic Extraction Manager
T-OE-GC-WI10910	Quick Silica Gel Cleanup by Methods 3630C and ECY 97-602 for Hydrocarbons by GC in Solid and Water Matrices	Organic Extraction Manager
T-OE-GC-WI10913	Sonic Probe Extraction for TPH in Solids by Washington DX	Organic Extraction Manager
T-OE-GC-WI10914	Separatory Funnel Extraction for EPH in Waters by Massachusetts, New Jersey, and Louisiana Protocol	Organic Extraction Manager
T-OE-GC-WI10930	Microwave Extraction Method 3546 for DRO and Saturated Hydrocarbons in a Solid Matrix	Organic Extraction Manager
T-OE-GC-WI10932	Extraction by EPA 3546 for DRO and/or RRO in Solids for Alaska Methodology	Organic Extraction Manager
T-OE-GC-WI10944	Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	Organic Extraction Manager

T-OE-GC-WI10949	3 g Silica Gel Column Cleanup for DRO by Method 3630C	Organic Extraction Manager
T-OE-GC-WI11364	Extraction of Total Petroleum Hydrocarbon Organics in Waters by Texas Methodology	Organic Extraction Manager
T-OE-GC-WI11365	Extraction of Total Petroleum Hydrocarbons in a Solid Matrix by Texas Methodology	Organic Extraction Manager
T-OE-GC-WI21921	Acid Cleanup Procedure for Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	Organic Extraction Manager

8.13.04 D4036 Organic Extraction - General

Work Instruction

T-OE-GEN-WI10860	Ultrasonic Processor Maintenance and Tuning	Organic Extraction Manager
T-OE-GEN-WI10861	Steam Bath, N-Evap, Buchi Concentrator, and RapidVap Usage, Calibration, and Maintenance	Organic Extraction Manager
T-OE-GEN-WI10862	Electrothermal Heating Mantles	Organic Extraction Manager
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions	Organic Extraction Manager
T-OE-GEN-WI10865	Solvent, Reagent, and Amber GC Vial Lot Testing for Organic Extractions	Organic Extraction Manager
T-OE-GEN-WI10866	pH Meters and Electrodes	Organic Extraction Manager
T-OE-GEN-WI10867	Procedure for Containment and Clean Up of Hazardous materials Spills in Organic Prep Lab	Organic Extraction Manager
T-OE-GEN-WI10868	Scheduling Sample Request Forms (SRFs)	Organic Extraction Manager
T-OE-GEN-WI10869	Spike Solution Testing and Approval	Organic Extraction Manager
T-OE-GEN-WI10870	Ultrasonic Probe Horn Cleaning	Organic Extraction Manager
T-OE-GEN-WI10871	Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation	Organic Extraction Manager
T-OE-GEN-WI10873	Glassware Cleaning Using Automatic Washers for non-Organic Extraction Glassware	Organic Extraction Manager
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling	Organic Extraction Manager
T-OE-GEN-WI10877	Maintenance and Calibration of the Microwave Accelerated Reaction System	Organic Extraction Manager
T-OE-GEN-WI11369	Determining QC Sample Volume for Organic Extractions	Organic Extraction Manager
T-OE-GEN-WI11400	Multipette Stream Operation and Calibration	Organic Extraction Manager
T-OE-GEN-WI11408	Percentage Lipids Using Soxhlet Extraction by Method 3540C	Organic Extraction Manager
T-OE-GEN-WI11418	Refrigerated Recirculators	Organic Extraction Manager
T-OE-GEN-WI11420	Routine Maintenance of Miele Glass Washers	Organic Extraction Manager
T-OE-GEN-WI38993	Sep Funnel Separation of Bulk Waste	Organic Extraction Manager
T-OE-GEN-WI58373	Bottle Rinse Extraction by Method 3510C	Organic Extraction Manager
T-OE-GEN-WI7154	Food and Tissue Preparation	Organic Extraction Manager

8.14 D4037 HRMS Group

Work Instruction

T-HRMS-WI12003	Determination of Tetra- Through Octa-chlorinated Dioxins and Furans, Dioxin-like Polychlorinated Biphenyls, and Indicator Polychlorinated Biphenyls by HRGC/HRMS in Aqueous, Solid, Oil, and Oleoresin Matrices (foods/feeds) by Methods 1613B and 1668 Modified	HRMS Manager

T-HRMS-WI12013	Determination of Percentage Lipids in Animal and Marine Tissue using EPA Method 1613B	HRMS Manager
T-HRMS-WI12032	Separatory Funnel Extraction Procedure for HRMS Analysis in an Aqueous Matrix Using Method 1613B, 8290A, 1668A, and 1668C	HRMS Manager
T-HRMS-WI19229	DFS HRGC/HRMS Preventative and Corrective Maintenance	HRMS Manager
T-HRMS-WI21311	Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water and solid samples using HRGC/HRMS	HRMS Manager
T-HRMS-WI21528	Separatory Funnel Extraction Procedure for HRMS Analysis in an Aqueous Matrix	HRMS Manager
T-HRMS-WI21536	Soxhlet Extraction Procedure for HRMS Analysis in a Solid matrix	HRMS Manager
T-HRMS-WI39008	HRMS Extract Cleanup Using GPC by Method 3640A	HRMS Manager
T-HRMS-WI69029	Determination of Tetra- Through Octa-chlorinated Dioxins and Furans, Dioxin-like Polychlorinated Biphenyls, and Indicator Polychlorinated Biphenyls by HRGC/HRMS in Aqueous, Solid, Oil, and Oleoresin Matrices (foods/feeds) by Methods 1613B and 1668 Modified with APGC	HRMS Manager
T-HRMS-WI9432	PCB Congeners by Method 1668 HRGC/HRMS in Aqueous and Solid Matrices	HRMS Manager
T-HRMS-WI9446	Standards Management in the High Resolution Mass Spectrometry Laboratory	HRMS Manager
T-HRMS-WI9476	Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 Method 8290A	HRMS Manager
T-HRMS-WI9485	Glassware Cleaning for HRMS Extractions	HRMS Manager
T-HRMS-WI9487	Preparation of Aqueous and Solid Samples for Food and Feed Using Microwave or Soxhlet Extraction for Analysis by HRMS	HRMS Manager
T-HRMS-WI9488	Soxhlet Extraction Procedure for HRMS Analysis in a Solid Matrix by Methods: 1613B, 8290A, 1668C, and 1668A	HRMS Manager
T-HRMS-WI9489	Preparation of Oils and Oleoresins for Food and Feed Analysis by HRMS	HRMS Manager

Instrument	# of Units	Detector Type/Manufacturer
Liquid Chromatography/Gas Chromatography/Mass Spectrometry (LC/GC/MS)		
LC/MS/MS *(1 – 4033)*	1	AB Sciex X500R QTOF with Exion LC
LC/MS/MS *(2 – 4033) (2 – 4034)*	4	AB Sciex Tripple Quad 4500 with Exion LC
LC/MS/MS *(1 – 4033)*	1	AB Sciex Tripple Quad 5500 with Exion LC
LC/MS/MS (14 - 4033)	14	AB Sciex Tripple Quad 5500+ with Exion LC
LC/MS/MS *(12 – 4033)*	12	AB Sciex Tripple Quad 7500 with Exion LC 2.0
LC/MS/MS *(1 – 4033)*	1	AB Sciex 4000 with Exion LC
LC/MS/MS (6 – 4033)	6	AB Sciex Triple Quad 5500+ QTRAP
LC/MS/MS *(1 – 4034)*	1	Agilent
LC/MS/MS *(2 – 4034)*	2	Agilent LC with Micromass Quattro micro MS/MS and Waters 2996 Photodiode Array UV-Vis Detector
LC/MS/MS *(1 – 4034)*	1	Thermo Scientific TSQ Quantum Access with Acella LC
GC/MS *(25 – 4021) (4 – 4030) (1 – 4024) (14 – 4026)*	44	Agilent
GC/MS *(1 – 4034)*	1	DSQ II MS
GC/MS/MS *(1 - 4034)*	1	Thermo TSQ 8000 MSMS
GC/MS/MS (4 – 4026)	4	Shimadzu TQ8050NX
HRGC/HRMS	6	Thermo Scientific DFS
APGC/HRMS	1	Water Atmospheric Pressure GC/MS/MS
Gas Chromatograph *(2 – 4030) (1 – 4032) (6 – 4021)*	9	Flame Ionization / Photoionization
Gas Chromatograph *(1 – 4032)*	1	Flame Ionization / ELCD
Gas Chromatorgraph *(1 – 4032)*	1	Flame Ionization / Thermoconductivity
Gas Chromatograph *(14 – 4024)*	14	Electron Capture
Gas Chromatograph *(16 – 4032)*	16	Flame Ionization
Auxiliary Equipment for Gas Chromatographs		
Most of the GC/MS and GC systems include autosamplers and approximately half are fitted with purge and trap concentrators for analysis of volatiles.		

High Performance Liquid Chromatography		
High Performance Liquid Chromatograph(4024)	2	Agilent 1100 LC
High Performance Liquid Chromatograph(4024)	4	Agilent 1200 HPLC
High Performance Liquid Chromatograph(4024)	1	Waters alliance 2695
High Performance Liquid Chromatograph	1	Waters alliance 2795

Gel Permeation Chromatography		
Gel Permeation Chromatograph	3	J2Scientific AccuPrep

Combustion Ion Chromatography		
Combustion Chromatograph	2	Metrohm

Ion Chromatography		
Ion Chromatograph	4	Integrion
Ion Chromatograph	3	Aquion

Atomic Absorption/Emission Spectrophotometry		
ICP	2	Thermo ICAP™ 6000 Duo ICP Analyzer
ICP/MS	1	Agilent 7700

ICP/MS	4	Agilent 7900
ICP/MS	1	Agilent 7850
Mercury Analyzer	1	Leeman Labs Hydra II
Mercury Analyzer	2	Leeman Labs M-7600

UV Vis/IR Spectrophotometry:		
UV-Vis Spectrophotometer	3	Thermo Genesys 30
UV-Vis Spectrophotomenter	1	Hach DR2800

Miscellaneous Chemistry Instrumentation		
Auto-titrator System	2	Mantech
Automated COD Analyzer	1	Skalar
Turbidity meter	2	Hach 2100AN, VWR/Hach TU5200
Block Digestion Systems	8	Environmental Express SC150
Block Digestion Systems	8	Environmental Express SC154
Centrifuge	5	Various
Chilled water recirculators		Various
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
Automated SPE HEM Extractor	4	Horizon SPE-DEX 3100
Automated SPE HEM Extractor	2	Environmental Express SPE-Express
Automated SPE Extractor (D4033)	42	Various
Cyanide Midi Distillation Kits	3	Various
Automated BOD Analyzer, DO Meter	3	Mantech with YSI – LDO probes
Discrete Auto Analyzer	1	Seal AQ700
Flow Solution Auto Analyzer	3	OI FS3700
Flow Solution Auto Analyzer	1	OI FS3100
Flow Solution Auto Analyzer	1	Skalar San++
Discrete Auto Analyzer	1	Thermo Gallery Plus
Glassware washer - automated	6	Miele – (2) PG8257 (1) G7827 (1) G7704 (2) G7883 (10) G7804
Kjehldal Distillation Apparatus	2	Fisher
Microwave Extractors	3	CEM MarsXpress
pH meters	13	Various
Phenol Midi Distillation	2	Andrews Glass
Pressurized Solvent Extractor	2	Dionex ASE200
Puck Mill	1	ESSA/2000
Sonicators	12	Various
TOC Analyzer	5	O.I. Corp. 1030
TOC Automated Combustion Analyzer	2	Skalar Primacs ATC-100
TOC Automated Combustion Analyzer	1	Elementar - Cube
Turbidimeter	1	Hach 2100AN
Zero Headspace Extractor	74	Various Models

Computer Equipment

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA Program (see section on Quality Assurance). Numerous physical and virtual servers are used to support the systems. Internet access is provided with an ASA firewall to control incoming and outgoing traffic. The laboratory uses 3 phase power supply and backup generators for life safety and sample integrity preservation.

Appendix B Eurofins PFAS Standard Operating Procedure

eurofins	Always check on-line for validity. **Solid PFAS Prep by Sonication and Analysis by LC-MS-MS by EPA 1633 and EPA 1633A**	Level: **Work Instruction**
Document number: **T-PFAS-WI72213**		
Old Reference:		
Version: **5**		Organisation level: **5-Sub-BU**
Approved by: **TYZ8** Effective Date: **11-MAR-2025**	Document users: **5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_BKK_Data_Reviewers, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep**	Responsible: **5_EUUSLA_PFAS_Manager**

PROPRIETARY AND COMPANY CONFIDENTIAL

This documentation has been prepared by Eurofins Lancaster Laboratories Environment Testing, LLC and its affiliates ("Eurofins"), solely for their own use. The user of this document agrees by its acceptance to return it to Eurofins upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

THIS DOCUMENT CONTAINS VALUABLE CONFIDENTIAL AND PROPRIETARY INFORMATION. DISCLOSURE, USE OR REPRODUCTION OF THESE MATERIALS WITHOUT THE WRITTEN AUTHORIZATION OF EUROFINS IS STRICTLY PROHIBITED. THIS UNPUBLISHED WORK BY EUROFINS IS PROTECTED BY STATE AND FEDERAL LAW OF THE UNITED STATES.

Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Precaution to Minimize Method Interference
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
A) Solid Sample Preparation
B) Manual Sample Phase Extraction
C) Automated Solid Phase Extraction (SPE) by Promochrom
D) Vialing and Addition of Internal standard
E) LC/MS/MS Analysis
F) Dilution
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 05	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Cross Reference	Enhancement	Added Moisture form, QC rotation form
Sample Collection, Preservation, and Handling	Clarification	Clarified sample container
Reagents and Standards	Enhancement	Added sand
Procedure A	Enhancement	Added an additional centrifugation step. Added Data Types. Added uncertainty to biosolid weights. Added requirement to check sonicator water level. Added solvents to clean manifold ports. Added drip rate.

	Revision: 04	**Effective date:** 31.OCT.2024
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Apparatus and Equipment	Enhancement	Added missing vendors. Standards are stored in the dark.
Calibration	Enhancement	CCVs are run every 10 injections of field sample extracts
Reagents and Standards	Enhancement	Added missing vendors.
Procedure A, B, C	Clarification	Clarified prep procedure
Procedure D	Clarification	removed references to Cal0. Added additional ICB in sequence. Rearranged section.
Procedure E	Enhancement	Added section to address dilutions
QA/QC	Clarification	IAR ratio is based off the mid-point CCV standard
Attachments	Clarification	Updates to Att 01, 02, 11,12, 16

Reference

1. USEPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.

2. USEPA Method 1633 Revision A, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, December 2024.

3. Chemical Hygiene Plan, current version.

Cross Reference

Document	Document Title
T-PFAS-WI21568	Environmental Monitoring in the PFAS Lab
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
T-PFAS-WI23588	Preventative and Corrective Maintenance for the AB Sciex Liquid Chromatograph Mass Spectrometers (LC-MS/MS)
G-DC-FRM23907	Redacted SOPs
T-PFAS-FRM74731	D4033 - Moisture Calculation

Scope

This method is applicable for the determination of selected per- and polyfluorinated alkyl substances (PFAS) in solid samples to include solids and biosolids. The compounds analyzed in this method are

Confidential

listed in the table below. The most current MDLs and LOQs are listed in the LIMS. Compounds other than those listed may be analyzed by client request.

Analyte	Acronym	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	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
1H,1H,2H,2H-Perfluorohexane sulfonic acid	4:2 FTS	757124-72-4
1H,1H,2H,2H-Perfluorooctane sulfonic acid	6:2 FTS	27619-97-2
1H,1H,2H,2H-Perfluorodecane sulfonic acid	8:2 FTS	39108-34-4
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluorooctane sulfonamide	NMeFOSA, N-MePFOSA	31506-32-8
N-ethylperfluorooctane sulfonamide	NEtFOSA, N-EtPFOSA	4151-50-2
N-methylperfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethylperfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
N-methylperfluorooctane sulfonamidoethanol	NMeFOSE, NMePFOSAE	24448-09-7
N-ethylperfluorooctane sulfonamidoethanol	NEtFOSE, NEtFOSAE	1691-99-2
Hexafluoropropylene Oxide Dimer Acid	HFPO-DA, GenX	13252-13-6
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4 *
Perfluoro-3-methoxypropanoic acid	PFMPA, PFECA F	377-73-1

Confidential

Analyte	Acronym	CAS#
Perfluoro-4-methoxybutanoic acid	PFMBA, PFECA A	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA, PFECA B	151772-58-6
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Perfluoro (2-ethoxyethane) sulfonic acid	PFEESA, PES	113507-82-7
Perfluoro-4-ethylcyclohexanesulfonic acid	PFECHS	133201-07-7
Perfluorobutylsulfonamide	FBSA	30334-69-1
Perfluorohexanesulfonamide	FHxSA	41997-13-1

*CAS# for the free acid form of the analyte

Basic Principles

A solid sample is fortified with isotopically-labeled extraction standards. The sample is sonicated, centrifuged, and the supernatant decanted. Carbon cleanup is performed on each sample extract. Sample extract is diluted to volume and then concentrated. The sample is then passed through a solid phase extraction (SPE) cartridge to extract the analytes. The compounds are eluted from the solid phase with a combination of solvents. The extract is fortified with Isotopically-labeled injection internal standards. It is then analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Precaution to Minimize Method Interference

1. LC system components contain many of the target analytes. To minimize the background PFAS peaks, PTFE solvent frits and tubing are replaced by PEEK™ solvent frits and tubing where possible.

2. A precolumn, Proprietary Content, is installed before the injection valve to separate PFAS in standards/samples from those from the LC system and mobile phases.

3. All parts of the SPE manifold must be cleaned as per *T-PFAS-WI21568*.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

Confidential

Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IPR (IDOC) and the DOC consist of 4 laboratory control samples (or alternatively, one blind sample for the DOC) that are spiked at the LCS level and carried through all steps of the extraction and analysis. Using results of the set of four analyses, compute the average percent recovery and the relative standard deviation (RSD) of the concentration for each analyte.

- For each target, the RSD and percent recovery must meet the criteria in Table 7. If any individual RSD exceeds the precision limit or any individual percent recovery falls outside the range for recovery for a target, system performance is unacceptable for that compound. Correct the problem and repeat the test.

- For each EIS and NIS, the percent recovery must meet the criteria defined in Table 8. There are is no RSD criteria for the EIS or NIS. If any individual percent recovery falls outside the range for an EIS or NIS, system performance is unacceptable for that compound. Correct the problem and repeat the test.

See *QA-SOP11178* for additional information on IDOC and DOC.

Sample Collection, Preservation, and Handling

A. Sample Collection

The samples are collected in 4-oz HDPE specimen containers with polyethylene screw caps. Keep the sample sealed from time of collection until extraction.

NOTE: PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

B. Sample Storage and Shipment

1. Solid and Biosolid samples must be chilled during shipment and must not exceed 6°C during the first 48 hours after collection. Sample temperature must be confirmed to be at 0° to 6°C when the samples are received at the laboratory.

Confidential

2. Solid and Biosolid samples stored in the lab must be protected from light and held at a temperature of 0° to 6°C, or less than or equal to -20°C, until extraction.

3. Solid and Biosolid samples must be extracted within 90 days.

NOTE: Biosolid samples stored under refrigeration may produce gases that may cause sample to be expelled from the container when opened. This may produce noxious odors. It is recommended to store frozen if extraction will not occur for a few days.

4. Extracts must be analyzed within 28 days after extraction when stored at a temperature of 0° to 6°C, not frozen, and protected from light. Extracts must be analyzed within 90 days after extraction when stored at a temperature less than or equal to -20°C and protected from light.

Apparatus and Equipment

A. Apparatus

1. Specimen container; PP; natural; graduated; non-sterile; separate 1/4-turn red screwcap; 4 oz. Greenwood Products, Inc., Part No. HP30011 or equivalent

Note: One bottle per lot must be tested and demonstrated to be PFAS-free at or below the laboratory's MDLs for all target analytes. See *T-PFAS-WI21568* for additional details.

2. Centrifuge tubes, 15-mL conical polypropylene with polypropylene screw caps. Fisher Scientific, Catalog No. 05-539-5 or equivalent.

3. HDPE bottles for extraction fluid storage, 1L. Environmental Sampling Supply, Catalog No. 1000-1902-PC or equivalent.

4. Analytical Balance – Capable of weighing to 0.0001 g

5. Top-Loading Balance – Capable of weighing to 0.01 g

6. Solid phase extraction (SPE) Cartridge; Proprietary Content or equivalent.

7. GCB filter cartridge, Proprietary Content or equivalent.

8. Large-volume SPE Reservoir, 25-mL. Millipore-Sigma, Product No. 54258-U or equivalent.

9. SPE Tube Adapter. Millipore-Sigma, Catalog No. 57020-U or equivalent.

10. SPE vacuum extraction manifold – "Resprep" 24-port manifold. Restek, Catalog No. 26080 or equivalent.

11. Polypropylene SPE delivery needles. Agilent, Catalog No. 12234511 or equivalent.

12. Centrifuge, capable of a minimum rotational force of 3500 rcf, rotor radius 19.5 cm. Sorvall ST4 Plus-MD; Fisher Scientific, Catalog No. 75009510 or equivalent.

13. Auto Pipettes, Eppendorf Repeater, capable of accurately dispensing 10- to 1000-µL. Fisher Scientific, Catalog No. 14-287-150 or equivalent.

14. Polypropylene pipette tips, 0.1-200 µL. Fisher Scientific, Catalog No. 02-681-135 or equivalent.

15. Polypropylene pipette tips, 101-1000 µL. Fisher Scientific, Catalog No. 02-707-507 or equivalent.

16. Polypropylene pipette tips, 1 – 10 mL. Eppendorf, Catalog No. 022492098 or equivalent.

17. Pipettes, disposable transfer. Fisher Scientific, Catalog No. 13-711-7M or equivalent.

18. Vortex mixer, variable speed, Fisher Scientific or equivalent.

19. N-Evap sample extract concentrator with N_2 supply and water bath for temperature control. Organomation, Inc., Catalog No. 11250, or equivalent.

Confidential

20. Reagent Water Purification System: Capable of producing ultrapure "Type 1/Milli-Q"-grade water from in-house deionized water system. Millipore SAS, Catalog No. FTPF08831.

21. SureStart Polyspring inserts. Fisher Scientific, Catalog No. 03452340 or equivalent.

22. Short-Cap Vial with Grad Marking Spot, 9-425 Screw-Thread, 2.0 mL, 9 mm, Clear. Restek, Catalog No. 21141 or equivalent.

23. Short Screw Caps, Polypropylene, Screw-Thread, PTFE/Silicone Septa, Blue, Preassembled, 2.0 mL, 9 mm. Restek, Catalog No. 24485 or equivalent.

24. Centrifuge tubes, 50-mL conical polypropylene with polypropylene screw caps. Fisher Scientific, Catalog No. 06-443-21 or equivalent.

25. Polypropylene bottles for standard storage, 4 mL. Fisher Scientific, Catalog No. 2006-9125 or equivalent.

26. Stainless steel spatula/scoop set. Bel-Art SP Scienceware, Product No. 11-865-130 or equivalent.

27. pH paper, Hydrion, range 5.5-8.0. Fisher Scientific, Catalog No. 14-853-275 or equivalent.

28. Syringe filter, 25 mm Syringe Filter, 0.22 um, 100-pk. Restek, Catalog No. 26148 or equivalent.

29. Sonicator bath - Branson 3800 or equivalent.

30. Wooden Tongue Depressors. Fisher Scientific, Catalog No. 11-700-555 or equivalent.

31. Mobile phase bottles, 5 L. Fisher Scientific, Catalog No. 064141F or equivalent.

B. Equipment

1. AB Sciex Triple Quad 5500/5500+ Turbo V Ion Source or equivalent.

   ExionLC Controller
   ExionLC AC Pump
   ExionLC AC Autosampler
   Exion AC Column Oven
   Data system – Analyst 1.6.3

2. AB Sciex Triple Quad 7500 QTRAP Ready or equivalent.

   Shimadzu DGU-405 Degasser
   Shimadzu LC-40D XR Pump A
   Shimadzu LC-40D XR Pump B
   Shimadzu SIL-40C XR Autosampler
   Shimadzu CBM-40 Controller
   Shimadzu CTO-40C Column Oven
   Data system – Sciex OS (Version 3.1.6.44)

3. Automated extractor, Proprietary Content or equivalent

4. HPLC columns

   a. Analytical column: Proprietary Content or equivalent.
   b. Pre-column: Proprietary Content or equivalent.

Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or pressure resistant steel drums. Solvents, acids, and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions.

Confidential

A. Reagents

1. Methanol (MeOH), "Chromasolv LC-MS" grade. Honeywell, Catalog No. 34966-4X4L or equivalent.
2. Acetonitrile (ACN). J.T. Baker, Catalog No. 9012-03 or equivalent.
3. Ammonium acetate. Sigma Aldrich, Catalog No. 431311-250G or equivalent. Store at 0-6°C.
4. Proprietary Content or equivalent. Store at room temperature.
    a. Proprietary Content Store at room temperature. Replace after 3 months.
    b. Proprietary Content Store at room temperature. Replace after 1 month.
    c. Proprietary Content. Store at room temperature. Replace after 1 month.
5. 30:70 (v/v) Methanol:Water – Add methanol (300 mL) to water (700 mL). Store at room temperature. Replace after 1 month.
6. Methanol with 5% water - Add reagent water (50 mL) to methanol (950 mL). Store at room temperature. Replace after 1 month.
7. Acetic Acid, ACS grade. Sigma Aldrich, Catalog No. 695092-100mL or equivalent. Store at room temperature.
    a. Acetic Acid (0.1% v/v) – Dissolve acetic acid (1 mL) in reagent water (1 L). Store at room temperature. Replace after 3 months.
8. Formic Acid, ACS-grade. Sigma, Catalog No. 33015-1L or equivalent.
    a. Formic acid (aqueous, 0.1 M) - Dissolve formic acid (4.6 g or 3.8 mL) in reagent water (1 L). Store at room temperature. Replace after 2 years
    b. Formic acid (aqueous, 0.3 M) - Dissolve formic acid (13.8 g or 11.3 mL) in reagent water (1 L). Store at room temperature. Replace after 2 years
    c. Formic acid (aqueous, 5% v/v) - Mix 5 mL formic acid with 95 mL reagent water. store at room temperature. Replace after 2 years
    d. Formic acid (aqueous, 50% v/v) - Mix 50 mL formic acid with 50 mL reagent water. Store at room temperature. Replace after 2 years.
9. Proprietary Content or equivalent. Store at room temperature. Replace 1 year after opening.
    a. Proprietary Content. Store at room temperature. Expires 1 month after preparation.
10. Sand - Sigma-Aldrich, Part No. 274739-5Kg or equivalent.
11. Mobile Phase A: Proprietary Content. Store at room temperature for up to 2 months. Different volumes can be prepared as long as final concentrations are equivalent.
12. Mobile Phase B: 100% acetonitrile into a 2-L glass mobile phase bottle. Store at room temperature for up to 2 months.

B. Standards

Confidential

Standards are prepared using calibrated pipettes, polypropylene microcentrifuge tubes, and polypropylene bottles to create solutions at desired concentrations. The concentrated solution is injected below the surface of the diluting solvent. After preparation is completed, standards should be vortexed to ensure complete mixing. Measurement of volumes less than 5 µl should be avoided in routine production operations.

All stock, intermediate and spiking solutions are prepared using methanol. All initial calibration, initial calibration verification, and linear branched working standard solutions are prepared using Proprietary Content.

All diluted solutions must be stored in HDPE containers that have been thoroughly rinsed with methanol.

Stock standard and intermediate standard solutions are stored in the dark in the refrigerator in labeled polypropylene screw-top vials, polypropylene bottles, or polypropylene centrifuge tubes.

Expiration dates are managed through LIMS Reagent module. Solutions transferred from sealed glass ampules to screw-capped vials are given expiration dates of 1 year from the date opened or the expiration date provided by the vendor, whichever occurs sooner. Intermediate solutions are given an expiration date of 6 months from the preparation date, or the expiration date from the ampule provided by the vendor, whichever occurs sooner. The ampules and transferred solutions are stored in the refrigerator in the dark.

Working native and labeled (extraction surrogate and internal standard) compound spiking solutions are given an expiration date of 6 months, or the expiration date of the solutions used to prepare the working solution, whichever occurs sooner. The solutions are stored in labeled polypropylene screw-top vials in the refrigerator in the dark. When these solutions are prepared they must be tested prior to use in the PFAS extraction lab and verified monthly until they are consumed by operations or expire. Records of the standard verification are maintained by the laboratory. Prior to use, the working spiking solution should be evaluated against recovery windows of 85-115% for all compounds that will be analyzed using that solution. Should a standard fail to meet these criteria, the data must be reviewed by departmental management for acceptability and/or corrective action.

Working initial calibration solutions are given an expiration date of 6 months, or the expiration date of the solutions used to prepare the working initial calibration solution, whichever occurs sooner.

The primary/preferred standard vendor is Wellington Laboratories, Inc. Ontario, Canada. Listed catalog numbers are taken from Wellington product lists. Equivalent standards may be substituted, if the listed standards are unavailable.

The solution concentration listed is as presented on the certificate of analysis and includes adjustment for purity and the salt form of the compound used.

The concentrations referenced for the sulfonate salts, (for example PFBS, PFHxS and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of analysis (CofA). See Attachment 4. If the compound purity is assayed to be 98% or greater, weight can be used without correction to calculate concentrations.

Log purchased standards into LIMS Reagent. Select the solution category SOURCE for purchased mixes and/or single-compound ampules. LIMS Reagent system will assign formatted names to the purchased standard solutions. The automatically-generated name can be overwritten with a manually created name if desired. Use labels printed through the LIMS Reagent to identify and track standard solutions after transfer from original ampule to storage vial. The CofA for the ampulated stock standard is attached in LIMS Reagent for reference.

Standards are prepared by transferring a known quantity of Standard to a final volume of solvent. Standard Preparation is documented in LIMS Reagent. Solutions are stored by Type in LIMS Reagent, i.e., INTERMEDIATE=working solutions and intermediate standards and SOURCE=stocks (ampulated solutions). Each Standard is given a unique name.

The following attachments provide examples of standard preparation and purchasing information. Refer to the documentation in LIMS Reagent for standards preparation information.

Attachment 05 - 1633 Native PFAS Intermediate A
Attachment 06 - 1633 Native PFAS Intermediate B
Attachment 07 - 1633 Native PFAS CAL8 Intermediate
Attachment 08 - 1633 Extracted Internal Standard Intermediate

Confidential

Attachment 09 - 1633 Non-Extracted Internal Standard Intermediate
Attachment 10 - 1633 TOP Surrogate Intermediate
Attachment 11 - 1633 ICAL Standard Preparation Scheme
Attachment 12 - 1633 Initial Calibration Standard Concentrations
Attachment 13 - Bile Salts Stock Solution
Attachment 14 - Bile Salts Intermediate
Attachment 15 - Bile Salts Working Solution
Attachment 16 - 1633 WDM Standard
Attachment 17 - 1633 Native Mid-Level Spike
Attachment 18 - 1633 Native Low-Level Spike
Attachment 19 - 1633 ICV Working Standard
Attachment 20 - 1633 Purchased/Ampulated Standards

Calibration

A. Mass Calibration

Frequency	Acceptance Criteria	Corrective Action
Calibration - at least annually or as recommended by the instrument manufacturer, whichever is more frequent, to maintain instrument sensitivity and stability.	Per manufacturer recommendations. Optimize the precursor and product ions in *Attachment 01*	Repeat as needed.
Verification - on an as-needed basis (e.g., QC failures, ion masses fall outside of the required mass window, major instrument maintenance, or if the instrument is moved) prior to the analysis of any standards and samples and after each subsequent mass calibration.	Resolution must meet manufacturer recommendations. The mass assignments must be within ±0.2 amu of the values shown in *Attachment 01*.	Recalibrate as needed. Otherwise, proceed to ICAL.

B. Chromatographic conditions

The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak. See the AB Sciex (5500/5500 Plus/7500) Acquisition, Quantitation, Gradient, and Detector Condition files for the most up to date chromatographic conditions. An example acquisition method and chromatographic conditions are shown in *Proprietary* . Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process. All injections must use the same parameters as used in the ICAL.

C. Retention Time Calibration

Confidential

Frequency	Acceptance Criteria	Corrective Action
once per ICAL and at the beginning of the analytical sequence	EIS, and NIS peaks shall be set using the midpoint standard of the ICAL curve when ICAL is performed. When an ICAL is not performed, the initial CV retention times or the midpoint standard of the ICAL curve can be used to establish the RT window position. The RTs for the target analytes, EIS, and NIS compounds must fall within 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial CV, whichever was used to establish the RT window position for the analytical batch. All branched isomer peaks identified in either the calibration standard or the qualitative (technical grade) standard also must fall within 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial CV. For all target analytes with exact corresponding isotopically labeled analogs, target analytes must elute within 0.1 minutes of the associated EIS compound.	Recalibrate.

D. Initial Calibration

Confidential

Frequency	Acceptance Criteria	Corrective Action
Prior to the analysis of samples, and after the mass calibration verification has met all criteria whenever the laboratory takes an action that changes the chromatographic conditions or might change or affect the initial calibration criteria when either the CV or Instrument Sensitivity Check (ISC) acceptance criteria have not been met.	A minimum of six calibration standards are required when using an average or linear curve fit. A minimum of seven calibration standards are required for a second-order curve fit (quadratic). The lowest standard must be at or below the RL. In general, Cal1 (at the RL), Cal2, Cal3, Cal4, Cal5, Cal6, Cal7, and Cal8 are included in the initial calibration. S/N ratio for the lowest standard within the quantitation range must be greater than or equal to 3:1 for quantification ions and the confirmation ions, or greater than or equal to 10:1 if the analyte only has a quantification ion. To use Average Response Factor: • %RSD for the response factors is less than or equal to 20% • if greater than 20%, try a Linear Regression. To use Linear Regression with a concentration weighing factor of 1/x: • The %RSE for all method analytes must be less than or equal to 20%. • if greater than 20%, try a Quadratic fit. To use Quadratic fit with a concentration weighing factor of $1/x^2$: • The %RSE for all method analytes must be less than or equal to 20%. For all curve fits, each calibration point is calculated back against the curve. The back calculated concentration for each calibration point must be within ±30% of its true value.	If the criteria are not met, the source of the problem must be determined and corrected. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

E. Initial Calibration Verification (ICV)

Confidential

Frequency	Acceptance Criteria	Corrective Action
After ICAL prior to analyzing samples	ICV must be prepared from a second source. If a second source is not available, a separate preparation from the same stock (including intermediates) by a second analyst may be used. The calculated amount for each analyte must be within ±30% of the true value.	If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

F. Calibration Verification (CV)

Frequency	Acceptance Criteria	Corrective Action
Once the calibration curve has been established, the continuing accuracy must be verified by analysis of a continuing calibration verification (CCV) standard at the beginning of each analytical sequence, every ten injections of a field sample extract, and at the end of the analytical sequence.	The calculated amount for each native in the CCV standard must be within ±30% of the true value. The absolute areas of the injection internal standard must be greater than 30% of the average areas measured during the initial calibration.	Samples that are not bracketed by acceptable CCV analyses must be reanalyzed. The exception to this would be if the CCV recoveries are high, indicating increased sensitivity, and there are no positive detections in the associated samples, the data may be reported with a qualifying comment. The source of the problem must be determined and the system recalibrated before continuing sample analysis.

Procedure

Data Types are included in brackets. If a Data Type is not needed (for example, no reagents were needed for pH adjustment), "NA" may be used.

A) Solid Sample Preparation

NOTE: Prior to weighing out samples, thoroughly mix each sample using a separate wooden tongue depressor or stainless steel spoon to ensure a homogeneous sample matrix. Stir from the bottom to the top in a circular motion along the sides of the jar, breaking particles to less than 1 mm by pressing against the side of the container. Remove rocks, invertebrates, and foreign objects. Vegetation can either be removed or cut into smaller pieces based on project requirements.

1. On a calibrated, top-loading balance [*BalanceID*], accurately weigh:

    - 2.0 ± 0.10g for solids (dry weight; note: maximum 4.0g sample aliquot)
    - 0.5 ± 0.025g for biosolids (dry weight; note: maximum 1.0g sample aliquot)

    into a tared, labeled 50-mL centrifuge tube [*TubeLotID*] using a disposable polypropylene spatula [*SpatulaID*]. Record sample weight in the prep entry system to 2 decimal places [*InitialAmount*]. These weights are based on dry weights. Use T-PFAS-FRM74731 to calculate dry weight based on the percent moisture.

2. For each batch of no more than 20 field samples include the following quality control samples:

    a. Method Blank, LCS, LCSD, and LLCS: Weigh 2.0 ± 0.10g (0.5 ± 0.025g for biosolids) of sand [*BlankMtrxID, BlkMatLot, QCBottleLotID*] wetted with 1.0g (0.25g for biosolids) of reagent water. Record "2.00g" as the Initial Amount.

    b. Matrix Spike/Matrix Spike Duplicate (MS/MSD): Weigh 2.0g ± 0.10g (dry weight; note: maximum 2.5g sample aliquot) (0.5g for biosolids (dry weight; note: maximum 1g sample

Confidential

aliquot)) of sample as specified in sample preparation log. **Note**: if not enough sample to prepare an MS/MSD, an LCS/LCSD must be prepared instead.

3. Bring all spike solutions to room temperature and vortex for 30 seconds prior to use.

4. Spike QC and all samples with 25 µL of 1633_125 EIS (1633_125_SS_#####). Spike LCS/LCSD/MS/MSD with 50 µL of 1633_125 Native Spike Mid (1633_125_MS_M_#####). Spike LLCS with 40 µL of 1633_125 Native Spike Low (1633_125_MS_L_#####). Vortex/Shake containers to mix thoroughly. Let samples equilibrate for 30 minutes after spiking. Document the technician who spike the sample [*Analyst ID - Reagent Drop*] as well as the spike witness [*Analyst ID - Reagent Drop Witness*].

5. Cap and vortex for 30 seconds.

6. Allow samples/QC to equilibrate for at least 30 minutes.

7. Add 10 mL of Proprietary Content to each centrifuge tube.

8. Cap and vortex for 30 seconds.

9. Sonicate in an ultrasonic bath [*SonicatorID*] for 1 hour. Record start and stop times. [S*onicationStart* and *SonicationStop]* Ensure the bath is filled with water to the optimal water level mark inside the tank.

10. Centrifuge [*CentrifugeID*] at 3500 rcf for 5 minutes and transfer supernatant to a clean 50-mL centrifuge tube.

11. Add 4 mL of 0.4% (w/v) methanolic potassium hydroxide to the remaining solid sample in each centrifuge tube. Cap and vortex for 30 seconds.

12. Centrifuge at 3500 rcf for 5 minutes and decant the supernatant from the second extraction into the 50-mL centrifuge tube with the supernatant from the first extraction.

13. Centrifuge the combined extracts at 3500 rcf for 5 minutes and decant the supernatant from the 50-mL centrifuge tube to a clean 125-mL HDPE bottle.

14. Bring the 125-mL HDPE container up to 125 mL with Milli-Q water.

15. Check that the pH is 6.0 ± 0.5 and adjust as necessary with 50% formic acid or 30% ammonium hydroxide (or with 5% formic acid and 3% aqueous ammonium hydroxide). **NOTE: Never put pH test strips into the sample.** Record the acid or base lot number [*RgtID*] and amount used [*Amt*]. Use a disposable pipette [*TranferPipID*] to place a few drops of sample onto the pH paper [*pHIndID*].

16. Invert container to thoroughly mix.

17. Continue to either Manual SPE (Procedure B) or Automated SPE (Procedure C.)

B) Manual Sample Phase Extraction

1. Before use, rinse each port of the SPE manifold [*ManifoldID*] with several milliliters of the following solvents in order:

   Proprietary
   Proprietary
   Proprietary
   Proprietary

2. Label each SPE cartridge [*SPECartType*] and *SPECartLot#*] to correspond with each associated sample/QC piece and attach to a rinsed SPE port. Record the SPE port number for each sample/QC piece on the batchlog.

3. Condition each SPE cartridge with the following reagents in the following order:

   a. Proprietary Content
   b. Proprietary Content
   c. Proprietary Content

Confidential

d. Proprietary Content

4. Label each sample bottle, cap, 15-mL centrifuge tube, and reservoir with the same number to ensure samples are not inadvertently switched during the extraction procedure (i.e.; 1,1,1; 2,2,2; 3,3,3; etc.).

5. Attach the labeled 25-mL SPE reservoir [*SPEResID*] to each cartridge. Load the QC and samples to their respective cartridges. Allow full volume to pass through each cartridge by gravity, if possible. Allow sample to pass through. The drip rate should be approximately 3-5 drops per second.

6. After sample/QC has passed through, rinse the walls of the sample/QC bottle with 5 mL reagent water. Add to cartridge and allow to pass through using vacuum. Then repeat.

7. After Milli-Q water has passed through, rinse the walls of the sample/QC bottle with 5 mL 30:70 (v/v) methanol:water [*RinseSolventName* and *RinseSolventLot*]. Add to cartridge and allow to pass through using vacuum. Then repeat.

8. Apply full vacuum to dry the cartridges until they are visually similar to an unused cartridge. This may take up to 10 minutes for some cartridges.

9. Discard the waste and rinse the waste reservoir with isopropyl alcohol. Wipe each needle with a Kim-wipe/methanol.

10. Attach Proprietary Content to the bottom of each SPE cartridge.

11. Place labeled 15-mL polypropylene centrifuge collection tubes [*CentrifugeTube*] under each respective SPE cartridge.

12. Rinse the inside of each empty sample/QC bottle with 5 mL of Proprietary Content. Add to reservoir and cartridge.

13. Apply a slight vacuum to the manifold in order to reclaim as much solvent as possible from the SPE cartridges.

14. Disconnect the cartridge/adapter from the manifold. Remove the collection tubes.

15. Bring each sample extract to final volume 5 mL using methanol with Proprietary Content. Cap and vortex for 30 seconds to mix.

16. Proceed to Procedure D - Vialing and Addition of Internal Standard

C) Automated Solid Phase Extraction (SPE) by Proprietary

This procedure can be used in place of the manual extraction described above.

1. Label each SPE cartridge [*SPECartType* and *SPECartLot#*] to correspond with each associated sample/QC piece and attach to a rinsed SPE port. Record the SPE port number for each sample/QC piece on the batchlog.

2. Check to make sure all reagent bottles are filled and that reagents are not expired. Record Proprietary Content ID and reagent lot numbers. [*ManifoldID*, *SPE_Cond#1ID*, *SPE_Cond#2ID*, *RinseSolventName*, *RinseSolventLot*, *SolventName*, and *SolventLot*]

3. Label each sample bottle, cap, and Proprietary Content cartridge with the same number to ensure samples are not inadvertently switched during the extraction procedure (i.e.; 1,1,1; 2,2,2; 3,3,3; etc.).

4. Select "Proprietary Content" from the drop down menu to start the cleaning cycle prior to SPE. Make sure the "Clean" cartridges and bottles are attached for this cycle.

5. Remove "Clean" cartridges and attach the labeled cartridges that will be used when running the samples. Disconnect the "Clean" bottles. Attach the sample bottle by twisting the bottle and not the cap. Place sample bottle upside down in corresponding numbered location on shaker. Attach a filter [*FilterEXPID*] to each cap. Poke two holes into the lip of each bottle. Load labeled centrifuge tubes [*CentrifugeTube*] in the moving tray beneath the cartridges.

Confidential

6. Select “Proprietary Content” from the drop down menu and press the green check mark to start the procedure. The Proprietary Content program is described in *Proprietary* .

7. When the cycle pauses after cartridge drying, attach Proprietary Content to the bottom of each SPE cartridge and uncapped tubes in the moving tray.

8. Once the cycle is complete, remove centrifuge tubes and discard the used cartridges and bottles. Reattach “Clean” bottles and cartridges, select "Proprietary Content" from menu, select “start”. This must be done between each batch and at the beginning and the end of the day. At the end of the day, run the "Proprietary Content" clean cycle.

9. The batch QC must be rotated among the Proprietary Content ports so that all the ports are covered over the course of a quarter. Use form T-PFAS-FRM80101 for tracking.

10. Bring each sample extract to final volume 5 mL using Proprietary Content. Cap and vortex for 30 seconds to mix.

11. Proceed to Procedure D - Vialing and Addition of Internal Standard

D) Vialing and Addition of Internal standard

Note: The instrument lab chemist performs these steps.

1. Determine the sample aliquot to use for analysis. Add Internal Standard Spike Solution (1633_125_IS_V_#####) to the corresponding labeled autosampler vial [*VialLot#*].

    - 10 µL IS into a 190 µL aliquot of sample (final volume = 200 µL)
    - 25 µL IS into a 475 µL aliquot of sample (final volume = 500 µL)
    - 50 µL IS into a 950 µL aliquot of sample (final volume = 1000 µL)

2. Transfer an aliquot of the final extract (as determined in Step 1 above) to the corresponding labeled auto-sampler vial.

3. Cap the auto-sampler vial [*Caps*] and vortex for 30 seconds. Samples are now ready for analysis.

4. Cap the centrifuge tube. The remaining centrifuged extracts are stored in the refrigerator for dilution or reinjection if needed.

E) LC/MS/MS Analysis

1. Load sample vials containing calibration standards, quality control samples, and sample extracts into the autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks to clean the instrument prior to sample acquisition.

2. Bring standards to room temperature and vortex before calibrating. To eliminate the need for a qualitative identification standard, the calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA, NEtFOSAA, PFNA, PFOA, PFOSA, NEtFOSE, NMeFOSE, NEtFOSA, and NMeFOSA. Mass Transitions are defined in *Attachment 01*.

Example Initial Calibration Sequence (LIMS ID) (Example instrument method is in *Attachment 03*.):

Instrument Blank to clean instrument (at least 3)

1. CAL 1 (IC)
2. CAL 2 (IC)
3. CAL 3 (IC)
4. CAL 4 (IC)
5. CAL 5 (ICISAV)
6. CAL 6 (IC)
7. CAL 7 (IC)
8. CAL 8 (IC)
9. Instrument Blank (ICB)
10. Initial Calibration Verification (ICV)
11. Bile Salts Standard (WDM)

Confidential

3. Isotopically-labeled compounds are not available for some compounds. See below for compounds without labeled isotopes and their referenced extraction standards. See *Attachment 02* shows the full list of analytes and their EIS and NIS.

Note: For better accuracy, PFTrDA is quantitated using the average of the areas of labeled compounds 13C2-PFTeDA and 13C2-PFDoA.

Native	Extracted Internal Standard
3:3FTCA	13C5-PFPeA
PFMPA	
PFMBA	
NFDHA	13C5-PFHxA
5:3FTCA	
7:3FTCA	
PFEESA	
DONA	13C3-HFPO-DA
9Cl-PF3ONS	
11Cl-PF3OUdS	
PFTrDA	Avg 13C2-PFTeDA and 13C2-PFDoA
PFHpS	13C8-PFOS
PFNS	
PFDS	
PFDoS	
PFPeS	13C3-PFHxS
TFSI	
FHxSA	
PFECHS	
PFODA	13C2-PFTeDA
FBSA	13C3-PFBS

Example Sample Sequence (LIMS ID):

Instrument Blanks to clean instrument if needed (at least 3)
1. Instrument Sensitivity Check at CAL1 (CCVO)
2. Calibration Verification at CAL4 (CCV)
3. Instrument Blank (CCB)
4. Bile Salts marker (WDM)
5. Method Blank (MB)
6. On-going Precision and Recovery (LCS)
7. Low-level OPR (LLCS)
8. On-going Precision and Recovery Duplicate (LCSD)
9. Samples (10 or less)
10. Calibration Verification at CAL4 (CCV)
11. Instrument Blank (CCB)

4. Instrument Blank (ICB, CCB) - Instrument Blanks need to be analyzed immediately following the highest standard analyzed and daily at the start of a sequence. The concentration of all analytes

Confidential

must be less than the MDL. If acceptance criteria are not met, the calibration must be performed using a lower concentration standard for the high standard until the criteria are met.

5. Instrument Sensitivity Check (CCVO) - Prior to sample analysis, an Instrument Sensitivity Check (ISC) must be performed. The ISC standard concentration must be at the LOQ. The CAL1 standard's concentration is at the LOQ, so the CAL1 standard will be analyzed. All analyte concentrations must be within ±30% of their true values. The signal-to-noise ratio must be greater than or equal to 3:1 for the quantitation ions and confirmation ions, and 10:1 for quantitation ions that have no confirmation ion. If the criteria are not met, correct problem and rerun ISC. If a target analyte (or EIS) reads back high with no detection (or in-spec recoveries) in the samples, data may be reported. If problem persists, repeat the ICAL. No samples can be analyzed until the ISC meets acceptance criteria.

6. Bile Salt Interference Check (WDM) - Analyze a Window-Defining Matrix (WDM) standard containing 100 ppb of Taurodeoxycholic Acid (TDCA), Taurochenodeoxycholic Acid (TCDCA), and Tauroursodeoxycholic Acid (TUDCA). The laboratory must establish chromatographic conditions to ensure the bile salt (TDCA) does not cause interference during the analysis of samples. To demonstrate successful separation the retention time of TDCA must be at least 1 minute outside the retention time window of PFOS. This is demonstrated as a comparison of the RT of TDCA (measured at the apex of the TCDA peak) separated by at least 1.4 minutes from the RT of the linear isomer of PFOS (measured at the apex of the peak of the linear isomer of PFOS). If the mobile phase does not contain acetonitrile, this check must include all three bile salts (TDCA, TCDCA, and TUDCA). If adequate separation is not achieved, adjust the chromatographic conditions and reevaluate the separation of TDCA from PFOS.

7. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration F for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

8. Quantitate results for the Method Blank (MB). Calculate the recoveries of spiked analytes for the LCS and its duplicate (LCSD, if needed), Low-Level LCS, Matrix Spike and Matrix Spike Duplicate (MS/MSD) by comparing concentrations observed to the true values. Calculate the relative percent difference (RPD) between the duplicates.

9. Isotopically-labeled Extraction Standards (EIS) are added to all samples, MB, LLCS, LCS/LCSD, and MS/MSD prior to extraction. Isotopically-labeled Injection Standards (NIS) are added to each QC and field sample extract prior to analysis. Quantitation by isotope dilution generally precludes any adverse effect on data quality due to EIS recoveries being outside of the acceptance limits as long as the signal-to-noise ratio is greater than 10:1.

10. To identify a target or EIS:

    a. Peak responses of quantitation and confirmation ions must have S/N of at least 3:1. If there is no confirmation ion, the quantitation ion must have S/N of at least 10:1. If the S/N ratio is not met, the analyte is considered to be ND.

    b. The retention times should not vary by more than 0.4 minutes from the expected retention time from the midpoint of the ICAL or initial CV. Furthermore, native compounds with an exact isotopically-labeled analogue must elute within 0.1 minutes from their associated analog. If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

    c. For concentrations at or above the LOQ, the Ion Abundance Ratio (IAR) must fall within ±50% of the IAR observed in the mid-point initial calibration standard. The total response of all isomers (branched and linear) in the quantitative standards must be used to define the IAR. In samples, the total response should include only the branched isomer peaks that have been identified in either the quantitative or qualitative standard.

11. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFECA F (PFMPA), PFECA A (PFMBA), NMeFOSE, NEtFOSE, FBSA, and FHxSA. The expected ion ratio for each compound is calculated by using the average of ion ratios

Confidential

of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, see QA/QC section for Corrective Action.

F) Dilution

When the area of the primary transition of a target analyte is above the area of the highest calibration point a sample dilution is required. Dilute the extract as follows:

1. Remove extracts from storage and allow to come to room temperature for approximately 60-90 minutes.
2. Vortex the extract for one minute.
3. Using a pipette or syringe, remove an aliquot of the extract, this extract should target a dilution equivalent to the mid-level concentration of the calibration curve to avoid over diluting the extract.
4. Dilute the aliquot to volume using Proprietary Content.
5. Fortify with additional NIS to achieve the same concentration of NIS in the original extract.
6. Vortex an aliquot for analysis.

If the S/N of EIS associated with the analyte requiring dilution in the extract meets the S/N requirement for EIS and the recovery of the associated EIS meet the method criteria, the results from the dilution can be reported. If these criteria are not met and additional sample is available, a smaller volume/mass of sample should be extracted.

Calculations

1. Peak Area Ratio

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

2. On-Column Analyte Concentration using average RRF

On-column Concentration = peak area ratio ÷ AVE RRF

3. On-Column Analyte Concentration using linear curve

On-column Concentration = (peak area ratio - intercept) ÷ slope

4. Sample Concentration

Sample concentration (ng/g) = (On-column concentration x Final Sample Volume x DF) ÷ Initial Sample Volume

5. Ion Abundance Ratio (IAR)

ion abundance ratio = (peak area or height of quantifier)/(peak area or height of qualifier)

6. See *T-PEST-WI9847* for additional calculations used to evaluate the calibrations and quality control samples.

Statistical Information/Method Performance

Historical data for LCS/Ds, LLCSs, MS/Ds, and EIS is reviewed at least annually. However, all samples are reported using the limits in EPA 1633 Tables 7 and 8. When target analytes not on these tables are requested, statistical limits are used for LCS/MS. (Preliminary limits of 70-130% Recovery and <20%

Confidential

RPD can be used until enough data points are generated.) Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

As MDL studies are run on clean laboratory matrices, statistically derived MDL values could be artificially lower than achievable limits in real world samples. Nominal MDL values, set at no lower than 1/4 the calculated and verified Reporting Limit (or Limit of Quantitation) will be used as a method to avoid artificially low bias in MDL studies.

Quality Assurance/Quality Control

For each batch of samples extracted, a method blank, an LCS, and an LLCS must be extracted and analyzed. An MS/MSD are extracted only if requested and submitted by the client. If no MS/MSD is provided, an LCS/LCSD must be extracted and analyzed instead. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

QC Item	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	One per extraction batch of no more than 20 field samples	No target analytes greater than RL, or greater than 1/10 the amount measured in any sample, or 1/10 the regulatory limit (whichever is greater).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.
Low-Level On-going Precision and Recovery (LLCS)	One per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 7 and 8 of Method 1633)	Reanalyze LLCS once. If acceptable, report. Evaluate samples for detections, and LLCS for high bias. If LLCS has high bias, and samples non-detect, report and narrate. If LLCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LLCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.
On-going Precision and Recovery and its Duplicate (LCS)	One per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 7 and 8 of Method 1633)	Reanalyze LCS once. If acceptable, report. Evaluate samples for detections, and LCS for high bias. If LCS has high bias, and samples non-detect, report and narrate. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.

Confidential

QC Item	Frequency	Acceptance Criteria	Corrective Action
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	*at client request*, one per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 7 and 8 of Method 1633) RPD less than 30%	If outside the acceptance windows, consult a supervisor to determine the appropriate course of action based on batch and sample results.
Extracted Internal Standards (EIS) or Isotope Dilution Analyte (IDA), added prior to extraction	per sample (including MB, LCS, LCSD, LLCS, MS, MSD) during preparation	Acceptance criteria defined in *Attachment 22* (Table 8 of Method 1633)	1. If EIS outside windows, check for errors and correct. Re-analyze sample, if needed. 2. If EIS out high and samples are non-detect, report and narrate. If EIS out high with detections, but EIS <200% (FTS <350%), report and narrate. If EIS out high with detections and EIS >200% (FTS >350%), dilute 10X, re-analyze, report, and narrate. 3. If EIS low but > 5% and S/N > 10:1, narrate and report. If EIS <5% then contact client to re-extract at smaller aliquot.
Non-extracted Internal Standards (NIS) added following extraction and prior to analysis	per sample (including MB, LCS, LCSD, LLCS, MS, MSD) during preparation	NIS areas 50-200% of the mean area of the most recent ICAL in undiluted sample extracts and sample extracts that require NIS to be added.	If fails high, check for errors and report. If fails low, re-analyze fresh aliquot of sample. If in control, report. If the failure confirms report the initial analysis and narrate.
Ion Abundance Ratio (IAR)	Each detected analyte (except PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, PFMBA, FBSA, FHxSA)	Acceptance window of 50-150% of the ratio in the mid-point CCV standard.	Check for error, if none found report as outlined below. 1. If outside limits and value is less than the RL, report as ND at RL. 2. If outside limits, but within 2X rule* flag, report and narrate. 3. If ratio outside 2X rule* then report as ND at elevated RL, apply G flag and narrate. 4. If ratio out due to branched isomer contribution, report as positive with narration. 5. If outside limits (and RT window) due to matrix, report as ND at elevated RL, apply G flag and narrate.
E-flagged data	NA	NA	Dilute sample extract. If still E-flagged after dilution, consult the client for course of action.

Confidential

*2X Rule: If the ion ratio <0.5X the lower control limit or >2X the upper control limit, then do not report the analyte. It should be either Non-Detect at the RL or elevate the RL as needed (G flag). As an example if the target ion ratio is 4.00. The Chrom-determined limits are 2.00-6.00. If the ratio is <1.00 (2.00 X 0.5) or >12.00 (6.00 X 2) follow the specifications above.

Attachment:
Attachment 01 - Mass Transitions (.pdf)
Attachment 02 - Standard Relationships (.pdf)
Attachment 03 – Proprietary Content
Attachment 04 - Example CoA (.pdf)
Attachment 05 - Native PFAS Intermediate A (.pdf)
Attachment 06 - Native PFAS Intermediate B (.pdf)
Attachment 07 - Native PFAS CAL8 Intermediate (.pdf)
Attachment 08 - 1633 EIS Intermediate (.pdf)
Attachment 09 - 1633 NIS Intermediate (.pdf)
Attachment 10 - 1633 TOP SS Intermediate (.pdf)
Attachment 11 - Initial Calibration Standards Preparation (.pdf)
Attachment 12 - Initial Calibration Standard Concentrations (.pdf)
Attachment 13 - Bile Salts Stock Solutions (.pdf)
Attachment 14 - Bile Salts Intermediate (.pdf)
Attachment 15 - Bile Salts Working Solution (.pdf)
Attachment 16 - 1633 WDM (.pdf)
Attachment 17 - Native Mid Level Spike (.pdf)
Attachment 18 - Native Low Level Spike (.pdf)
Attachment 19 - ICV Working Standard (.pdf)
Attachment 20 - Purchased Standards (.pdf)
Attachment 21 – Proprietary Content
Attachment 22 - Tables 7-8 (EPA 1633) (.docx)

G-DC-FRM23907 Redacted SOPs
QA-SOP11178 Demonstrations of Capability
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
T-PEST-WI9847 Common Equations Used During Chromatographic Analyses
T-PFAS-FRM74731 D4033 - Moisture Calculation
T-PFAS-WI21568 Environmental Monitoring in the PFAS Lab
T-PFAS-WI23588 Preventative and Corrective Maintenance for the AB Sciex Liquid Chromatograph Mass Spectrometers (LC/MS/MS)
Attachment: Attachment 01 - Mass Transitions (pdf)
Attachment: Attachment 02 - Standard Relationships (pdf)
Attachment: Attachment 03 – Proprietary Content
Attachment: Attachment 04 - Example CoA (pdf)
Attachment: Attachment 05 - Native PFAS Intermediate A (pdf)
Attachment: Attachment 06 - Native PFAS Intermediate B (pdf)
Attachment: Attachment 07 - Native PFAS CAL8 Intermediate (pdf)
Attachment: Attachment 08 - 1633 EIS Intermediate (pdf)
Attachment: Attachment 09 - 1633 NIS Intermediate (pdf)
Attachment: Attachment 10 - 1633 TOP SS Intermediate (pdf)
Attachment: Attachment 11 - Initial Calibration Standards Preparation (pdf)
Attachment: Attachment 12 - Initial Calibration Standard Concentrations (pdf)
Attachment: Attachment 13 - Bile Salts Stock Solutions (pdf)
Attachment: Attachment 14 - Bile Salts Intermediate (pdf)
Attachment: Attachment 15 - Bile Salts Working Solution (pdf)
Attachment: Attachment 16 - 1633 WDM (pdf)
Attachment: Attachment 17 - Native Mid Level Spike (pdf)
Attachment: Attachment 18 - Native Low Level Spike (pdf)
Attachment: Attachment 19 - ICV Working Standard (pdf)
Attachment: Attachment 20 - Purchased Standards (pdf)
Attachment: Attachment 21 – Proprietary Content
Attachment: Attachment 22 - Tables 7-8 (EPA 1633) (docx)

End of document

Confidential

Version history

Version	Approval	Revision information	
3.1	27.AUG.2024		
4	31.OCT.2024		
5	11.MAR.2025		

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
422-64-0	PFPrA	163.00	119.00
STL03194	13C3-PFPrA	166.00	121.00
STL02680	13C3-PFBA	216.00	172.00
STL00992	13C4-PFBA	216.80	171.90
375-22-4	PFBA	212.80	168.90
377-73-1	PFECA F (PFMPA)	229.00	84.90
356-02-5	3:3 FTCA	241.00	177.00
	3:3 FTCA (2)	241.00	117.00
2706-90-3	PFPeA	263.00	219.00
STL01893	13C5-PFPeA	268.30	223.00
863090-89-5	PFECA A (PFMBA)	279.00	85.10
82113-65-3	TFSI	280.00	147.00
	TFSI (2)	280.00	78.00
13252-13-6	HFPODA	284.90	168.90
	HFPODA (2)	284.90	184.90
STL02255	13C3-HFPODA	286.90	168.90
	13C3-HFPODA (2)	286.90	184.90
151772-58-6	PFECA B (NFDHA)	295.00	201.00
	PFECA B (NFDHA) (2)	295.00	84.90
375-73-5	PFBS	298.70	79.90
	PFBS (2)	298.70	98.80
STL02337	13C3-PFBS	302.10	79.90
307-24-4	PFHxA	313.00	269.00
	PFHxA (2)	313.00	118.90
113507-82-7	PFEESA (PES)	314.80	134.90
	PFEESA (PES) (2)	314.80	82.90
STL00993	13C2-PFHxA	315.10	270.00
STL02577	13C5-PFHxA	318.00	273.00
757124-72-4	4:2-FTS	327.10	307.00
	4:2-FTS (2)	327.10	80.90
914637-49-3	5:3 FTCA	341.00	237.10
	5:3 FTCA (2)	341.00	217.00
2706-91-4	PFPeS	349.10	79.90
	PFPeS (2)	349.10	98.90
375-85-9	PFHpA	363.10	319.00
	PFHpA (2)	363.10	169.00
STL01892	13C4-PFHpA	367.10	322.00
919005-14-4	DONA	376.90	250.90
	DONA (2)	376.90	84.80
41997-13-1	FHxSA	397.90	78.00

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
355-46-4	PFHxS	398.70	79.90
	PFHxS (2)	398.70	98.90
STL02581	13C3-PFHxS	402.10	79.90
STL00994	18O2-PFHxS	403.00	83.90
335-67-1	PFOA	413.00	369.00
	PFOA (2)	413.00	169.00
STL00623	13C2-PFOA	415.00	370.00
STL00990	13C4-PFOA	417.10	372.00
STL01054	13C8-PFOA	421.10	376.00
27619-97-2	6:2-FTS	427.10	407.00
	6:2-FTS (2)	427.10	80.90
STL02279	13C2-6:2-FTS	429.10	80.90
812-70-4	7:3 FTCA	441.00	316.90
	7:3 FTCA (2)	441.00	336.90
375-92-8	PFHpS	449.00	79.90
	PFHpS (2)	449.00	98.80
133201-07-7	PFECHS	461.00	381.00
	PFECHS (2)	461.00	99.00
375-95-1	PFNA	463.00	419.00
	PFNA (2)	463.00	219.00
STL00995	13C5-PFNA	468.00	423.00
STL02578	13C9-PFNA	472.10	427.00
516-50-7	TDCA	498.00	80.00
754-91-6	PFOSA	498.10	77.90
	PFOSA (2)	498.10	478.00
516-35-8	TCDCA	498.10	80.00
14605-22-2	TUDCA	498.20	80.00
1763-23-1	PFOS	498.90	79.90
	PFOS (2)	498.90	98.80
STL00991	13C4-PFOS	502.80	79.90
STL01056	13C8-PFOSA	506.10	77.80
STL01054	13C8-PFOS	507.10	79.90
31506-32-8	NMeFOSA	511.90	219.00
	NMeFOSA (2)	511.90	169.00
335-76-2	PFDA	512.90	469.00
	PFDA (2)	512.90	219.00
STL02705	d3-NMeFOSA	515.00	219.00
STL00996	13C2-PFDA	515.10	470.10
STL02579	13C6-PFDA	519.10	474.10
4151-50-2	NEtFOSA	526.00	219.00
	NEtFOSA (2)	526.00	169.00
39108-34-4	8:2-FTS	527.10	507.00
	8:2-FTS (2)	527.10	80.80

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
STL02280	13C2-8:2-FTS	529.10	80.90
756426-58-1	9Cl-PF3ONS	530.80	351.00
	9Cl-PF3ONS (2)	532.80	353.00
STL02704	d5-NEtFOSA	531.10	219.00
68259-12-1	PFNS	548.80	79.90
	PFNS (2)	548.80	98.80
2058-94-8	PFUnA	563.10	519.00
	PFUnA (2)	563.10	269.10
STL00997	13C2-PFUnA	565.00	520.00
STL02580	13C7-PFUnA	570.00	525.10
2355-31-9	NMeFOSAA	570.10	419.00
	NMeFOSAA (2)	570.10	483.00
STL02118	d3-NMeFOSAA	573.20	419.00
2991-50-6	NEtFOSAA	584.20	419.10
	NEtFOSAA (2)	584.20	526.00
STL02117	d5-NEtFOSAA	589.20	419.00
335-77-3	PFDS	599.00	79.90
	PFDS (2)	599.00	98.80
307-55-1	PFDoDA	613.10	569.00
	PFDoDA (2)	613.10	319.00
STL00998	13C2-PFDoDA	615.10	570.00
24448-09-7	NMeFOSE	616.10	58.90
STL02277	d7-NMeFOSE	623.20	58.90
1691-99-2	NEtFOSE	630.00	58.90
763051-92-9	11Cl-PF3OUdS	630.90	450.90
	11Cl-PF3OUdS (2)	632.90	452.90
STL02278	d9-NEtFOSE	639.20	58.90
72629-94-8	PFTrDA	663.00	619.00
	PFTrDA (2)	663.00	168.90
79780-39-5	PFDoS	699.10	79.90
	PFDoS (2)	699.10	98.80
376-06-7	PFTeDA	713.10	168.90
	PFTeDA (2)	713.10	219.00
STL02116	13C2-PFTeDA	715.20	670.00
16517-11-6	PFODA	913.00	869.00
	PFODA (2)	913.00	169.00

Confidential

Attachment 2 - PFAS Injection Standards/Extraction Standards/Native Compounds

Native	Extraction Standard	Internal Standard
PFBA	13C4-PFBA	13C3-PFBA
PFPrA	13C3-PFPrA	
PFPeA	13C5-PFPeA	13C2-PFHxA
3:3FTCA		
PFMPA		
PFMBA		
PFHxA	13C5-PFHxA	
NFDHA		
5:3FTCA		
7:3FTCA		
PFEESA		
PFHpA	13C4-PFHpA	
HFPO-DA	13C3-HFPO-DA	
ADONA		
9Cl-PF3ONS		
11Cl-PF3OUdS		
PFOA	13C8-PFOA	13C4-PFOA
PFNA	13C9-PFNA	13C5-PFNA
PFDA	13C6-PFDA	13C2-PFDA
PFUnA	13C7-PFUnA	
PFDoA	13C2-PFDoA	
PFTeDA	13C2-PFTeDA	
PFODA		
PFTrDA	Avg 13C2-PFTeDA and 13C2-PFDoA	
PFBS	13C3-PFBS	18O2-PFHxS
FBSA		
PFPeS	13C3-PFHxS	
PFHxS		
FHxSA		
PFECHS		
TFSI		
4:2-FTS	13C2-4:2-FTS	
6:2-FTS	13C2-6:2-FTS	
8:2-FTS	13C2-8:2-FTS	
PFHpS	13C8-PFOS	13C4-PFOS
PFOS		

Confidential

Attachment 2 - PFAS Injection Standards/Extraction Standards/Native Compounds

Native	Extraction Standard	Internal Standard
PFNS		
PFDS		
PFDoS		
PFOSA	13C8-PFOSA	
NMeFOSA	d3-NMeFOSA	
NEtFOSA	d5-NEtFOSA	
NMeFOSAA	d3-NMeFOSAA	
NEtFOSAA	d5-NEtFOSAA	
NMeFOSE	d7-N-MeFOSE-M	
NEtFOSE	d9-N-EtFOSE-M	

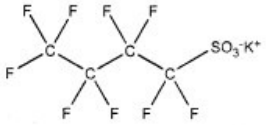
Confidential

Attachment 4 – Example CoA

WELLINGTON LABORATORIES

CERTIFICATE OF ANALYSIS
DOCUMENTATION

PRODUCT CODE:	L-PFBS	**LOT NUMBER:**	LPFBS1022
COMPOUND:	Potassium perfluoro-1-butanesulfonate		
STRUCTURE:		**CAS #:**	29420-49-3



MOLECULAR FORMULA:	$C_4F_9SO_3K$	**MOLECULAR WEIGHT:**	338.19
CONCENTRATION:	50.0 ± 2.5 µg/mL (K salt)	**SOLVENT(S):**	Methanol
	44.4 ± 2.2 µg/mL (PFBS acid)		
	44.2 ± 2.2 µg/mL (PFBS anion)		
CHEMICAL PURITY:	>98%		
LAST TESTED: (mm/dd/yyyy)	10/04/2022		
EXPIRY DATE: (mm/dd/yyyy)	10/04/2027		
RECOMMENDED STORAGE:	Store ampoule in a cool, dark place		

DOCUMENTATION/ DATA ATTACHED:

Figure 1: LC/MS Data (Full Scan and Mass Spectrum)
Figure 2: LC/MS/MS Data (Selected MRM Transitions)

ADDITIONAL INFORMATION:

- See page 2 for further details.

FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE

Certified By: _____ **Date:** 10/14/2022 (mm/dd/yyyy)
B.G. Chittim, General Manager

Wellington Laboratories Inc., 345 Southgate Dr. Guelph ON N1G 3M5 CANADA
519-822-2436 • Fax: 519-822-2849 • info@well-labs.com

Form#:27, Issued 2004-11-10
Revision#:9, Revised 2020-12-23

INTENDED USE:

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compound it contains.

HANDLING:

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

SYNTHESIS / CHARACTERIZATION:

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

HOMOGENEITY:

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products are compared to older lots in the same manner, which further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

UNCERTAINTY:

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty, $u_c(y)$, of a value y and the uncertainty of the independent parameters $x_1, x_2, \ldots x_n$ on which it depends is:

$$u_c(y(x_1, x_2, \ldots x_n)) = \sqrt{\sum_{i=1}^{n} u(y, x_i)^2}$$

where x is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of ±5% (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

TRACEABILITY:

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class A tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

EXPIRY DATE / PERIOD OF VALIDITY:

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

LIMITED WARRANTY:

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

QUALITY MANAGEMENT:

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAI Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A1226), and ISO 17034 by ANSI National Accreditation Board (ANAB; AR-1523).

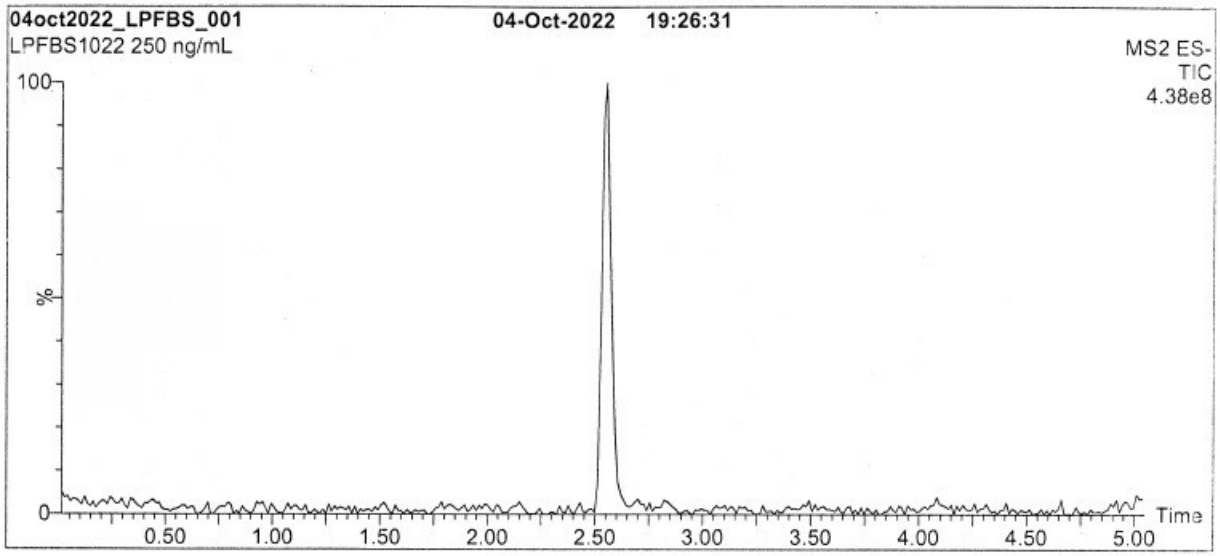
CALA Testing Accreditation No. A1226

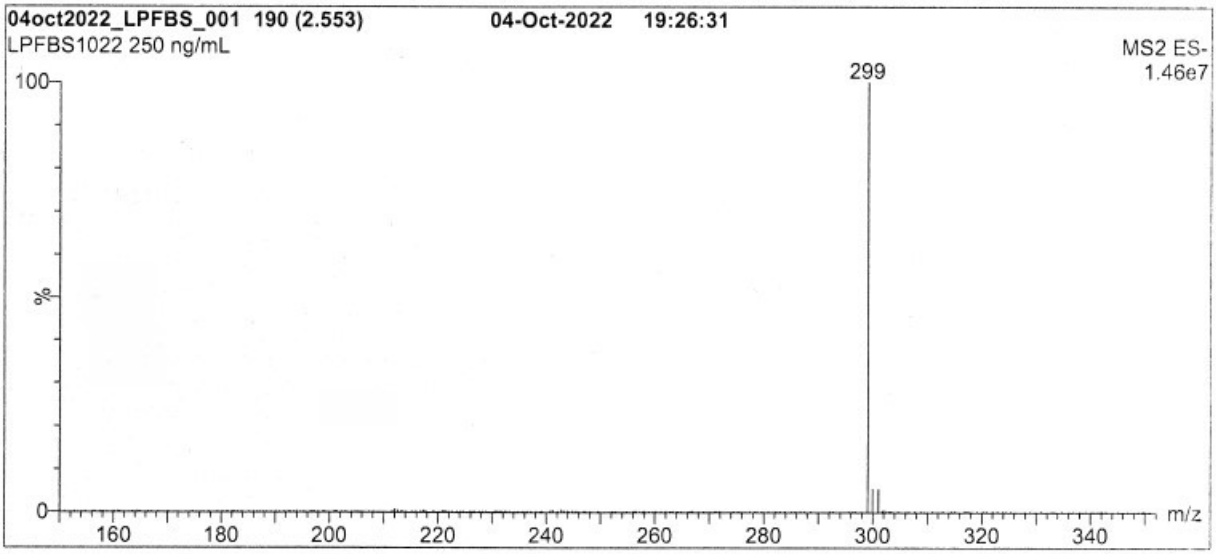
ANAB ANSI National Accreditation Board ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

For additional information or assistance concerning this or any other products from Wellington Laboratories Inc., please visit our website at www.well-labs.com or contact us directly at info@well-labs.com

Attachment 4 – Example CoA

Figure 1: **L-PFBS; LC/MS Data (Full Scan and Mass Spectrum)**





Conditions for Figure 1:

Waters Acquity Ultra Performance LC
Waters Xevo TQ-S micro MS

Chromatographic Conditions:

Column: Acquity UPLC BEH Shield RP_{18}
1.7 µm, 2.1 x 100 mm

Mobile phase: Gradient
Start: 60% H_2O / 40% (80:20 MeOH:ACN)
(both with 10 mM NH_4OAc buffer)
Ramp to 90% organic over 8 min and hold for 2 min
before returning to initial conditions over 0.75 min.
Time: 12 min

Flow: 300 µL/min

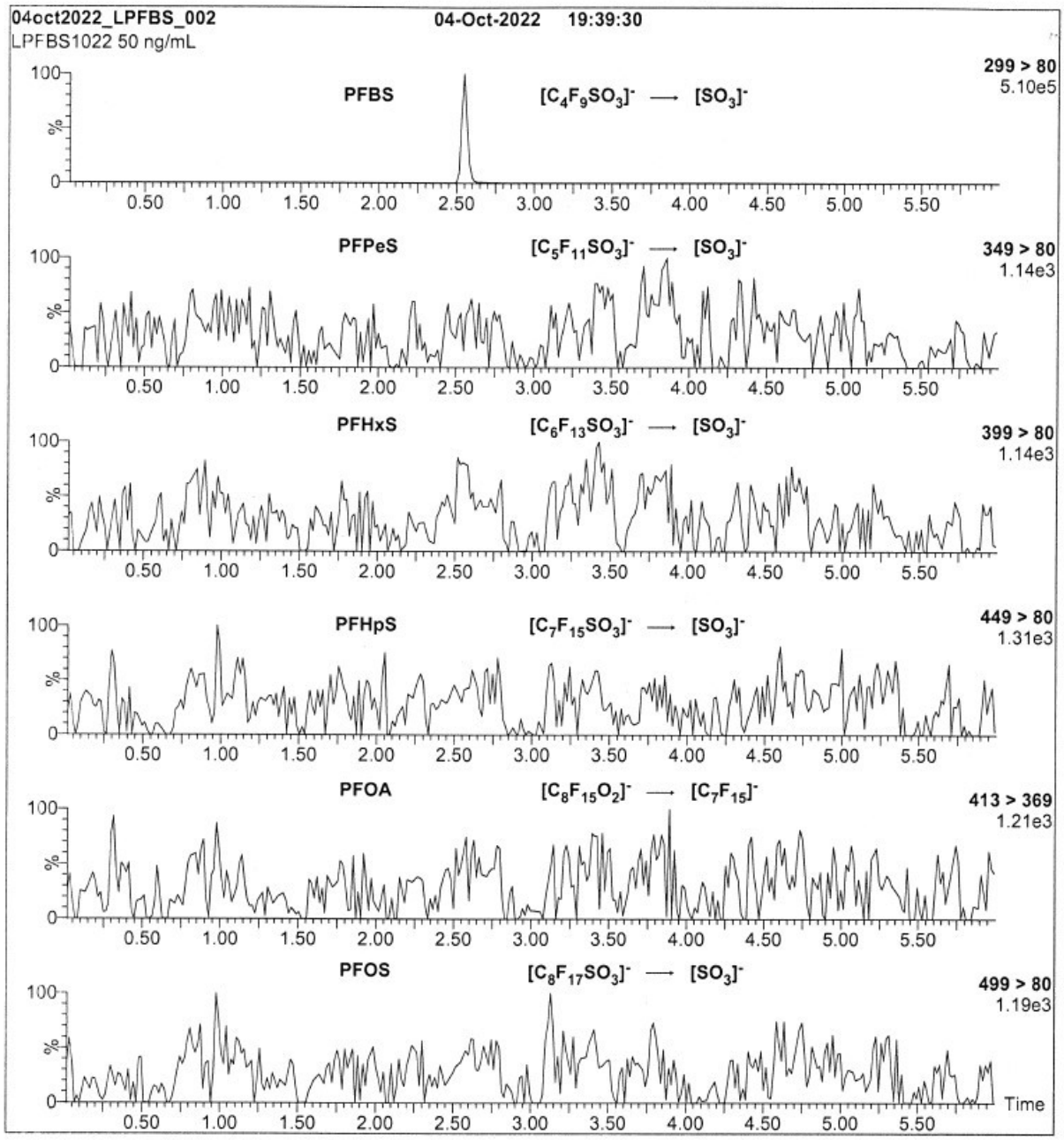
MS Parameters:

Experiment: Full Scan (150 - 850 amu)

Source: Electrospray (negative)
Capillary Voltage (kV) = 2.00
Cone Voltage (V) = 10.00
Desolvation Temperature (°C) = 500
Desolvation Gas Flow (L/hr) = 1000

Attachment 4 – Example CoA

Figure 2: **L-PFBS; LC/MS/MS Data (Selected MRM Transitions)**



Conditions for Figure 2:

Injection:	On-column (L-PFBS)
Mobile phase:	Same as Figure 1
Flow:	300 µL/min

MS Parameters:

Collision Gas (mbar) = 3.29e-3
Collision Energy (eV) = 30

Form#:27, Issued 2004-11-10
Revision#:9, Revised 2020-12-23

LPFBS1022 (4 of 4)
rev0

Attachment 05 - Native PFAS Intermediate A								
Vendor	Catalog Number	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume (mL)	Final Conc. (ng/mL)
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000	0.100	10	500
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000	0.050		250
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000	0.050		250
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000	0.050		250
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000	0.050		250
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000	0.050		250
Wellington	PFDA	Perfluorodecanoic acid	335-76-2	PFDA	50000	0.050		250
Wellington	PFUdA	Perfluoroundecanoic acid	2058-94-8	PFUnA	50000	0.050		250
Wellington	MPFDOA	Perfluorododecanoic acid	307-55-1	PFDoA	50000	0.050		250
Wellington	PFTrDA	Perfluorotridecanoic acid	72629-94-8	PFTrDA	50000	0.050		250
Wellington	PFTeDA	Perfluorotetradecanoic acid	376-06-7	PFTeDA	50000	0.050		250
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200	0.050		221
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900	0.050		235
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500	0.050		228
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600	0.050		238
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600	0.050		233
Wellington	L-PFNS	Perfluorononanesulfonic acid	68259-12-1	PFNS	48000	0.050		240
Wellington	L-PFDS	Perfluorodecanesulfonic acid	335-77-3	PFDS	48200	0.050		241
Wellington	L-PFDoS	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	48400	0.050		242
Wellington	4;2 FTS	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	46700	0.100		467
Wellington	6;2 FTS	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	47400	0.100		474
Wellington	8;2 FTS	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	47900	0.100		479
Wellington	br-FOSA	Perfluorooctanesulfonamide	754-91-6	PFOSA	50000	0.050		250
Wellington	br-NMeFOSA	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	50000	0.050		250
Wellington	br-NEtFOSA	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	50000	0.050		250
Wellington	br-NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	50000	0.050		250
Wellington	br-NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	50000	0.050		250
Wellington	br-NMeFOSE	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	50000	0.250		1250
Wellington	br-NMeFOSE	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	50000	0.250		1250
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000	0.0375		187.5
Wellington	NaDONA	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	47100	0.050		236
Wellington	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	44500	0.050		223
Wellington	PF4OPeA	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	50000	0.050		250
Wellington	PF5OHxA	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	50000	0.050		250
Wellington	3,6-OPFHpA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	50000	0.050		250
Wellington	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	46600	0.050		233
Wellington	11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	47100	0.050		236
Wellington	FPrPA	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	50000	0.100		500
Wellington	FPePA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	50000	0.250		1250
Wellington	FHpPA	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	50000	0.250		1250
Wellington	PFECHS	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	46100	0.050		231
Wellington	FBSA-I	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	50000	0.050		250
Wellington	FHxSA-I	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	50000	0.050		250
Wellington	PFPrA	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	50000	0.250		1250
Wellington	PFODA	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	50000	0.050		250
AccuStandard	PFOS-030S	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	97900	0.0250		245

Confidential

Attachment 06 - Native PFAS Intermediate B							
Source Rgt Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL**	**Final Conc. (ng/mL)**
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.1	10	5
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			2.5
	Perfluorohexanoic acid	307-24-4	PFHxA	250			2.5
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			2.5
	Perfluorooctanoic acid	335-67-1	PFOA	250			2.5
	Perfluorononanoic acid	375-95-1	PFNA	250			2.5
	Perfluorodecanoic acid	335-76-2	PFDA	250			2.5
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			2.5
	Perfluorododecanoic acid	307-55-1	PFDoA	250			2.5
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			2.5
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			2.5
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			2.21
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			2.35
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			2.28
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			2.38
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			2.33
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			2.4
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			2.41
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			2.42
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			4.67
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			4.74
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			4.79
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			2.5
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			2.5
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			2.5
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			2.5
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			2.5
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			12.5
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			12.5
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			1.875
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			2.36
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			2.23
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			2.5
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			2.5
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			2.5
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			2.33
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			2.36
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			5
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			12.5
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			12.5
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			2.31
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			2.5
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			2.5
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			12.5
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			2.5
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			2.45

Confidential

Attachment 07 - Native PFAS CAL8 Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL)**	**Final Conc. (ng/mL)**
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000	0.100	10	500
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000	0.050		250
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000	0.050		250
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000	0.050		250
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000	0.050		250
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000	0.050		250
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200	0.050		221
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900	0.050		235
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500	0.050		228
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600	0.050		238
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600	0.050		233
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000	0.0375		187.5

Confidential

Attachment 08 - 1633 EIS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume**	**Final Conc. (ng/mL)**
Wellington	MPFBA	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	50000	0.08	10	400
Wellington	M5PFPeA	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	50000	0.08		400
Wellington	M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	50000	0.08		400
Wellington	M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	50000	0.08		400
Wellington	M8PFOA	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	50000	0.08		400
Wellington	M9PFNA	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	50000	0.08		400
Wellington	M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	50000	0.08		400
Wellington	M7PFUdA	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	50000	0.08		400
Wellington	MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	50000	0.08		400
Wellington	M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	50000	0.08		400
Wellington	M3PFBS	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	46500	0.08		372
Wellington	M3PFHxS	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	47300	0.08		378
Wellington	M8PFOS	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	47800	0.08		382
Wellington	M8FOSA-I	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	50000	0.08		400
Wellington	d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	50000	0.2		1000
Wellington	d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	50000	0.2		1000
Wellington	M2-4;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	46700	0.2		934
Wellington	M2-6;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	47500	0.2		950
Wellington	M2-8;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	47900	0.2		958
Wellington	M3HFPO-DA	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	50000	0.08		400
Wellington	d7-N-MeFOSE-M	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	50000	0.2		1000
Wellington	d9-N-EtFOSE-M	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	50000	0.2		1000
Wellington	d-N-MeFOSA-M	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	50000	0.08		400
Wellington	d-N-EtFOSA-M	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	50000	0.08		400
Cambridge Isotope	CLM-11324-A-1.2	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	50000	0.08		400

Confidential

Attachment 09 - 1633 NIS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL)**	**Final Conc. (ng/mL)**
Wellington	M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	50000	0.08	10	400
Wellington	MPFOA	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	50000	0.2		1000
Wellington	MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	50000	0.08		400
Wellington	MPFOS	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	47800	0.08		382.4
Wellington	MPFNA	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	50000	0.08		400
Wellington	MPFHxA	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	50000	0.2		1000
Wellington	MPFHxS	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	47300	0.08		378.4

Confidential

Attachment 10 - 1633 TOP SS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume**	**Final Conc. (ng/mL)**
Wellington	M2PFOA	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	50000	0.025	10	125
Wellington	MPFUdA	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	50000	0.025		125
Wellington	M3PFPeA	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	50000	0.025		125

Confidential

Attachment 11 - 1633 Initial Calibration Standards Preparation								
Solution Name	**CAL1**	**CAL2**	**CAL3**	**CAL4**	**CAL5**	**CAL6**	**CAL7**	**CAL8**
Native PFAS CAL8 Intermediate (mL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0
Native PFAS Intermediate A (mL)	N/A	N/A	0.02	0.04	0.1	0.2	0.4	N/A
Native PFAS Intermediate B (mL)	0.2	0.5	N/A	N/A	N/A	N/A	N/A	N/A
1633 TOP SS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
1633 EIS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
1633 NIS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Final Volume (mL)	10	10	10	10	10	10	10	10

Confidential

Attachment 12 - 1633 Initial Calibration Standard Concentrations								
	CAL1	CAL2	CAL3	CAL4	CAL5	CAL6	CAL7	CAL8
Analyte Name	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)
PFBA	0.100	0.250	1.00	2.00	5.00	10.0	20.0	100
PFPeA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFHxA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFHpA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFOA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFNA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFUnA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFDoA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFTrDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFTeDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFBS	0.044	0.111	0.442	0.884	2.21	4.42	8.84	44.2
PFPeS	0.047	0.117	0.469	0.938	2.35	4.69	9.38	46.9
PFHxS	0.046	0.114	0.455	0.910	2.28	4.55	9.10	45.5
PFHpS	0.048	0.119	0.476	0.952	2.38	4.76	9.52	47.6
PFOS	0.047	0.117	0.466	0.932	2.33	4.66	9.32	46.6
PFNS	0.048	0.120	0.480	0.960	2.40	4.80	9.60	N/A
PFDS	0.048	0.121	0.482	0.964	2.41	4.82	9.64	N/A
PFDoS	0.048	0.121	0.484	0.968	2.42	4.84	9.68	N/A
4:2-FTS	0.093	0.234	0.934	1.87	4.67	9.34	18.7	N/A
6:2-FTS	0.095	0.237	0.948	1.90	4.74	9.48	19.0	N/A
8:2-FTS	0.096	0.240	0.958	1.92	4.79	9.58	19.2	N/A
PFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMeFOSA / N-MePFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NEtFOSA / N-EtPFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMeFOSAA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NEtFOSAA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMePFOSAE / NMeFOSE	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
NEtPFOSAE / NEtFOSE	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
HFPO-DA / GenX	0.038	0.094	0.38	0.750	1.88	3.75	7.50	37.5
ADONA	0.047	0.118	0.471	0.942	2.36	4.71	9.42	N/A
PFEESA / PES	0.045	0.111	0.445	0.890	2.23	4.45	8.90	N/A
PFMPA / PFECA F	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFMBA / PFECA A	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NFDHA / PFECA B	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
9Cl-PF3ONS	0.047	0.117	0.466	0.93	2.33	4.66	9.32	N/A
11Cl-PF3OUdS	0.047	0.118	0.471	0.94	2.36	4.71	9.42	N/A
3:3 FTCA	0.100	0.250	1.00	2.00	5.00	10.0	20.0	N/A
5:3 FTCA	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
7:3 FTCA	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
PFECHS	0.046	0.116	0.462	0.92	2.31	4.62	9.24	N/A
FBSA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
FHxSA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
PFPrA / PPF Acid	0.250	0.625	2.500	5.00	12.5	25.0	50.0	N/A
PFODA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
TFSI	0.049	0.122	0.490	0.98	2.45	4.90	9.79	N/A
$^{13}C_3$-PFPrA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFBA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFPeA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFHxA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFHpA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_9$-PFNA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_6$-PFDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_7$-PFUnA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFDoA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFTeDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFBS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFHxS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_3-NMeFOSAA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_5-NEtFOSAA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-4:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-6:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-8:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_3$-HFPO-DA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_7-N-MeFOSE-M	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_9-N-EtFOSE-M	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_5-NEtPFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_3-NMePFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFBA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFOA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-PFDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFOS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFNA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFHxA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{18}O_2$-PFHxS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFOA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625
$^{13}C_2$-PFUnA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625
$^{13}C_3$-PFPeA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625

Confidential

Attachment 13 - Bile Salts Stock Solution							
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Aliquot (g)**	**Final Volume**	**Final Conc. (ng/mL)**
Sigma Aldrich	T0557-500MG	Taurodeoxycholic acid	516-50-7	TDCA	0.05	50	1000000
Sigma Aldrich	T6260-1G	Taurochenodeoxycholic acid	516-35-8	TCDCA	0.05		950000
Calbiochem	580549-1GM	Tauroursodeoxycholic acid	14605-22-2	TUDCA	0.05		1000000

Confidential

Attachment 14 - Bile Salts Intermediate							
Source Rgt Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume**	**Final Conc. (ng/mL)**
Bile Salts Stock Solution	Taurodeoxycholic acid	516-50-7	TDCA	1000000	1	4	250000
	Taurochenodeoxycholic acid	516-35-8	TCDCA	950000			237500
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	1000000			250000

Confidential

Attachment 15 - Bile Salts Working Solution							
Source Rgt Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume**	**Final Conc. (ng/mL)**
Bile Salts Intermediate	Taurodeoxycholic acid	516-50-7	TDCA	250000	0.1	5	5000
	Taurochenodeoxycholic acid	516-35-8	TCDCA	237500			4750
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	250000			5000

Confidential

Attachment 16 - 1633 Window-Defining Matrix Standard							
Source Rgt. Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume* (mL)**	**Final Conc. (ng/mL)**
Bile Salts Working Solution	Taurodeoxycholic acid	516-50-7	TDCA	5000	0.05	10	25
	Taurochenodeoxycholic acid	516-35-8	TCDCA	4750			23.8
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	5000			25

Confidential

Attachment 17 - Native 1633 Mid-Level Spike							
Source Rgt. Name	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume	Final Conc. (ng/mL)
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	4	10	200
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			100
	Perfluorohexanoic acid	307-24-4	PFHxA	250			100
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			100
	Perfluorooctanoic acid	335-67-1	PFOA	250			100
	Perfluorononanoic acid	375-95-1	PFNA	250			100
	Perfluorodecanoic acid	335-76-2	PFDA	250			100
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			100
	Perfluorododecanoic acid	307-55-1	PFDoA	250			100
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			100
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			100
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			88.4
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			93.8
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			91.0
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			95.2
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			93.2
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			96.0
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			96.4
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			96.8
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			187
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			190
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			192
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			100
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			100
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			100
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			100
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			100
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			500
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			500
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			75.0
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			94.2
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			89.0
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			100
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			100
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			100
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			93.2
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			94.2
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			200
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			500
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			500
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			92.2
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			100
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			100
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			500
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			100
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			97.9

Confidential

Attachment 18 - Native 1633 Low-Level Spike							
Source Rgt. Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume**	**Final Conc. (ng/mL)**
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.5	10	25.00
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			12.50
	Perfluorohexanoic acid	307-24-4	PFHxA	250			12.50
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			12.50
	Perfluorooctanoic acid	335-67-1	PFOA	250			12.50
	Perfluorononanoic acid	375-95-1	PFNA	250			12.50
	Perfluorodecanoic acid	335-76-2	PFDA	250			12.50
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			12.50
	Perfluorododecanoic acid	307-55-1	PFDoA	250			12.50
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			12.50
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			12.50
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			11.05
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			11.73
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			11.38
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			11.90
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			11.65
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			12.00
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			12.05
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			12.10
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			23.35
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			23.70
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			23.95
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			12.50
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			12.50
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			12.50
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			12.50
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			12.50
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			62.50
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			62.50
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			9.38
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	235.5			11.78
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			11.13
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			12.50
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			12.50
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			12.50
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			11.65
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	235.5			11.78
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			25.00
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			62.50
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			62.50
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	230.5			11.53
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			12.50
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			12.50
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			62.50
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			12.50
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	244.75			12.24

Confidential

Attachment 19 - 1633 ICV Working Standard							
Source Rgt. Name	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume	Final Conc. (ng/mL)
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.050	10	2.50
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			1.25
	Perfluorohexanoic acid	307-24-4	PFHxA	250			1.25
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			1.25
	Perfluorooctanoic acid	335-67-1	PFOA	250			1.25
	Perfluorononanoic acid	375-95-1	PFNA	250			1.25
	Perfluorodecanoic acid	335-76-2	PFDA	250			1.25
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			1.25
	Perfluorododecanoic acid	307-55-1	PFDoA	250			1.25
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			1.25
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			1.25
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			1.105
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			1.173
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			1.138
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			1.190
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			1.165
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			1.200
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			1.205
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			1.210
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			2.34
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			2.37
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			2.40
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			1.25
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			1.25
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			1.25
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			1.25
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			1.25
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			6.25
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			6.25
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			0.938
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			1.178
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			1.113
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			1.25
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			1.25
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			1.25
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			1.165
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			1.178
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			2.50
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			6.25
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			6.25
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			1.153
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			1.25
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			1.25
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			6.25
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			1.25
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			1.224
1633 TOP SS Intermediate	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	125	0.050		0.625
	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	125			0.625
	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	125			0.625
1633 EIS Intermediate	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	400	0.050		2.00
	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	400			2.00
	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	400			2.00
	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	400			2.00
	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	400			2.00
	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	400			2.00
	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	400			2.00
	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	400			2.00
	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	400			2.00
	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	400			2.00
	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	372			1.86
	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	378			1.89
	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	382			1.91
	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	400			2.00
	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	1000			5.00
	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	1000			5.00
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	934			4.67
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	950			4.75
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	958			4.79
	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	400			2.00
	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	1000			5.00
	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	1000			5.00
	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	400			2.00
	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	400			2.00
	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	400			2.00
1633 NIS Intermediate	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	400	0.050		2.00
	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	1000			5.00
	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	400			2.00
	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	382			1.91
	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	400			2.00
	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	1000			5.00
	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	378			1.89

Confidential

Attachment 20 - Purchased Standards					
Vendor	Cat. No.	Analyte	CAS#	Acronym	Conc. (ng/ml)
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000
Wellington	PFDA	Perfluorodecanoic acid	335-76-2	PFDA	50000
Wellington	PFUdA	Perfluoroundecanoic acid	2058-94-8	PFUnA	50000
Wellington	MPFDOA	Perfluorododecanoic acid	307-55-1	PFDoA	50000
Wellington	PFTrDA	Perfluorotridecanoic acid	72629-94-8	PFTrDA	50000
Wellington	PFTeDA	Perfluorotetradecanoic acid	376-06-7	PFTeDA	50000
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600
Wellington	L-PFNS	Perfluorononanesulfonic acid	68259-12-1	PFNS	48000
Wellington	L-PFDS	Perfluorodecanesulfonic acid	335-77-3	PFDS	48200
Wellington	L-PFDoS	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	48400
Wellington	4;2 FTS	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	46700
Wellington	6;2 FTS	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	47400
Wellington	8;2 FTS	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	47900
Wellington	br-FOSA	Perfluorooctanesulfonamide	754-91-6	PFOSA	50000
Wellington	br-NMeFOSA	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	50000
Wellington	br-NEtFOSA	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	50000
Wellington	br-NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	50000
Wellington	br-NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	50000
Wellington	br-NMeFOSE	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	50000
Wellington	br-NEtFOSE	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	50000
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000
Wellington	NaDONA	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	47100
Wellington	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	44500
Wellington	PF4OPeA	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	50000
Wellington	PF5OHxA	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	50000
Wellington	3,6-OPFHpA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	50000
Wellington	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	46600
Wellington	11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	47100
Wellington	FPrPA	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	50000
Wellington	FPePA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	50000
Wellington	FHpPA	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	50000
Wellington	PFECHS	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	46100
Wellington	FBSA-I	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	50000
Wellington	FHxSA-I	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	50000
Wellington	PFPrA	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	50000
Wellington	PFODA	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	50000
AccuStandard	PFOS-030S	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	97900
Wellington	MPFBA	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	50000
Wellington	M5PFPeA	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	50000
Wellington	M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	50000
Wellington	M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	50000
Wellington	M8PFOA	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	50000
Wellington	M9PFNA	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	50000
Wellington	M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	50000
Wellington	M7PFUdA	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	50000
Wellington	MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	50000
Wellington	M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	50000
Wellington	M3PFBS	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	46500
Wellington	M3PFHxS	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	47300
Wellington	M8PFOS	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	47800
Wellington	M8FOSA-I	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	50000
Wellington	d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	50000
Wellington	d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	50000
Wellington	M2-4;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	46700
Wellington	M2-6;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	47500
Wellington	M2-8;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	47900
Wellington	M3HFPO-DA	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	50000
Wellington	d7-N-MeFOSE-M	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	50000
Wellington	d9-N-EtFOSE-M	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	50000
Wellington	d-N-MeFOSA-M	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	50000
Wellington	d-N-EtFOSA-M	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	50000
Cambridge Isotope	CLM-11324-A-1.2	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	50000
Wellington	M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	50000
Wellington	MPFOA	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	50000
Wellington	MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	50000
Wellington	MPFOS	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	47800
Wellington	MPFNA	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	50000
Wellington	MPFHxA	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	50000
Wellington	MPFHxS	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	47300
Wellington	M2PFOA	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	50000
Wellington	MPFUdA	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	50000
Wellington	M3PFPeA	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	50000
Sigma Aldrich	T0557-500MG	Taurodeoxycholic acid	516-50-7	TDCA	neat
Sigma Aldrich	T6260-1G	Taurochenodeoxycholic acid	516-35-8	TCDCA	neat
Calbiochem	580549-1GM	Tauroursodeoxycholic acid	14605-22-2	TUDCA	neat

Confidential

Table 7. IPR/OPR/LLOPR Acceptance Limits for Target Analytes in Solid, Biosolid, and Tissue Matrices

	Solid and Biosolid Matrices[1]			Tissue Matrix[1]		
	IPR			IPR		
Compound	Mean Recovery (%)	RSD (%)	OPR/LLOPR Recovery (%)	Mean Recovery (%)	RSD (%)	OPR/LLOPR Recovery (%)
PFBA	70 - 140	17	70 - 140	70 - 135	20	60 - 140
PFPeA	70 - 140	26	60 - 150	70 - 130	20	60 - 145
PFHxA	70 - 135	23	65 - 140	70 - 140	20	60 - 160
PFHpA	70 - 140	21	65 - 145	70 - 140	20	60 - 145
PFOA	70 - 140	23	70 - 150	70 - 130	25	60 - 150
PFNA	65 - 145	24	70 - 155	70 - 140	20	60 - 145
PFDA	70 - 145	26	70 - 155	70 - 135	20	60 - 150
PFUnA	70 - 145	26	70 - 155	70 - 135	20	60 - 155
PFDoA	70 - 145	25	70 - 150	70 - 135	20	60 - 140
PFTrDA	55 - 160	26	65 - 150	55 - 160	20	60 - 150
PFTeDA	70 - 145	24	65 - 150	70 - 140	25	60 - 140
PFBS	60 - 145	25	65 - 145	70 - 145	20	60 - 150
PFPeS	65 - 140	29	55 - 160	70 - 150	20	60 - 145
PFHxS	65 - 145	28	60 - 150	70 - 140	25	60 - 155
PFHpS	70 - 140	27	65 - 155	70 - 145	20	60 - 140
PFOS	70 - 135	27	65 - 160	70 - 135	30	60 - 160
PFNS	70 - 140	27	55 - 140	60 - 130	20	45 - 140
PFDS	50 - 150	31	40 - 155	55 - 135	20	50 - 140
PFDoS	40 - 140	40	25 - 160	25 - 145	45	25 - 140
4:2FTS	70 - 135	27	60 - 150	65 - 140	30	55 - 150
6:2FTS	60 - 160	50	55 - 200	70 - 140	25	60 - 150
8:2FTS	70 - 140	27	70 - 150	70 - 150	25	60 - 170
PFOSA	70 - 140	19	70 - 140	70 - 140	20	60 - 150
NMeFOSA	65 - 145	26	70 - 155	70 - 140	30	60 - 160
NEtFOSA	70 - 135	19	70 - 140	70 - 140	40	60 - 150
NMeFOSAA	65 - 145	31	65 - 155	70 - 140	20	60 - 145
NEtFOSAA	60 - 150	31	65 - 165	70 - 140	25	60 - 145
NMeFOSE	70 - 140	19	70 - 140	60 - 150	20	40 - 180
NEtFOSE	70 - 135	17	70 - 135	70 - 145	40	60 - 205
HFPO-DA	70 - 140	25	70 - 145	70 - 140	25	60 - 145
ADONA	70 - 155	26	70 - 160	70 - 145	20	55 - 165
PFMPA	70 - 140	25	30 - 140	70 - 145	40	25 - 145
PFMBA	55 - 145	33	60 - 150	70 - 140	20	60 - 150
NFDHA	45 - 145	27	60 - 155	70 - 155	30	60 - 180
9Cl-PF3ONS	65 - 135	23	70 - 150	70 - 140	20	60 - 170
11Cl-PF3OUdS	50 - 135	31	45 - 160	65 - 140	20	50 - 170
PFEESA	70 - 140	20	70 - 140	70 - 145	25	50 - 150
3:3FTCA	45 - 155	32	45 - 130	55 - 130	25	30 - 140
5:3FTCA	70 - 135	28	60 - 130	70 - 145	20	60 - 160
7:3FTCA	70 - 145	39	60 - 150	70 - 155	20	60 - 200

[1] The recovery limits apply to the target analyte results for IPR, OPR, and LLOPR samples for solid, biosolids, and tissue matrices. Data were derived from the multi-laboratory validation study and are therefore the limits required for this method.

Table 8. Acceptance Limits for EIS and NIS Compounds in Soil-Sediment, Tissue, and Biosolid Matrices and Associated QC Samples

EIS Compound[1]	Soil/Sediment Samples[2] Recovery (%)	Tissue Samples[2] Recovery (%)	Biosolid Samples[2] Recovery (%)
$^{13}C_4$-PFBA	8[3] - 130	5[3] - 130	5[3] - 130
$^{13}C_5$-PFPeA	35 - 130	10 - 185	35 - 130
$^{13}C_5$-PFHxA	40 - 130	25 - 170	40 – 130
$^{13}C_4$-PFHpA	40 - 130	25 - 150	40 – 130
$^{13}C_8$-PFOA	40 - 130	25 - 150	40 – 130
$^{13}C_9$-PFNA	40 - 130	35 - 185	40 – 145
$^{13}C_6$-PFDA	40 - 130	30 - 150	40 – 130
$^{13}C_7$-PFUnA	40 - 130	30 - 180	40 – 130
$^{13}C_2$-PFDoA	40 - 130	35 - 180	40 – 130
$^{13}C_2$-PFTeDA	20 - 130	20 - 160	10 - 160
$^{13}C_3$-PFBS	40 - 135	25 - 190	40 - 150
$^{13}C_3$-PFHxS	40 - 130	35 - 175	40 - 140
$^{13}C_8$-PFOS	40 - 130	40 - 160	40 - 130
$^{13}C_2$-4:2FTS	40 - 165	30 - 300	40 - 300
$^{13}C_2$-6:2FTS	40 - 215	35 - 300	40 - 300
$^{13}C_2$-8:2FTS	40 - 275	40 - 365	40 - 300
$^{13}C_8$-PFOSA	40 - 130	25 - 180	20 - 140
D_3-NMeFOSA	10 - 130	5[4] - 130	20 - 130
D_5-NEtFOSA	10 - 130	5[4]- 130	20 - 130
D_3-NMeFOSAA	40 - 135	30 - 250	30 – 150
D_5-NEtFOSAA	40 - 150	30 - 235	20 - 140
D_7-NMeFOSE	20 - 130	5[4] - 160	25 - 130
D_9-NEtFOSE	15 - 130	5[4] - 130	20 - 130
$^{13}C_3$-HFPO-DA	40 - 130	20 - 185	40 - 130
$^{13}C_3$-PFBA	50 - 200	50 - 200	50 - 200
$^{13}C_2$-PFHxA			
$^{13}C_4$-PFOA			
$^{13}C_5$-PFNA			
$^{13}C_2$-PFDA			
$^{18}O_2$-PFHxS			
$^{13}C_4$-PFOS			

[1] Limits apply to the EIS and NIS recoveries from samples of all solid, biosolid, and tissue matrices.

[2] The recovery limits for the EIS compounds were derived by EPA from the solid, tissue, and biosolids sample data from multi-laboratory validation study. To simplify laboratory operations, EPA has applied the same EIS recovery limits used for field sample analyses to the EIS recoveries in the method blank, IPR, OPR, and LLOPR samples. There are no IPR mean or RSD criteria for the EIS compounds.

[3] Recovery of $^{13}C_4$-PFBA, can be problematic in some soil, tissue, and biosolids samples. Although the lower limits for recovery for these EISs are set below 10%, laboratories should routinely track recoveries of these EISs and take reasonable steps to ensure that recoveries are at least 10% in the majority of samples.

[4] Recoveries of D_3-NMeFOSA, D_5-NEtFOSA, D_7-NMeFOSE, and D_9-NEtFOSE can be problematic in tissue samples. The 5% the lower limit for recovery for these EISs may not be achievable for all laboratories in tissue samples. Any result associated with an EIS recovery below 5% should be considered estimated.

eurofins	Always check on-line for validity.	Level:
Document number: **T-PFAS-WI69608**	**Aqueous PFAS Prep by SPE and Analysis by LC-MS-MS by EPA 1633 and EPA 1633A**	**Work Instruction**
Old Reference:		
Version: **5**		Organisation level: **5-Sub-BU**
Approved by: **TYZ8** Effective Date: **11-MAR-2025**	Document users: **5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_BKK_Data_Reviewers, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep**	Responsible: **5_EUUSLA_PFAS_Manager**

PROPRIETARY AND COMPANY CONFIDENTIAL

This documentation has been prepared by Eurofins Lancaster Laboratories Environment Testing, LLC and its affiliates ("Eurofins"), solely for their own use. The user of this document agrees by its acceptance to return it to Eurofins upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

THIS DOCUMENT CONTAINS VALUABLE CONFIDENTIAL AND PROPRIETARY INFORMATION. DISCLOSURE, USE OR REPRODUCTION OF THESE MATERIALS WITHOUT THE WRITTEN AUTHORIZATION OF EUROFINS IS STRICTLY PROHIBITED. THIS UNPUBLISHED WORK BY EUROFINS IS PROTECTED BY STATE AND FEDERAL LAW OF THE UNITED STATES.

Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Precaution to Minimize Method Interference
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
A) Sample Preparation and Prescreen
B) Manual Solid Phase Extraction (SPE)
C) Automated Solid Phase Extraction (SPE) by Promochrom
D) Vialing and Addition of Internal Standard
E) LC/MS/MS Analysis
F) Dilutions
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 05	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
References	Enhancement	Added Revision A
Cross Reference	Enhancement	Added Prescreen SOP QC Rotation form
Reagents and Standards	Enhancement	Added sand
Procedure	Enhancement	Added 5% solids visual standard prep instructions. Added reconstitution standard prep instructions. Added pre-prep dilution instruction section. Added data types. Clarified Manual SPE steps. Added requirement for to rotate QC.

	Revision: 04	**Effective date:** 31.OCT.2024
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Apparatus and Equipment	Enhancement	Added missing vendors. Standards are stored in the dark.
Calibration	Enhancement	CCVs are run every 10 injections of field sample extracts
Reagents and Standards	Enhancement	Added missing vendors.
Procedure A, B, C	Clarification	Clarified prep procedure
Procedure D	Clarification	removed references to Cal0. Added additional ICB in sequence. Rearranged section.
Procedure E	Enhancement	Added section to address dilutions
QA/QC	Clarification	IAR ratio is based off the mid-point CCV standard
Attachments	Clarification	Updates to Att 01, 02, 11,12, 16

Reference

1. USEPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, January 2024.

2. USEPA Method 1633 Revision A, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, December 2024.

3. Chemical Hygiene Plan, current version.

Cross Reference

Document	Document Title
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
G-DC-FRM23907	Redacted SOPs
T-PFAS-WI21568	Environmental Monitoring in the PFAS Lab
T-PFAS-WI23588	Preventative and Corrective Maintenance for the AB Sciex Liquid Chromatograph Mass Spectrometers (LC/MS/MS)
T-PFAS-WI50447	PFAS Prescreen Method in Water Samples Requesting PFAS by Isotope Dilution
T-PFAS-FRM80101	D4033 - QC Rotation Tracking

Confidential

Scope

This method is applicable for the determination of selected per- and polyfluorinated alkyl substances (PFAS) in aqueous samples to include non-potable waters and non-regulatory potable water when directed by the client. The compounds analyzed in this method are listed in the table below. The most current MDLs and LOQs are listed in the LIMS. Compounds other than those listed may be analyzed by client request.

Analyte	Acronym	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	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
1H,1H,2H,2H-Perfluorohexane sulfonic acid	4:2 FTS	757124-72-4
1H,1H,2H,2H-Perfluorooctane sulfonic acid	6:2 FTS	27619-97-2
1H,1H,2H,2H-Perfluorodecane sulfonic acid	8:2 FTS	39108-34-4
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluorooctane sulfonamide	NMeFOSA, N-MePFOSA	31506-32-8
N-ethylperfluorooctane sulfonamide	NEtFOSA, N-EtPFOSA	4151-50-2
N-methylperfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethylperfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
N-methylperfluorooctane sulfonamidoethanol	NMeFOSE, NMePFOSAE	24448-09-7
N-ethylperfluorooctane sulfonamidoethanol	NEtFOSE, NEtFOSAE	1691-99-2

Confidential

Analyte	Acronym	CAS#
Hexafluoropropylene Oxide Dimer Acid	HFPO-DA, GenX	13252-13-6
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4 *
Perfluoro-3-methoxypropanoic acid	PFMPA, PFECA F	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA, PFECA A	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA, PFECA B	151772-58-6
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Perfluoro (2-ethoxyethane) sulfonic acid	PFEESA, PES	113507-82-7
Perfluoro-4-ethylcyclohexanesulfonic acid	PFECHS	133201-07-7
Perfluorobutylsulfonamide	FBSA	30334-69-1
Perfluorohexanesulfonamide	FHxSA	41997-13-1

*CAS# for the free acid form of the analyte

Basic Principles

An aqueous sample is fortified with isotopically-labeled extraction standards and is passed through a solid phase extraction (SPE) cartridge to extract the analytes. The compounds are eluted from the solid phase with a combination of solvents. Carbon cleanup is performed during SPE. The extract is fortified with Isotopically-labeled injection internal standards. It is then analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

Reference Modifications

This method is "performance-based," which means that modifications may be made without additional EPA review to improve performance (e.g., overcome interferences, or improve the sensitivity, accuracy, or precision of the results) provided that all performance criteria in this method are met. These options include alternative extraction, concentration, and cleanup procedures, and changes in sample volumes, columns, and detectors. Changes in performance, sensitivity, selectivity, precision, recovery, etc., that result from modifications must be documented, as well as how these modifications compare to the specifications in this method.

Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Precaution to Minimize Method Interference

1. LC system components contain many of the target analytes. To minimize the background PFAS peaks, PTFE solvent frits and tubing are replaced by PEEK™ solvent frits and tubing where

Confidential

possible.

2. A precolumn, Proprietary Content, is installed before the injection valve to separate PFAS in standards/samples from those from the LC system and mobile phases.

3. All part of the SPE manifold must be cleaned as per *T-PFAS-WI21568*.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IPR (IDOC) and the DOC consist of 4 laboratory control samples (or alternatively, one blind sample for the DOC) that are spiked at the LCS level and carried through all steps of the extraction and analysis. Using results of the set of four analyses, compute the average percent recovery and the relative standard deviation (RSD) of the concentration for each analyte.

- For each target, the RSD and percent recovery must meet the criteria in Table 5. If any individual RSD exceeds the precision limit or any individual percent recovery falls outside the range for recovery for a target, system performance is unacceptable for that compound. Correct the problem and repeat the test.

- For each EIS and NIS, the percent recovery must meet the criteria defined in Table 6. There are is no RSD criteria for the EIS or NIS. If any individual percent recovery falls outside the range for an EIS or NIS, system performance is unacceptable for that compound. Correct the problem and repeat the test.

See *QA-SOP11178* for additional information on IDOC and DOC.

Confidential

Sample Collection, Preservation, and Handling

A. Sample Collection

The samples are collected in 125-mL HDPE containers. All sample containers must have linerless HDPE or polypropylene caps. Keep the sample sealed from time of collection until extraction. The entire aqueous sample that is collected must be prepared and analyzed, and subsampling must be avoided whenever possible.

NOTE: PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

B. Sample Storage and Shipment

1. Samples must be chilled during shipment and must not exceed 6°C during the first 48 hours after collection. Sample temperature must be confirmed to be at 0° to 6°C when the samples are received at the laboratory.

2. Samples stored in the lab must be held at a temperature of 0° to 6°C, not frozen, and protected from light until extraction. Alternatively, to meet project requirements, samples may be stored at less than or equal to -20°C and protected from light until extraction.

3. Water samples must be extracted within 28 days when stored at a temperature of 0° to 6°C, not frozen, and protected from light. Water samples must be extracted within 90 days when stored at a temperature less than or equal to -20°C and protected from light.

4. Extracts must be analyzed within 28 days after extraction when stored at a temperature of 0° to 6°C, not frozen, and protected from light. Extracts must be analyzed within 90 days after extraction when stored at a temperature less than or equal to -20°C and protected from light.

Apparatus and Equipment

A. Apparatus

1. 125-mL HDPE bottles. CapSure Leak-Proof bottles, Catalog No. 0125-1060-QC or equivalent.

   Note: One bottle per lot must be tested and demonstrated to be PFAS-free at or below the laboratory's MDLs for all target analytes. See *T-PFAS-WI21568* for additional details.

2. Centrifuge tubes, 15-mL conical polypropylene with polypropylene screw caps. Fisher Scientific, Catalog No. 05-539-5 or equivalent.

3. HDPE bottles for extraction fluid storage, 1L. Environmental Sampling Supply, Catalog No. 1000-1902-PC or equivalent.

4. Analytical Balance – Capable of weighing to 0.0001 g

5. Top-Loading Balance – Capable of weighing to 0.01 g

6. Solid phase extraction (SPE) Proprietary Content.

7. GCB filter cartridge, Proprietary Content

8. Large-volume SPE Reservoir, 25-mL. Millipore-Sigma, Product No. 54258-U or equivalent.

9. SPE Tube Adapter. Millipore-Sigma, Catalog No. 57020-U or equivalent.

10. SPE vacuum extraction manifold – "Resprep" 24-port manifold. Restek, Catalog No. 26080 or equivalent.

11. Polypropylene SPE delivery needles. Agilent, Catalog No. 12234511 or equivalent.

Confidential

12. Centrifuge, capable of a minimum rotational force of 3500 rcf, rotor radius 19.5 cm. Sorvall ST4 Plus-MD; Fisher Scientific, Catalog No. 75009510 or equivalent.

13. Auto Pipettes, Eppendorf Repeater, capable of accurately dispensing 10- to 1000-µL. Fisher Scientific, Catalog No. 14-287-150 or equivalent.

14. Polypropylene pipette tips, 0.1-200 µL. Fisher Scientific, Catalog No. 02-681-135 or equivalent.

15. Polypropylene pipette tips, 100-1000 µL. Fisher Scientific, Catalog No. 02-707-507 or equivalent.

16. Polypropylene pipette tips, 1 – 10 mL. Eppendorf, Catalog No. 022492098 or equivalent.

17. Pipettes, disposable transfer. Fisher Scientific, Catalog No. 13-711-7M or equivalent.

18. Vortex mixer, variable speed. Fisher Scientific or equivalent.

19. N-Evap sample extract concentrator with N_2 supply and water bath for temperature control. Organomation, Inc., Catalog No. 11250 or equivalent.

20. Reagent Water Purification System: Capable of producing ultrapure "Type 1/Milli-Q"-grade water from in-house deionized water system. Millipore SAS, Catalog No. FTPF08831.

21. SureStart Polyspring inserts. Fisher Scientific, Catalog No. 03452340 or equivalent.

22. Short-Cap Vial with Grad Marking Spot, 9-425 Screw-Thread, 2.0 mL, 9 mm, Clear. Restek, Catalog No. 21141 or equivalent.

23. Short Screw Caps, Polypropylene, Screw-Thread, PTFE/Silicone Septa, Blue, Preassembled, 2.0 mL, 9 mm. Restek, Catalog No. 24485 or equivalent.

24. Centrifuge tubes, 50-mL conical polypropylene with polypropylene screw caps. Fisher Scientific, Catalog No. 06-443-21 or equivalent.

25. Polypropylene bottles for standard storage, 4-mL. Fisher Scientific, Catalog No. 02-923-11E or equivalent.

26. Stainless steel spatula/scoop set. Bel-Art SP Scienceware, Product No. 11-865-130 or equivalent.

27. pH paper, Hydrion, range 5.5-8.0. Fisher Scientific, Catalog No. 14-853-275 or equivalent.

28. Disposable syringe filter, 25-mm, 0.2µm Nylon membrane, PALL/Acrodisc or equivalent.

29. Wheaton Bottle, 15-mL, narrow mouth, HDPE, Leak resistant; DWK Life Sciences, Catalog No. 209044SP or equivalent.

30. Graduated Medicine Cups, Plastic, 30-mL. Medline Industries, Catalog No. DYND8000 or equivalent.

31. Mobile phase bottles, 5 L. Fisher Scientific, Catalog No. 064141F or equivalent.

B. Equipment

1. AB Sciex Triple Quad 5500/5500+ Turbo V Ion Source or equivalent.

   ExionLC Controller
   ExionLC AC Pump
   ExionLC AC Autosampler
   Exion AC Column Oven
   Data system – Analyst 1.6.3

2. AB Sciex Triple Quad 7500 QTRAP Ready or equivalent.

   Shimadzu DGU-405 Degasser
   Shimadzu LC-40D XR Pump A
   Shimadzu LC-40D XR Pump B
   Shimadzu SIL-40C XR Autosampler

Confidential

Shimadzu CBM-40 Controller
Shimadzu CTO-40C Column Oven
Data system – Sciex OS (Version 3.1.6.44)

3. Automated extractor, Proprietary Content or equivalent

4. HPLC columns

   a. Analytical column: Proprietary Content Catalog No. 00B-4439-Y0 or equivalent.
   b. Pre-column: Proprietary Content Catalog No. 00D-4435-Y0 or equivalent.

Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or pressure resistant steel drums. Solvents, acids, and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions.

A. Reagents

1. Methanol (MeOH), "Chromasolv LC-MS" grade. Honeywell, Catalog No. 34966-4X4L or equivalent.

2. Acetonitrile (ACN). J.T. Baker, Catalog No. 9012-03 or equivalent.

3. Ammonium acetate. Sigma Aldrich, Catalog No. 431311-250G or equivalent. Store at 0-6°C.

4. Proprietary Content.

   a. Proprietary Content.

   b. Proprietary content.

   c. Proprietary Content.

5. 30:70 (v/v) Methanol:Water – Add methanol (300 mL) to water (700 mL). Store at room temperature. Replace after 1 month.

6. Methanol with 5% water - Add reagent water (50 mL) to methanol (950 mL). Store at room temperature. Replace after 1 month.

7. Formic Acid, ACS-grade. Sigma, Catalog No. 33015-1L or equivalent.

   a. Formic acid (aqueous, 0.1 M) - Dissolve formic acid (4.6 g or 3.8 mL) in reagent water (1 L). Store at room temperature. Replace after 2 years.

   b. Formic acid (aqueous, 0.3 M) - Dissolve formic acid (13.8 g or 11.3 mL) in reagent water (1 L). Store at room temperature. Replace after 2 years.

   c. Formic acid (aqueous, 5% v/v) - Mix 5 mL formic acid with 95 mL reagent water. store at room temperature. Replace after 2 years.

   d. Formic acid (aqueous, 50% v/v) - Mix 50 mL formic acid with 50 mL reagent water. Store at room temperature. Replace after 2 years.

8. Mobile Phase A: Proprietary Content. Store at room temperature for up to 2 months. Different volumes can be prepared as long as final concentrations are equivalent.

Confidential

9. Mobile Phase B: Proprietary Content into a 2-L glass mobile phase bottle. Store at room temperature for up to 2 months.

10. Sand - Sigma-Aldrich, Part No. 274739-5Kg or equivalent.

B. Standards

Standards are prepared using calibrated pipettes, polypropylene microcentrifuge tubes, and polypropylene bottles to create solutions at desired concentrations. The concentrated solution is injected below the surface of the diluting solvent. After preparation is completed, standards should be vortexed to ensure complete mixing. Measurement of volumes less than 5 µl should be avoided in routine production operations.

All stock, intermediate and spiking solutions are prepared using methanol. All initial calibration, initial calibration verification, and linear branched working standard solutions are prepared using Proprietary Content.

All diluted solutions must be stored in HDPE containers that have been thoroughly rinsed with methanol.

Stock standard and intermediate standard solutions are stored in the dark in the refrigerator in labeled polypropylene screw-top vials, polypropylene bottles, or polypropylene centrifuge tubes.

Expiration dates are managed through LIMS Reagent module. Solutions transferred from sealed glass ampules to screw-capped vials are given expiration dates of 1 year from the date opened or the expiration date provided by the vendor, whichever occurs sooner. Intermediate solutions are given an expiration date of 6 months from the preparation date, or the expiration date from the ampule provided by the vendor, whichever occurs sooner. The ampules and transferred solutions are stored in the refrigerator in the dark.

Working native and labeled (extraction surrogate and internal standard) compound spiking solutions are given an expiration date of 6 months, or the expiration date of the solutions used to prepare the working solution, whichever occurs sooner. The solutions are stored in labeled polypropylene screw-top vials in the refrigerator in the dark. When these solutions are prepared they must be tested prior to use in the PFAS extraction lab and verified monthly until they are consumed by operations or expire. Records of the standard verification are maintained by the laboratory. Prior to use, the working spiking solution should be evaluated against recovery windows of 85-115% for all compounds that will be analyzed using that solution. Should a standard fail to meet these criteria, the data must be reviewed by departmental management for acceptability and/or corrective action.

Working initial calibration solutions are given an expiration date of 6 months, or the expiration date of the solutions used to prepare the working initial calibration solution, whichever occurs sooner.

The primary/preferred standard vendor is Wellington Laboratories, Inc. Ontario, Canada. Listed catalog numbers are taken from Wellington product lists. Equivalent standards may be substituted, if the listed standards are unavailable.

The solution concentration listed is as presented on the certificate of analysis and includes adjustment for purity and the salt form of the compound used.

The concentrations referenced for the sulfonate salts, (for example PFBS, PFHxS and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of analysis (CofA). See *Attachment 04*. If the compound purity is assayed to be 98% or greater, weight can be used without correction to calculate concentrations.

Log purchased standards into LIMS Reagent. Select the solution category SOURCE for purchased mixes and/or single-compound ampules. LIMS Reagent system will assign formatted names to the purchased standard solutions. The automatically-generated name can be overwritten with a manually created name if desired. Use labels printed through the LIMS Reagent to identify and track standard solutions after transfer from original ampule to storage vial. The CofA for the ampulated stock standard is attached in LIMS Reagent for reference.

Standards are prepared by transferring a known quantity of Standard to a final volume of solvent. Standard Preparation is documented in LIMS Reagent. Solutions are stored by Type in LIMS Reagent,

Confidential

i.e., INTERMEDIATE=working solutions and intermediate standards and SOURCE=stocks (ampulated solutions). Each Standard is given a unique name.

The following attachments provide examples of standard preparation and purchasing information. Refer to the documentation in LIMS Reagent for standards preparation information.

Attachment 05 - 1633 Native PFAS Intermediate A
Attachment 06 - 1633 Native PFAS Intermediate B
Attachment 07 - 1633 Native PFAS CAL8 Intermediate
Attachment 08 - 1633 Extracted Internal Standard Intermediate
Attachment 09 - 1633 Non-Extracted Internal Standard Intermediate
Attachment 10 - 1633 TOP Surrogate Intermediate
Attachment 11 - 1633 ICAL Standard Preparation Scheme
Attachment 12 - 1633 Initial Calibration Standard Concentrations
Attachment 13 - Bile Salts Stock Solution
Attachment 14 - Bile Salts Intermediate
Attachment 15 - Bile Salts Working Solution
Attachment 16 - 1633 WDM Standard
Attachment 17 - 1633 Native Mid-Level Spike
Attachment 18 - 1633 Native Low-Level Spike
Attachment 19 - 1633 ICV Working Standard
Attachment 20 - 1633 Purchased/Ampulated Standards

Calibration

A. Mass Calibration

Frequency	Acceptance Criteria	Corrective Action
Calibration - at least annually or as recommended by the instrument manufacturer, whichever is more frequent, to maintain instrument sensitivity and stability.	Per manufacturer recommendations. Optimize the precursor and product ions in *Attachment 01*	Repeat as needed.
Verification - on an as-needed basis (e.g., QC failures, ion masses fall outside of the required mass window, major instrument maintenance, or if the instrument is moved) prior to the analysis of any standards and samples and after each subsequent mass calibration.	Resolution must meet manufacturer recommendations. The mass assignments must be within ±0.2 amu of the values shown in *Attachment 01*.	Recalibrate as needed. Otherwise, proceed to ICAL.

B. Chromatographic conditions

The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak. See the AB Sciex (5500/5500 Plus/7500) Acquisition, Quantitation, Gradient, and Detector Condition files for the most up to date chromatographic conditions. An example acquisition method and chromatographic conditions are shown in *Proprietary* Content. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process. All injections must use the same parameters as used in the ICAL.

Confidential

C. Retention Time Calibration

Frequency	Acceptance Criteria	Corrective Action
once per ICAL and at the beginning of the analytical sequence	The position of all target, EIS, and NIS peaks shall be set using the midpoint standard of the ICAL curve when ICAL is performed. When an ICAL is not performed, the initial CV retention times or the midpoint standard of the ICAL curve can be used to establish the RT window position. The RTs for the target analytes, EIS, and NIS compounds must fall within 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial CV, whichever was used to establish the RT window position for the analytical batch. All branched isomer peaks identified in either the calibration standard or the qualitative (technical grade) standard also must fall within 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial CV. For all target analytes with exact corresponding isotopically labeled analogs, target analytes must elute within 0.1 minutes of the associated EIS compound.	Recalibrate

D. Initial Calibration

Confidential

Frequency	Acceptance Criteria	Corrective Action
Prior to the analysis of samples, and after the mass calibration verification has met all criteria whenever the laboratory takes an action that changes the chromatographic conditions or might change or affect the initial calibration criteria when either the CV or Instrument Sensitivity Check (ISC) acceptance criteria have not been met.	A minimum of six calibration standards are required when using an average or linear curve fit. A minimum of seven calibration standards are required for a second-order curve fit (quadratic). The lowest standard must be at or below the RL. In general, Cal1 (at the RL), Cal2, Cal3, Cal4, Cal5, Cal6, Cal7, and Cal8 are included in the initial calibration. S/N ratio for the lowest standard within the quantitation range must be greater than or equal to 3:1 for quantification ions and the confirmation ions, or greater than or equal to 10:1 if the analyte only has a quantification ion. To use Average Response Factor: • %RSD for the response factors is less than or equal to 20% • if greater than 20%, try a Linear Regression. To use Linear Regression with a concentration weighing factor of 1/x: • The %RSE for all method analytes must be less than or equal to 20%. • if greater than 20%, try a Quadratic fit. To use Quadratic fit with a concentration weighing factor of $1/x^2$: • The %RSE for all method analytes must be less than or equal to 20%. For all curve fits, each calibration point is calculated back against the curve. The back calculated concentration for each calibration point must be within ±30% of its true value.	If the criteria are not met, the source of the problem must be determined and corrected. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

E. Initial Calibration Verification (ICV)

Frequency	Acceptance Criteria	Corrective Action
After ICAL prior to analyzing samples	ICV must be prepared from a second source. If a second source is not available, a separate preparation from the same stock (including intermediates) by a second analyst may be used. The calculated amount for each analyte must be within ±30% of the true value.	If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

Confidential

F. Calibration Verification (CV)

Frequency	Acceptance Criteria	Corrective Action
Once the calibration curve has been established, the continuing accuracy must be verified by analysis of a continuing calibration verification (CCV) standard at the beginning of each analytical sequence, every ten injections of a field sample extract, and at the end of the analytical sequence.	The calculated amount for each native in the CCV standard must be within ±30% of the true value. The absolute areas of the injection internal standard must be greater than 30% of the average areas measured during the initial calibration.	Samples that are not bracketed by acceptable CCV analyses must be reanalyzed. The exception to this would be if the CCV recoveries are high, indicating increased sensitivity, and there are no positive detections in the associated samples, the data may be reported with a qualifying comment. The source of the problem must be determined and the system recalibrated before continuing sample analysis.

Procedure

Data Types are included in brackets. If a Data Type is not needed (for example, no reagents were needed for pH adjustment), "NA" may be used.

A) Sample Preparation and Prescreen

1. Bring all samples to room temperature and vortex prior to starting. Thaw frozen samples in room temperature water. Weigh sample container with contents on a calibrated top loading balance to 0.1g and record the first reading in the automated prep entry system [*Gross Weight*].

2. Sample Volume:

    a. For all samples, the full bottle must be extracted. The sample must remain in the original sample container until after spiking solutions have been added.

    b. If a limited sample volume is submitted, spike sample in original container, then add Milli-Q water to bring to final volume of 125 mL prior to SPE extraction (see Procedure A.7 for spiking details).

    c. All water samples should be evaluated for Total Suspended Solids (TSS) by visual inspection. Although the full container volume of sample should be extracted, this method is applicable to aqueous samples containing up to 50 mg of suspended solids. For samples containing > 50 mg of suspended solids, or when unavoidable due to high levels of PFAS, smaller samples volumes may be analyzed. However, ultimately, visual inspection and analyst experience are all used to determine the volume to be used to extract the sample.

    d. TSS above 400 mg/L will likely require sample manipulation to effectively mitigate impacts on the solid phase extraction process and there may be impacts on data quality objectives. Every effort should be made in the field to properly collect samples with less than 50 mg of suspended solids. If sample dilution is required, this will result in elevated final reporting limits.

Confidential

In most cases a dilution factor less than 5X is sufficient which would result in RLs being elevated by up to 5X. Eurofins analyst will conduct a visual inspection of the sample and use professional judgement to determine the necessary dilution. If sample dilution is not acceptable for the project DQOs or significantly high TSS is anticipated e.g. >2,000 mg/L in a 125mL sample, the laboratory will centrifuge the sample according to the following procedure. This approach must be agreed to as part of the project DQOs up front and the analyst will proceed accordingly without further client consultation. Centrifugation can only be performed if the solids have high enough density to form a pellet or mass at the bottom of the bottle. Please note, not all samples will form such a mass, and the solids will not be extracted as a separate sample. With the use of isotope dilution, once labeled surrogates (EIS) are added to the sample, they distribute between all phases of the sample system (solid fraction, aqueous fraction, air/water interface, and water/container interface). These surrogates (EIS) are then used for recovery correction and the total PFAS concentration can be accurately reported for the whole sample, provided surrogate (EIS) recoveries are acceptable. A potential outcome of this approach is poor recoveries of the labeled surrogates (EIS) that will preferentially sorb to the particulates leading to qualified QC in the final results.

Note: Fill a 125-mL HDPE bottle with 125 mL of Milli-Q water. Using a calibrated balance, add 6.25 g of sand to the bottle to create a 5% (w/v) standard. Record the preparation of this standard in the reagent prep logbook and replace annually.

e. All attempts will be made to use the full volume of sample. If multiple bottles sizes were sent from the field, the appropriate sample volume will be processed. In cases where this is not possible, the sample is first gently swirled and then subsampled for pre-dilution. The sample aliquot is placed into a clean 125-mL HDPE container, brought up to 125 mL with Milli-Q water, and vortexed for 30 seconds to mix. Continue the extraction process with Procedure A.4. Clients will be notified, and the laboratory will proceed with the pre-dilution as necessary.

3. Use a 125-mL HDPE bottle [*QCBottleLotID*] for the Method Blank (MB), the Laboratory Control Sample (LCS), and the Low-level Laboratory Control Sample (LLCS). If the client has not requested an MS/MSD, an LCSD must be prepared as well. Fill each bottle with 125 mL of Milli-Q water. Record "150.0 g" as the gross weight and "25.0 g" as the tare weight for the batch QC samples.

4. Check that the pH is 6.0 ± 0.5. If necessary, adjust the pH with 50% formic acid or 30% ammonium hydroxide (or with 5% formic acid or 3% aqueous ammonium hydroxide). **NOTE: Never put pH test strips into the sample.** Record the acid or base lot number [*RgtID*] and amount used [*Amt*]. Use a disposable pipette [*TranferPipID*] to place a few drops of sample onto the pH paper [*pHIndID*].

5. If a client requests centrifugation, see T-PFAS-FRM74046.

6. Bring all spike solutions to room temperature and vortex for 30 seconds prior to use.

7. Spike QC and all samples with 25 µL of 1633_125 EIS Intermediate (1633_125_SS_#####). Spike LCS/LCSD/MS/MSD with 50 µL of 1633_125 Native Spike Mid (1633_125_MS_M_#####). Spike LLCS with 40 µL of 1633_125 Native Spike Low (1633_125_MS_L_#####). Vortex/Shake containers to mix thoroughly. Let samples equilibrate for 30 minutes after spiking. Document the technician who spike the sample [*Analyst ID - Reagent Drop*] as well as the spike witness [*Analyst ID - Reagent Drop Witness*].

8. Continue to either Manual SPE (Procedure B) or Automated SPE (Procedure C.)

B) Manual Solid Phase Extraction (SPE)

1. Before use, rinse each port of the SPE manifold [*ManifoldID*] with several milliliters of the following solvents in order:

- Proprietary
- Proprietary
- Proprietary
- Proprietary

2. Label each SPE cartridge [*SPECartType*] and *SPECartLot#*] to correspond with each associated sample/QC piece and attach to a rinsed SPE port. Record the SPE port number for each sample/QC piece on the batchlog.

Confidential

3. Condition each SPE cartridge with the following reagents in the following order without allowing the cartridges to go dry. Do not use vacuum during this step.

   a. Proprietary Content
   b. Proprietary Content
   c. Proprietary Content
   d. Proprietary Content

4. Label each sample bottle, cap, 15-mL centrifuge tube, and reservoir with the same number to ensure samples are not inadvertently switched during the extraction procedure (i.e.; 1,1,1; 2,2,2; 3,3,3; etc.).

5. Attach the labeled 25-mL SPE reservoir to each cartridge. Load the QC and samples to their respective cartridges. Allow sample to pass through. The drip rate should be approximately 3-5 drops per second.

6. After sample/QC has passed through, rinse the walls of the sample bottle with 5 mL reagent water. Add to cartridge and allow to pass through using vacuum. Then repeat.

7. After Milli-Q water has passed through, rinse the walls of the sample/QC bottle with 5 mL 30:70 (v/v) methanol:water [*RinseSolventName* and *RinseSolventLot*]. Add to cartridge and allow to pass through using vacuum. Then repeat.

8. Apply full vacuum to dry the cartridges until visibly dry (at least 10 minutes). Discard the rinse solution.

   NOTE: If a given sample is too problematic to extract using one cartridge with full vacuum, a second cartridge is created following Procedure B.2-4 above.

9. Place each empty sample bottle on the top-loading balance and weigh. Record the second reading in the automated prep entry system. The prep entry system will calculate the sample weight to 0.1g. Record the calculated weight as the sample volume on the batchlog.

10. Proprietary Content to the bottom of each SPE cartridge.

11. Place labeled 15-mL polypropylene centrifuge collection tubes [*CentrifugeTube*]under each respective SPE cartridge ensuring the delivery needles to do not touch the sides of the tubes.

12. Rinse the inside of each empty sample/QC bottle with Proprietary Content. Add to reservoir and cartridge.

13. Apply a slight vacuum to the manifold in order to reclaim as much solvent as possible from the SPE cartridges.

14. Disconnect the cartridge/adapter from the manifold. Remove the collection tubes.

    Note: If a second cartridge was required, the eluent from the second cartridge is added to the first cartridge eluent with a methanol rinse and then blown down to 5 mL on an N-EVAP prior to step 16 below.

15. Bring each sample extract to final volume 5 mL using methanol with Proprietary Content. Cap and vortex for 30 seconds to mix.

16. Proceed to Procedure D - Vialing and Addition of Internal Standard

C) Automated Solid Phase Extraction (SPE) by Proprietary

This procedure can be used in place of the manual extraction described in Procedure B.

Note: all samples must be prescreened prior to use of the Proprietary to avoid carryover and contamination.

1. Label each SPE cartridge [*SPECartType* and *SPECartLot#*] to correspond with each associated sample/QC piece and attach to a rinsed SPE port. Record the SPE port number for each sample/QC piece on the batchlog.

Confidential

2. Check to make sure all reagent bottles are filled and that reagents are not expired. Record Proprietary ID and reagent lot numbers. [*ManifoldID*, *SPE_Cond#1ID*, *SPE_Cond#2ID*, *RinseSolventName*, *RinseSolventLot*, *SolventName*, and *SolventLot*]

3. Label each sample bottle, cap, and Proprietary cartridge with the same number to ensure samples are not inadvertently switched during the extraction procedure (i.e.; 1,1,1; 2,2,2; 3,3,3; etc.).

4. Select "Proprietary" from the drop down menu to start the cleaning cycle prior to SPE. Make sure the "Clean" cartridges and bottles are attached for this cycle.

5. Remove "Clean" cartridges and attach the labeled cartridges that will be used when running the samples when the system cleaning is complete. Disconnect the "Clean" bottles. Attach the labeled sample bottles by twisting the bottles and not the cap. Attach a filter [*FilterEXPID*] to each cap. Place sample bottles upside down in corresponding numbered location on shaker. Poke two holes into the lip of each bottle. Load labeled centrifuge tubes [*CentrifugeTube*] in the moving tray beneath the cartridges.

6. Select "Proprietary" from the drop down menu and press the green check mark to start the procedure. The Proprietary program is described in *Proprietary*.

7. When the cycle pauses after cartridge drying, attach Proprietary to the bottom of each SPE cartridge and uncapped tubes in the moving tray.

8. Once the cycle is complete, remove centrifuge tubes and discard the used cartridges and bottles. Reattach "Clean" bottles and cartridges, select "Proprietary" from menu, select "start". This must be done between each batch and at the beginning and the end of the day. At the end of the day, run the "Proprietary" clean cycle.

9. Place each empty sample bottle on the top-loading balance and weigh. Record the second reading in the automated prep entry system [*TareWeight*]. The prep entry system will calculate the sample weight to 0.1g. Record the calculated weight as the sample volume on the batchlog.

10. The batch QC must be rotated among the Proprietary ports so that all the ports are covered over the course of a quarter. Use form *T-PFAS-FRM80101* for tracking.

11. Bring each sample extract to final volume 5 mL using methanol with Proprietary. Cap and vortex for 30 seconds to mix.

12. Proceed to Procedure D - Vialing and Addition of Internal Standard

D) Vialing and Addition of Internal Standard

Note: The instrument lab chemist performs these steps.

1. Determine the sample aliquot to use for analysis. Add Internal Standard Spike Solution (1633_125_IS_V_#####) to the corresponding labeled autosampler vial [*VialLot#*].

    - 10 µL IS into a 190 µL aliquot of sample (final volume = 200 µL)
    - 25 µL IS into a 475 µL aliquot of sample (final volume = 500 µL)
    - 50 µL IS into a 950 µL aliquot of sample (final volume = 1000 µL)

2. Transfer an aliquot of the final extract (as determined in Step 1 above) to the corresponding labeled auto-sampler vial.

3. Cap the auto-sampler vial [*Caps*] and vortex for 30 seconds. Samples are now ready for analysis.

4. Cap the centrifuge tube. The remaining centrifuged extracts are stored in the refrigerator for dilution or reinjection if needed.

E) LC/MS/MS Analysis

1. Load sample vials containing calibration standards, quality control samples, and sample extracts into the autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass

Confidential

spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks to clean the instrument prior to sample acquisition.

2. Bring standards to room temperature and vortex before calibrating. To eliminate the need for a qualitative identification standard, the calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA, NEtFOSAA, PFNA, PFOA, PFOSA, NEtFOSE, NMeFOSE, NEtFOSA, and NMeFOSA. Mass Transitions are defined in *Attachment 01*.

Example Initial Calibration Sequence (LIMS ID):

Instrument Blank to clean instrument (at least 3)
1. CAL 1 (IC)
2. CAL 2 (IC)
3. CAL 3 (IC)
4. CAL 4 (IC)
5. CAL 5 (ICISAV)
6. CAL 6 (IC)
7. CAL 7 (IC)
8. CAL 8 (IC)
9. Instrument Blank (ICB)
10. Initial Calibration Verification (ICV)
11. Bile Salts Standard (WDM)

3. Isotopically-labeled compounds are not available for some compounds. See below for compounds without labeled isotopes and their referenced extraction standards. See *Attachment 02* shows the full list of analytes and their EIS and NIS.

Note: For better accuracy, PFTrDA is quantitated using the average of the areas of labeled compounds 13C2-PFTeDA and 13C2-PFDoA.

Native	Extracted Internal Standard
3:3FTCA	13C5-PFPeA
PFMPA	
PFMBA	
NFDHA	13C5-PFHxA
5:3FTCA	
7:3FTCA	
PFEESA	
DONA	13C3-HFPO-DA
9Cl-PF3ONS	
11Cl-PF3OUdS	
PFTrDA	Avg 13C2-PFTeDA and 13C2-PFDoA
PFHpS	13C8-PFOS
PFNS	
PFDS	
PFDoS	
PFPeS	13C3-PFHxS
TFSI	
FHxSA	
PFECHS	
PFODA	13C2-PFTeDA

Confidential

Native	Extracted Internal Standard
FBSA	13C3-PFBS

Example Sample Sequence (LIMS ID):

Instrument Blanks to clean instrument if needed (at least 3)
1. Instrument Sensitivity Check at CAL1 (CCVO)
2. Calibration Verification at CAL4 (CCV)
3. Instrument Blank (CCB)
4. Bile Salts marker (WDM)
5. Method Blank (MB)
6. On-going Precision and Recovery (LCS)
7. Low-level OPR (LLCS)
8. On-going Precision and Recovery Duplicate (LCSD)
9. Samples (10 or less)
10. Calibration Verification at CAL4 (CCV)
11. Instrument Blank (CCB)

4. Instrument Blank (ICB, CCB) - Instrument Blanks need to be analyzed immediately following the highest standard analyzed and daily at the start of a sequence. The concentration of all analytes must be less than the MDL. If acceptance criteria are not met, the calibration must be performed using a lower concentration standard for the high standard until the criteria are met.

5. Instrument Sensitivity Check (CCVO) - Prior to sample analysis, an Instrument Sensitivity Check (ISC) must be performed. The ISC standard concentration must be at the LOQ. The CAL1 standard's concentration is at the LOQ, so the CAL1 standard will be analyzed. All analyte concentrations must be within ±30% of their true values. The signal-to-noise ratio must be greater than or equal to 3:1 for the quantitation ions and confirmation ions, and 10:1 for quantitation ions that have no confirmation ion. If the criteria are not met, correct problem and rerun ISC. If a target analyte (or EIS) reads back high with no detection (or in-spec recoveries) in the samples, data may be reported. If problem persists, repeat the ICAL. No samples can be analyzed until the ISC meets acceptance criteria.

6. Bile Salt Interference Check (WDM) - Analyze a Window-Defining Matrix (WDM) standard containing 100 ppb of Taurodeoxycholic Acid (TDCA), Taurochenodeoxycholic Acid (TCDCA), and Tauroursodeoxycholic Acid (TUDCA). The laboratory must establish chromatographic conditions to ensure the bile salt (TDCA) does not cause interference during the analysis of samples. To demonstrate successful separation the retention time of TDCA must be at least 1 minute outside the retention time window of PFOS. This is demonstrated as a comparison of the RT of TDCA (measured at the apex of the TCDA peak) separated by at least 1.4 minutes from the RT of the linear isomer of PFOS (measured at the apex of the peak of the linear isomer of PFOS). If the mobile phase does not contain acetonitrile, this check must include all three bile salts (TDCA, TCDCA, and TUDCA). If adequate separation is not achieved, adjust the chromatographic conditions and reevaluate the separation of TDCA from PFOS.

7. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration F for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

8. Quantitate results for the Method Blank (MB). Calculate the recoveries of spiked analytes for the LCS and its duplicate (LCSD, if needed), Low-Level LCS, Matrix Spike and Matrix Spike Duplicate (MS/MSD) by comparing concentrations observed to the true values. Calculate the relative percent difference (RPD) between the duplicates.

9. Isotopically-labeled Extraction Standards (EIS) are added to all samples, MB, LLCS, LCS/LCSD, and MS/MSD prior to extraction. Isotopically-labeled Injection Standards (NIS) are added to each QC and field sample extract prior to analysis. Quantitation by isotope dilution generally precludes any adverse effect on data quality due to EIS recoveries being outside of the acceptance limits as long as the signal-to-noise ratio is greater than 10:1.

Confidential

10. To identify a target or EIS:

    a. Peak responses of quantitation and confirmation ions must have S/N of at least 3:1. If there is no confirmation ion, the quantitation ion must have S/N of at least 10:1. If the S/N ratio is not met, the analyte is considered to be ND.

    b. The retention times should not vary by more than 0.4 minutes from the expected retention time from the midpoint of the ICAL or initial CV. Furthermore, native compounds with an exact isotopically-labeled analogue must elute within 0.1 minutes from their associated analog. If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

    c. For concentrations at or above the LOQ, the Ion Abundance Ratio (IAR) must fall within ±50% of the IAR observed in the mid-point initial calibration standard. The total response of all isomers (branched and linear) in the quantitative standards must be used to define the IAR. In samples, the total response should include only the branched isomer peaks that have been identified in either the quantitative or qualitative standard.

11. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFECA F (PFMPA), PFECA A (PFMBA), NMeFOSE, NEtFOSE, FBSA, and FHxSA. The expected ion ratio for each compound is calculated by using the average of ion ratios of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, see QA/QC section for Corrective Action.

F) Dilutions

Aqueous samples are prescreened prior to extraction to ensure concentrations do not exceed the range of the method and will not contaminate the laboratory or instrumentation. Samples with high concentrations of target PFAS which have the potential to contaminate the laboratory or the instrument will be extracted at a lower volume to mitigate those risks. Samples determined to be at or above 100x the level of the high standard will be diluted to mitigate the need for dilutions of the sample extract above 10x. For example, prescreen results at 125x the high standard would require that the sample prior to extraction be diluted by a factor of 12.5x (125/10 = 12.5). This would be done by using a 10mL portion of the sample (125/12.5 = 10) and bringing to a final volume of 125mL for extraction.

All attempts will be made to use the full volume of sample if multiple bottles sizes were sent from the field. In cases where this is not possible, the sample is first shaken, then subsampled for pre-dilution. Clients will be notified, and the laboratory will proceed with the pre-dilution as necessary. Samples requiring dilution due to high concentrations will be noted in the case narrative. Note that results based solely off the pre-dilution of a sample DO NOT have a dilution factor as dilution factors are only applied to extract dilutions.

When the area of the primary transition of a target analyte is above the area of the highest calibration point a sample dilution is required. Dilute the extract as follows:

1. Remove extracts from storage and allow to come to room temperature for approximately 60-90 minutes.
2. Vortex the extract for one minute.
3. Using a pipette or syringe, remove an aliquot of the extract, this extract should target a dilution equivalent to the mid-level concentration of the calibration curve to avoid over diluting the extract.
4. Dilute the aliquot to volume using Proprietary Content.
5. Fortify with additional NIS to achieve the same concentration of NIS in the original extract.
6. Vortex an aliquot for analysis.

If the S/N of EIS associated with the analyte requiring dilution in the extract meets the S/N requirement for EIS and the recovery of the associated EIS meet the method criteria, the results from the dilution can be reported. If these criteria are not met and additional sample is available, a smaller volume/mass of sample should be extracted.

Calculations

1. Peak Area Ratio

Confidential

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

2. On-Column Analyte Concentration using average RRF

   On-column Concentration = peak area ratio ÷ AVE RRF

3. On-Column Analyte Concentration using linear curve

   On-column Concentration = (peak area ratio - intercept) ÷ slope

4. Sample Concentration

   Sample concentration (ng/l) = (On-column concentration x Final Sample Volume x DF) ÷ Initial Sample Volume

5. Ion Abundance Ratio (IAR)

   Ion Abundance Ratio (IAR) = (peak area or height of quantifier)/(peak area or height of qualifier)

6. See *T-PEST-WI9847* for additional calculations used to evaluate the calibrations and quality control samples.

Statistical Information/Method Performance

Historical data for LCS/Ds, LLCSs, MS/Ds, and EIS is reviewed at least annually. However, all samples are reported using the limits in EPA 1633 Tables 5 and 6. When target analytes not on these tables are requested, statistical limits are used for LCS/MS. (Preliminary limits of 70-130% Recovery and <20% RPD can be used until enough data points are generated.) Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

As MDL studies are run on clean laboratory matrices, statistically derived MDL values could be artificially lower than achievable limits in real world samples. Nominal MDL values, set at no lower than 1/4 the calculated and verified Reporting Limit (or Limit of Quantitation) will be used as a method to avoid artificially low bias in MDL studies.

Quality Assurance/Quality Control

For each batch of samples extracted, a method blank, an LCS, and an LLCS must be extracted and analyzed. An MS/MSD are extracted only if requested and submitted by the client. If no MS/MSD is provided, an LCS/LCSD must be extracted and analyzed instead. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Confidential

QC Item	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	One per extraction batch of no more than 20 field samples	No target analytes greater than RL, or greater than 1/10 the amount measured in any sample, or 1/10 the regulatory limit (whichever is greater).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.
Low-Level On-going Precision and Recovery (LLCS)	One per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 5 and 6 of Method 1633)	Reanalyze LLCS once. If acceptable, report. Evaluate samples for detections, and LLCS for high bias. If LLCS has high bias, and samples non-detect, report and narrate. If LLCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LLCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.
On-going Precision and Recovery and its Duplicate (LCS)	One per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 5 and 6 of Method 1633)	Reanalyze LCS once. If acceptable, report. Evaluate samples for detections, and LCS for high bias. If LCS has high bias, and samples non-detect, report and narrate. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	*at client request*, one per extraction batch of no more than 20 field samples	Acceptance criteria defined in *Attachment 22* (Tables 5 and 6 of Method 1633) RPD less than 30%	If outside the acceptance windows, consult a supervisor to determine the appropriate course of action based on batch and sample results.

Confidential

QC Item	Frequency	Acceptance Criteria	Corrective Action
Extracted Internal Standards (EIS) or Isotope Dilution Analyte (IDA), added prior to extraction	per sample (including MB, LCS, LCSD, LLCS, MS, MSD) during preparation	Acceptance criteria defined in *Attachment 22* (Table 6 of Method 1633)	1. If EIS outside windows, check for errors and correct. Re-analyze sample, if needed. 2. If EIS out high and samples are non-detect, report and narrate. If EIS out high with detections, but EIS <200% (FTS <350%), report and narrate. If EIS out high with detections and EIS >200% (FTS >350%), dilute 10X, re-analyze, report, and narrate. 3. If EIS low but > 5% and S/N > 10:1, narrate and report. If EIS <5% then contact client to re-extract at smaller aliquot.
Non-extracted Internal Standards (NIS) added following extraction and prior to analysis	per sample (including MB, LCS, LCSD, LLCS, MS, MSD) during preparation	NIS areas 50-200% of the mean area of the most recent ICAL in undiluted sample extracts and sample extracts that require NIS to be added.	If fails high, check for errors and report. If fails low, re-analyze fresh aliquot of sample. If in control, report. If the failure confirms report the initial analysis and narrate.
Ion Abundance Ratio (IAR)	Each detected analyte (except PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, PFMBA, FBSA, FHxSA)	Acceptance window of 50-150% of the ratio in the mid-point CCV standard.	Check for error, if none found report as outlined below. 1. If outside limits and value is less than the RL, report as ND at RL. 2. If outside limits, but within 2X rule* flag, report and narrate. 3. If ratio outside 2X rule* then report as ND at elevated RL, apply G flag and narrate. 4. If ratio out due to branched isomer contribution, report as positive with narration. 5. If outside limits (and RT window) due to matrix, report as ND at elevated RL, apply G flag and narrate.
E-flagged data	NA	NA	Dilute sample extract. If still E-flagged after dilution, consult the client for course of action.

*2X Rule: If the ion ratio <0.5X the lower control limit or >2X the upper control limit, then do not report the analyte. It should be either Non-Detect at the RL or elevate the RL as needed (G flag). As an example if the target ion ratio is 4.00. The Chrom-determined limits are 2.00-6.00. If the ratio is <1.00 (2.00 X 0.5) or >12.00 (6.00 X 2) follow the specifications above.

Confidential

Attachment:
Attachment 01 - Mass Transitions (.pdf)
Attachment 02 - Standard Relationships (.pdf)
Attachment 03 – Proprietary Content
Attachment 04 - Example CoA (.pdf)
Attachment 05 - Native PFAS Intermediate A (.pdf)
Attachment 06 - Native PFAS Intermediate B (.pdf)
Attachment 07 - Native PFAS CAL8 Intermediate (.pdf)
Attachment 08 - 1633 EIS Intermediate (.pdf)
Attachment 09 - 1633 NIS Intermediate (.pdf)
Attachment 10 - 1633 TOP SS Intermediate (.pdf)
Attachment 11 - Initial Calibration Standards Preparation (.pdf)
Attachment 12 - ICAL Standard Concentration (.pdf)
Attachment 13 - Bile Salts Stock Solutions (.pdf)
Attachment 14 - Bile Salts Intermediate (.pdf)
Attachment 15 - Bile Salts Working Solution (.pdf)
Attachment 16 - 1633 WDM (.pdf)
Attachment 17 - Native Mid Level Spike (.pdf)
Attachment 18 - Native Low Level Spike (.pdf)
Attachment 19 - ICV Working Standard (.pdf)
Attachment 20 - Purchased Standards (.pdf)
Attachment 21 – Proprietary Content
Attachment 22 - Tables 5-6 (EPA 1633) (.docx)

G-DC-FRM23907 Redacted SOPs
QA-SOP11178 Demonstrations of Capability
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
T-PEST-WI9847 Common Equations Used During Chromatographic Analyses
T-PFAS-FRM80101 D4033 - QC Rotation Tracking Form
T-PFAS-WI21568 Environmental Monitoring in the PFAS Lab
T-PFAS-WI23588 Preventative and Corrective Maintenance for the AB Sciex Liquid Chromatograph Mass Spectrometers (LC/MS/MS)
T-PFAS-WI50447 PFAS Prescreen Method in Water Samples Requesting PFAS by Isotope Dilution
T-WC-WI53304 Total Suspended Solids (TSS Gravimetric) Prescreen for PFAS by EPA Draft Methods in Aqueous Samples
Attachment: Attachment 01 - Mass Transitions (pdf)
Attachment: Attachment 02 - Standard Relationships (pdf)
Attachment: Attachment 03 – Proprietary Content Attachment:
Attachment 04 - Example CoA (pdf)
Attachment: Attachment 05 - Native PFAS Intermediate A (pdf)
Attachment: Attachment 06 - Native PFAS Intermediate B (pdf)
Attachment: Attachment 07 - Native PFAS CAL8 Intermediate (pdf)
Attachment: Attachment 08 - 1633 EIS Intermediate (pdf)
Attachment: Attachment 09 - 1633 NIS Intermediate (pdf)
Attachment: Attachment 10 - 1633 TOP SS Intermediate (pdf)
Attachment: Attachment 11 - Initial Calibration Standards Preparation (pdf)
Attachment: Attachment 12 - ICAL Standard Concentration (pdf)
Attachment: Attachment 13 - Bile Salts Stock Solutions (pdf)
Attachment: Attachment 14 - Bile Salts Intermediate (pdf)
Attachment: Attachment 15 - Bile Salts Working Solution (pdf)
Attachment: Attachment 16 - 1633 WDM (pdf)
Attachment: Attachment 17 - Native Mid Level Spike (pdf)
Attachment: Attachment 18 - Native Low Level Spike (pdf)
Attachment: Attachment 19 - ICV Working Standard (pdf)
Attachment: Attachment 20 - Purchased Standards (pdf)
Attachment: Attachment 21 – Proprietary Content
Attachment: Attachment 22 - Tables 5-6 (EPA 1633) (docx)

End of document

Confidential

Version history

Version	Approval	Revision information	
3.1	27.AUG.2024		
4	31.OCT.2024		
5	11.MAR.2025		

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
422-64-0	PFPrA	163.00	119.00
STL03194	13C3-PFPrA	166.00	121.00
STL02680	13C3-PFBA	216.00	172.00
STL00992	13C4-PFBA	216.80	171.90
375-22-4	PFBA	212.80	168.90
377-73-1	PFECA F (PFMPA)	229.00	84.90
356-02-5	3:3 FTCA	241.00	177.00
	3:3 FTCA (2)	241.00	117.00
2706-90-3	PFPeA	263.00	219.00
STL01893	13C5-PFPeA	268.30	223.00
863090-89-5	PFECA A (PFMBA)	279.00	85.10
82113-65-3	TFSI	280.00	147.00
	TFSI (2)	280.00	78.00
13252-13-6	HFPODA	284.90	168.90
	HFPODA (2)	284.90	184.90
STL02255	13C3-HFPODA	286.90	168.90
	13C3-HFPODA (2)	286.90	184.90
151772-58-6	PFECA B (NFDHA)	295.00	201.00
	PFECA B (NFDHA) (2)	295.00	84.90
375-73-5	PFBS	298.70	79.90
	PFBS (2)	298.70	98.80
STL02337	13C3-PFBS	302.10	79.90
307-24-4	PFHxA	313.00	269.00
	PFHxA (2)	313.00	118.90
113507-82-7	PFEESA (PES)	314.80	134.90
	PFEESA (PES) (2)	314.80	82.90
STL00993	13C2-PFHxA	315.10	270.00
STL02577	13C5-PFHxA	318.00	273.00
757124-72-4	4:2-FTS	327.10	307.00
	4:2-FTS (2)	327.10	80.90
914637-49-3	5:3 FTCA	341.00	237.10
	5:3 FTCA (2)	341.00	217.00
2706-91-4	PFPeS	349.10	79.90
	PFPeS (2)	349.10	98.90
375-85-9	PFHpA	363.10	319.00
	PFHpA (2)	363.10	169.00
STL01892	13C4-PFHpA	367.10	322.00
919005-14-4	DONA	376.90	250.90
	DONA (2)	376.90	84.80
41997-13-1	FHxSA	397.90	78.00

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
355-46-4	PFHxS	398.70	79.90
	PFHxS (2)	398.70	98.90
STL02581	13C3-PFHxS	402.10	79.90
STL00994	18O2-PFHxS	403.00	83.90
335-67-1	PFOA	413.00	369.00
	PFOA (2)	413.00	169.00
STL00623	13C2-PFOA	415.00	370.00
STL00990	13C4-PFOA	417.10	372.00
STL01054	13C8-PFOA	421.10	376.00
27619-97-2	6:2-FTS	427.10	407.00
	6:2-FTS (2)	427.10	80.90
STL02279	13C2-6:2-FTS	429.10	80.90
812-70-4	7:3 FTCA	441.00	316.90
	7:3 FTCA (2)	441.00	336.90
375-92-8	PFHpS	449.00	79.90
	PFHpS (2)	449.00	98.80
133201-07-7	PFECHS	461.00	381.00
	PFECHS (2)	461.00	99.00
375-95-1	PFNA	463.00	419.00
	PFNA (2)	463.00	219.00
STL00995	13C5-PFNA	468.00	423.00
STL02578	13C9-PFNA	472.10	427.00
516-50-7	TDCA	498.00	80.00
754-91-6	PFOSA	498.10	77.90
	PFOSA (2)	498.10	478.00
516-35-8	TCDCA	498.10	80.00
14605-22-2	TUDCA	498.20	80.00
1763-23-1	PFOS	498.90	79.90
	PFOS (2)	498.90	98.80
STL00991	13C4-PFOS	502.80	79.90
STL01056	13C8-PFOSA	506.10	77.80
STL01054	13C8-PFOS	507.10	79.90
31506-32-8	NMeFOSA	511.90	219.00
	NMeFOSA (2)	511.90	169.00
335-76-2	PFDA	512.90	469.00
	PFDA (2)	512.90	219.00
STL02705	d3-NMeFOSA	515.00	219.00
STL00996	13C2-PFDA	515.10	470.10
STL02579	13C6-PFDA	519.10	474.10
4151-50-2	NEtFOSA	526.00	219.00
	NEtFOSA (2)	526.00	169.00
39108-34-4	8:2-FTS	527.10	507.00
	8:2-FTS (2)	527.10	80.80

Confidential

Attachment 1 – Mass Transitions

CAS#	Compound	Parent Ion	Daughter Ion
STL02280	13C2-8:2-FTS	529.10	80.90
756426-58-1	9Cl-PF3ONS	530.80	351.00
	9Cl-PF3ONS (2)	532.80	353.00
STL02704	d5-NEtFOSA	531.10	219.00
68259-12-1	PFNS	548.80	79.90
	PFNS (2)	548.80	98.80
2058-94-8	PFUnA	563.10	519.00
	PFUnA (2)	563.10	269.10
STL00997	13C2-PFUnA	565.00	520.00
STL02580	13C7-PFUnA	570.00	525.10
2355-31-9	NMeFOSAA	570.10	419.00
	NMeFOSAA (2)	570.10	483.00
STL02118	d3-NMeFOSAA	573.20	419.00
2991-50-6	NEtFOSAA	584.20	419.10
	NEtFOSAA (2)	584.20	526.00
STL02117	d5-NEtFOSAA	589.20	419.00
335-77-3	PFDS	599.00	79.90
	PFDS (2)	599.00	98.80
307-55-1	PFDoDA	613.10	569.00
	PFDoDA (2)	613.10	319.00
STL00998	13C2-PFDoDA	615.10	570.00
24448-09-7	NMeFOSE	616.10	58.90
STL02277	d7-NMeFOSE	623.20	58.90
1691-99-2	NEtFOSE	630.00	58.90
763051-92-9	11Cl-PF3OUdS	630.90	450.90
	11Cl-PF3OUdS (2)	632.90	452.90
STL02278	d9-NEtFOSE	639.20	58.90
72629-94-8	PFTrDA	663.00	619.00
	PFTrDA (2)	663.00	168.90
79780-39-5	PFDoS	699.10	79.90
	PFDoS (2)	699.10	98.80
376-06-7	PFTeDA	713.10	168.90
	PFTeDA (2)	713.10	219.00
STL02116	13C2-PFTeDA	715.20	670.00
16517-11-6	PFODA	913.00	869.00
	PFODA (2)	913.00	169.00

Confidential

Attachment 2 - PFAS Injection Standards/Extraction Standards/Native Compounds

Native	Extraction Standard	Internal Standard
PFBA	13C4-PFBA	13C3-PFBA
PFPrA	13C3-PFPrA	
PFPeA	13C5-PFPeA	13C2-PFHxA
3:3FTCA		
PFMPA		
PFMBA		
PFHxA	13C5-PFHxA	
NFDHA		
5:3FTCA		
7:3FTCA		
PFEESA		
PFHpA	13C4-PFHpA	
HFPO-DA	13C3-HFPO-DA	
ADONA		
9Cl-PF3ONS		
11Cl-PF3OUdS		
PFOA	13C8-PFOA	13C4-PFOA
PFNA	13C9-PFNA	13C5-PFNA
PFDA	13C6-PFDA	13C2-PFDA
PFUnA	13C7-PFUnA	
PFDoA	13C2-PFDoA	
PFTeDA	13C2-PFTeDA	
PFODA		
PFTrDA	Avg 13C2-PFTeDA and 13C2-PFDoA	
PFBS	13C3-PFBS	18O2-PFHxS
FBSA		
PFPeS	13C3-PFHxS	
PFHxS		
FHxSA		
PFECHS		
TFSI		
4:2-FTS	13C2-4:2-FTS	
6:2-FTS	13C2-6:2-FTS	
8:2-FTS	13C2-8:2-FTS	
PFHpS	13C8-PFOS	13C4-PFOS
PFOS		

Confidential

Attachment 2 - PFAS Injection Standards/Extraction Standards/Native Compounds

Native	Extraction Standard	Internal Standard
PFNS		
PFDS		
PFDoS		
PFOSA	13C8-PFOSA	
NMeFOSA	d3-NMeFOSA	
NEtFOSA	d5-NEtFOSA	
NMeFOSAA	d3-NMeFOSAA	
NEtFOSAA	d5-NEtFOSAA	
NMeFOSE	d7-N-MeFOSE-M	
NEtFOSE	d9-N-EtFOSE-M	

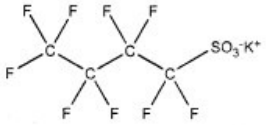
Confidential

Attachment 4 – Example CoA

WELLINGTON LABORATORIES

CERTIFICATE OF ANALYSIS
DOCUMENTATION

PRODUCT CODE:	L-PFBS	**LOT NUMBER:**	LPFBS1022
COMPOUND:	Potassium perfluoro-1-butanesulfonate		
STRUCTURE:		**CAS #:**	29420-49-3



MOLECULAR FORMULA:	$C_4F_9SO_3K$	**MOLECULAR WEIGHT:**	338.19
CONCENTRATION:	50.0 ± 2.5 µg/mL (K salt) 44.4 ± 2.2 µg/mL (PFBS acid) 44.2 ± 2.2 µg/mL (PFBS anion)	**SOLVENT(S):**	Methanol
CHEMICAL PURITY:	>98%		
LAST TESTED: (mm/dd/yyyy)	10/04/2022		
EXPIRY DATE: (mm/dd/yyyy)	10/04/2027		
RECOMMENDED STORAGE:	Store ampoule in a cool, dark place		

DOCUMENTATION/ DATA ATTACHED:

Figure 1: LC/MS Data (Full Scan and Mass Spectrum)
Figure 2: LC/MS/MS Data (Selected MRM Transitions)

ADDITIONAL INFORMATION:

- See page 2 for further details.

FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE

Certified By: _____ **Date:** 10/14/2022 (mm/dd/yyyy)
B.G. Chittim, General Manager

Wellington Laboratories Inc., 345 Southgate Dr. Guelph ON N1G 3M5 CANADA
519-822-2436 • Fax: 519-822-2849 • info@well-labs.com

Form#:27, Issued 2004-11-10
Revision#:9, Revised 2020-12-23

INTENDED USE:

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compound it contains.

HANDLING:

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

SYNTHESIS / CHARACTERIZATION:

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

HOMOGENEITY:

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products are compared to older lots in the same manner, which further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

UNCERTAINTY:

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty, $u_c(y)$, of a value y and the uncertainty of the independent parameters x_1, x_2,...x_n on which it depends is:

$$u_c(y(x_1, x_2, \ldots x_n)) = \sqrt{\sum_{i=1}^{n} u(y, x_i)^2}$$

where x is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of ±5% (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

TRACEABILITY:

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class A tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

EXPIRY DATE / PERIOD OF VALIDITY:

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

LIMITED WARRANTY:

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

QUALITY MANAGEMENT:

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAI Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A1226), and ISO 17034 by ANSI National Accreditation Board (ANAB; AR-1523).

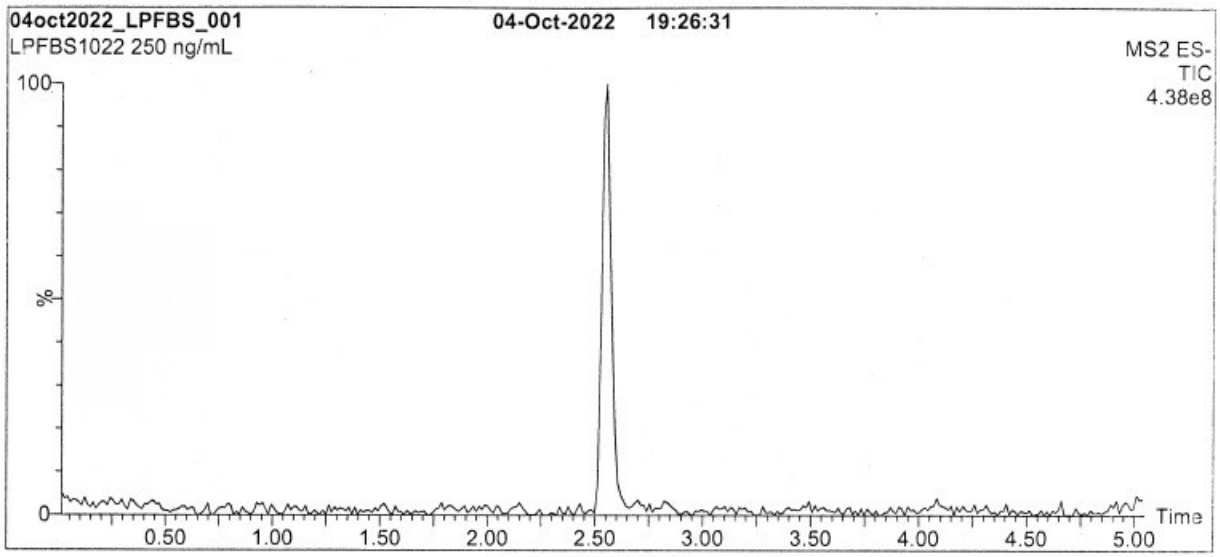
CALA Testing Accreditation No. A1226

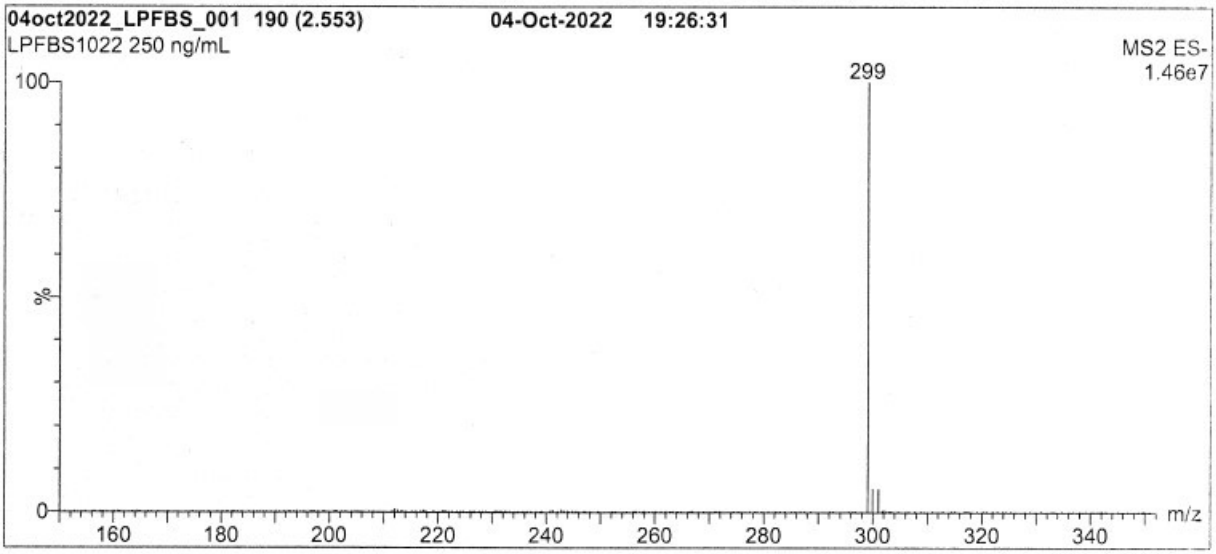
ANAB ANSI National Accreditation Board ACCREDITED ISO 17034 REFERENCE MATERIAL PRODUCER

For additional information or assistance concerning this or any other products from Wellington Laboratories Inc., please visit our website at www.well-labs.com or contact us directly at info@well-labs.com

Attachment 4 – Example CoA

Figure 1: **L-PFBS; LC/MS Data (Full Scan and Mass Spectrum)**





Conditions for Figure 1:

Waters Acquity Ultra Performance LC
Waters Xevo TQ-S micro MS

Chromatographic Conditions:

Column: Acquity UPLC BEH Shield RP_{18}
1.7 µm, 2.1 x 100 mm

Mobile phase: Gradient
Start: 60% H_2O / 40% (80:20 MeOH:ACN)
(both with 10 mM NH_4OAc buffer)
Ramp to 90% organic over 8 min and hold for 2 min
before returning to initial conditions over 0.75 min.
Time: 12 min

Flow: 300 µL/min

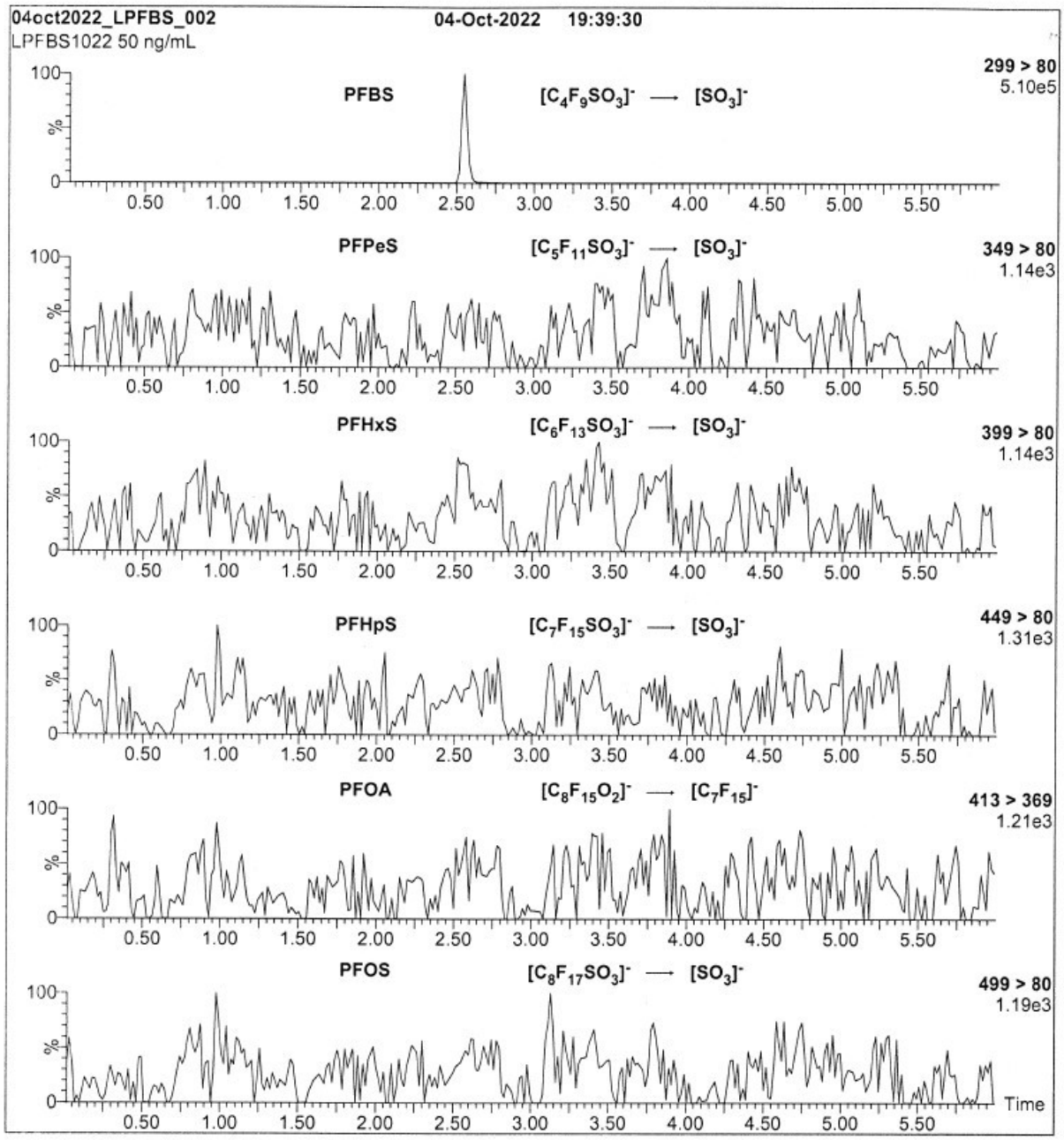
MS Parameters:

Experiment: Full Scan (150 - 850 amu)

Source: Electrospray (negative)
Capillary Voltage (kV) = 2.00
Cone Voltage (V) = 10.00
Desolvation Temperature (°C) = 500
Desolvation Gas Flow (L/hr) = 1000

Attachment 4 – Example CoA

Figure 2: **L-PFBS; LC/MS/MS Data (Selected MRM Transitions)**



Conditions for Figure 2:

Injection:	On-column (L-PFBS)
Mobile phase:	Same as Figure 1
Flow:	300 µL/min

MS Parameters:

Collision Gas (mbar) = 3.29e-3
Collision Energy (eV) = 30

Form#:27, Issued 2004-11-10
Revision#:9, Revised 2020-12-23

LPFBS1022 (4 of 4)
rev0

Attachment 05 - Native PFAS Intermediate A								
Vendor	Catalog Number	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume (mL) in MeOH	Final Conc. (ng/mL)
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000	0.100	10	500
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000	0.050		250
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000	0.050		250
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000	0.050		250
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000	0.050		250
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000	0.050		250
Wellington	PFDA	Perfluorodecanoic acid	335-76-2	PFDA	50000	0.050		250
Wellington	PFUdA	Perfluoroundecanoic acid	2058-94-8	PFUnA	50000	0.050		250
Wellington	MPFDOA	Perfluorododecanoic acid	307-55-1	PFDoA	50000	0.050		250
Wellington	PFTrDA	Perfluorotridecanoic acid	72629-94-8	PFTrDA	50000	0.050		250
Wellington	PFTeDA	Perfluorotetradecanoic acid	376-06-7	PFTeDA	50000	0.050		250
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200	0.050		221
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900	0.050		235
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500	0.050		228
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600	0.050		238
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600	0.050		233
Wellington	L-PFNS	Perfluorononanesulfonic acid	68259-12-1	PFNS	48000	0.050		240
Wellington	L-PFDS	Perfluorodecanesulfonic acid	335-77-3	PFDS	48200	0.050		241
Wellington	L-PFDoS	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	48400	0.050		242
Wellington	4;2 FTS	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	46700	0.100		467
Wellington	6;2 FTS	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	47400	0.100		474
Wellington	8;2 FTS	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	47900	0.100		479
Wellington	br-FOSA	Perfluorooctanesulfonamide	754-91-6	PFOSA	50000	0.050		250
Wellington	br-NMeFOSA	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	50000	0.050		250
Wellington	br-NEtFOSA	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	50000	0.050		250
Wellington	br-NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	50000	0.050		250
Wellington	br-NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	50000	0.050		250
Wellington	br-NMeFOSE	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	50000	0.250		1250
Wellington	br-NMeFOSE	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	50000	0.250		1250
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000	0.0375		187.5
Wellington	NaDONA	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	47100	0.050		236
Wellington	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	44500	0.050		223
Wellington	PF4OPeA	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	50000	0.050		250
Wellington	PF5OHxA	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	50000	0.050		250
Wellington	3,6-OPFHpA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	50000	0.050		250
Wellington	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	46600	0.050		233
Wellington	11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	47100	0.050		236
Wellington	FPrPA	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	50000	0.100		500
Wellington	FPePA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	50000	0.250		1250
Wellington	FHpPA	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	50000	0.250		1250
Wellington	PFECHS	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	46100	0.050		231
Wellington	FBSA-I	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	50000	0.050		250
Wellington	FHxSA-I	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	50000	0.050		250
Wellington	PFPrA	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	50000	0.250		1250
Wellington	PFODA	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	50000	0.050		250
AccuStandard	PFOS-030S	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	97900	0.0250		245

Confidential

Attachment 06 - Native PFAS Intermediate B							
Source Rgt Name	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume (mL) in MeOH	Final Conc. (ng/mL)
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.1	10	5
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			2.5
	Perfluorohexanoic acid	307-24-4	PFHxA	250			2.5
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			2.5
	Perfluorooctanoic acid	335-67-1	PFOA	250			2.5
	Perfluorononanoic acid	375-95-1	PFNA	250			2.5
	Perfluorodecanoic acid	335-76-2	PFDA	250			2.5
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			2.5
	Perfluorododecanoic acid	307-55-1	PFDoA	250			2.5
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			2.5
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			2.5
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			2.21
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			2.35
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			2.28
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			2.38
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			2.33
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			2.4
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			2.41
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			2.42
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			4.67
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			4.74
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			4.79
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			2.5
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			2.5
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			2.5
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			2.5
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			2.5
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			12.5
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			12.5
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			1.875
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			2.36
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			2.23
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			2.5
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			2.5
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			2.5
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			2.33
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			2.36
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			5
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			12.5
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			12.5
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			2.31
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			2.5
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			2.5
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			12.5
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			2.5
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			2.45

Confidential

Attachment 07 - Native PFAS CAL8 Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL) in MeOH**	**Final Conc. (ng/mL)**
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000	0.100	10	500
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000	0.050		250
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000	0.050		250
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000	0.050		250
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000	0.050		250
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000	0.050		250
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200	0.050		221
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900	0.050		235
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500	0.050		228
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600	0.050		238
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600	0.050		233
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000	0.0375		187.5

Confidential

Attachment 08 - 1633 EIS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL in MeOH)**	**Final Conc. (ng/mL)**
Wellington	MPFBA	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	50000	0.08	10	400
Wellington	M5PFPeA	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	50000	0.08		400
Wellington	M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	50000	0.08		400
Wellington	M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	50000	0.08		400
Wellington	M8PFOA	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	50000	0.08		400
Wellington	M9PFNA	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	50000	0.08		400
Wellington	M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	50000	0.08		400
Wellington	M7PFUdA	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	50000	0.08		400
Wellington	MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	50000	0.08		400
Wellington	M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	50000	0.08		400
Wellington	M3PFBS	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	46500	0.08		372
Wellington	M3PFHxS	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	47300	0.08		378
Wellington	M8PFOS	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	47800	0.08		382
Wellington	M8FOSA-I	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	50000	0.08		400
Wellington	d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	50000	0.2		1000
Wellington	d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	50000	0.2		1000
Wellington	M2-4;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	46700	0.2		934
Wellington	M2-6;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	47500	0.2		950
Wellington	M2-8;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	47900	0.2		958
Wellington	M3HFPO-DA	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	50000	0.08		400
Wellington	d7-N-MeFOSE-M	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	50000	0.2		1000
Wellington	d9-N-EtFOSE-M	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	50000	0.2		1000
Wellington	d-N-MeFOSA-M	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	50000	0.08		400
Wellington	d-N-EtFOSA-M	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	50000	0.08		400
Cambridge Isotope	CLM-11324-A-1.2	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	50000	0.08		400

Confidential

Attachment 09 - 1633 NIS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL) in MeOH**	**Final Conc. (ng/mL)**
Wellington	M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	50000	0.08	10	400
Wellington	MPFOA	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	50000	0.2		1000
Wellington	MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	50000	0.08		400
Wellington	MPFOS	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	47800	0.08		382.4
Wellington	MPFNA	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	50000	0.08		400
Wellington	MPFHxA	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	50000	0.2		1000
Wellington	MPFHxS	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	47300	0.08		378.4

Confidential

Attachment 10 - 1633 TOP SS Intermediate								
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL in MeOH)**	**Final Conc. (ng/mL)**
Wellington	M2PFOA	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	50000	0.025	10	125
Wellington	MPFUdA	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	50000	0.025		125
Wellington	M3PFPeA	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	50000	0.025		125

Confidential

Attachment 11 - 1633 Initial Calibration Standards Preparation								
Solution Name	**CAL1**	**CAL2**	**CAL3**	**CAL4**	**CAL5**	**CAL6**	**CAL7**	**CAL8**
Native PFAS CAL8 Intermediate (mL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0
Native PFAS Intermediate A (mL)	N/A	N/A	0.02	0.04	0.1	0.2	0.4	N/A
Native PFAS Intermediate B (mL)	0.2	0.5	N/A	N/A	N/A	N/A	N/A	N/A
1633 TOP SS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
1633 EIS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
1633 NIS Intermediate (mL)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Final Volume (mL)	10	10	10	10	10	10	10	10

Confidential

Attachment 12 - 1633 Initial Calibration Standard Concentrations								
	CAL1	CAL2	CAL3	CAL4	CAL5	CAL6	CAL7	CAL8
Analyte Name	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)	Conc. (ng/ml)
PFBA	0.100	0.250	1.00	2.00	5.00	10.0	20.0	100
PFPeA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFHxA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFHpA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFOA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFNA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	50.0
PFDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFUnA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFDoA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFTrDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFTeDA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFBS	0.044	0.111	0.442	0.884	2.21	4.42	8.84	44.2
PFPeS	0.047	0.117	0.469	0.938	2.35	4.69	9.38	46.9
PFHxS	0.046	0.114	0.455	0.910	2.28	4.55	9.10	45.5
PFHpS	0.048	0.119	0.476	0.952	2.38	4.76	9.52	47.6
PFOS	0.047	0.117	0.466	0.932	2.33	4.66	9.32	46.6
PFNS	0.048	0.120	0.480	0.960	2.40	4.80	9.60	N/A
PFDS	0.048	0.121	0.482	0.964	2.41	4.82	9.64	N/A
PFDoS	0.048	0.121	0.484	0.968	2.42	4.84	9.68	N/A
4:2-FTS	0.093	0.234	0.934	1.87	4.67	9.34	18.7	N/A
6:2-FTS	0.095	0.237	0.948	1.90	4.74	9.48	19.0	N/A
8:2-FTS	0.096	0.240	0.958	1.92	4.79	9.58	19.2	N/A
PFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMeFOSA / N-MePFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NEtFOSA / N-EtPFOSA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMeFOSAA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NEtFOSAA	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NMePFOSAE / NMeFOSE	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
NEtPFOSAE / NEtFOSE	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
HFPO-DA / GenX	0.038	0.094	0.38	0.750	1.88	3.75	7.50	37.5
ADONA	0.047	0.118	0.471	0.942	2.36	4.71	9.42	N/A
PFEESA / PES	0.045	0.111	0.445	0.890	2.23	4.45	8.90	N/A
PFMPA / PFECA F	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
PFMBA / PFECA A	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
NFDHA / PFECA B	0.050	0.125	0.50	1.00	2.50	5.00	10.0	N/A
9Cl-PF3ONS	0.047	0.117	0.466	0.93	2.33	4.66	9.32	N/A
11Cl-PF3OUdS	0.047	0.118	0.471	0.94	2.36	4.71	9.42	N/A
3:3 FTCA	0.100	0.250	1.00	2.00	5.00	10.0	20.0	N/A
5:3 FTCA	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
7:3 FTCA	0.250	0.625	2.50	5.00	12.5	25.0	50.0	N/A
PFECHS	0.046	0.116	0.462	0.92	2.31	4.62	9.24	N/A
FBSA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
FHxSA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
PFPrA / PPF Acid	0.250	0.625	2.500	5.00	12.5	25.0	50.0	N/A
PFODA	0.050	0.125	0.500	1.00	2.50	5.00	10.0	N/A
TFSI	0.049	0.122	0.490	0.98	2.45	4.90	9.79	N/A
$^{13}C_3$-PFPrA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFBA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFPeA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFHxA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFHpA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_9$-PFNA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_6$-PFDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_7$-PFUnA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFDoA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFTeDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFBS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFHxS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_8$-PFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_3-NMeFOSAA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_5-NEtFOSAA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-4:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-6:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-8:2FTS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_3$-HFPO-DA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_7-N-MeFOSE-M	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_9-N-EtFOSE-M	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
d_5-NEtPFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
d_3-NMePFOSA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_3$-PFBA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFOA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{13}C_2$-PFDA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_4$-PFOS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_5$-PFNA	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFHxA	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
$^{18}O_2$-PFHxS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
$^{13}C_2$-PFOA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625
$^{13}C_2$-PFUnA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625
$^{13}C_3$-PFPeA	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625

Confidential

Attachment 13 - Bile Salts Stock Solution							
Vendor	**Catalog Number**	**Analyte**	**CAS#**	**Acronym**	**Aliquot (g)**	**Final Volume (mL of MeOH)**	**Final Conc. (ng/mL)**
Sigma Aldrich	T0557-500MG	Taurodeoxycholic acid	516-50-7	TDCA	0.05	50	1000000
Sigma Aldrich	T6260-1G	Taurochenodeoxycholic acid	516-35-8	TCDCA	0.05		950000
Calbiochem	580549-1GM	Tauroursodeoxycholic acid	14605-22-2	TUDCA	0.05		1000000

Confidential

Attachment 14 - Bile Salts Intermediate							
Source Rgt Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL of MeOH)**	**Final Conc. (ng/mL)**
Bile Salts Stock Solution	Taurodeoxycholic acid	516-50-7	TDCA	1000000	1	4	250000
	Taurochenodeoxycholic acid	516-35-8	TCDCA	950000			237500
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	1000000			250000

Confidential

Attachment 15 - Bile Salts Working Solution							
Source Rgt Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL of MeOH)**	**Final Conc. (ng/mL)**
Bile Salts Intermediate	Taurodeoxycholic acid	516-50-7	TDCA	250000	0.1	5	5000
	Taurochenodeoxycholic acid	516-35-8	TCDCA	237500			4750
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	250000			5000

Confidential

Attachment 16 - 1633 Window-Defining Matrix Standard							
Source Rgt. Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume* (mL)**	**Final Conc. (ng/mL)**
Bile Salts Working Solution	Taurodeoxycholic acid	516-50-7	TDCA	5000	0.05	10	25
	Taurochenodeoxycholic acid	516-35-8	TCDCA	4750			23.8
	Tauroursodeoxycholic acid	14605-22-2	TUDCA	5000			25

Confidential

Attachment 17 - Native 1633 Mid-Level Spike							
Source Rgt. Name	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume (mL in MeOH)	Final Conc. (ng/mL)
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	4	10	200
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			100
	Perfluorohexanoic acid	307-24-4	PFHxA	250			100
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			100
	Perfluorooctanoic acid	335-67-1	PFOA	250			100
	Perfluorononanoic acid	375-95-1	PFNA	250			100
	Perfluorodecanoic acid	335-76-2	PFDA	250			100
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			100
	Perfluorododecanoic acid	307-55-1	PFDoA	250			100
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			100
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			100
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			88.4
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			93.8
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			91.0
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			95.2
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			93.2
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			96.0
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			96.4
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			96.8
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			187
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			190
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			192
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			100
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			100
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			100
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			100
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			100
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			500
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			500
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			75.0
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			94.2
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			89.0
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			100
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			100
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			100
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			93.2
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			94.2
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			200
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			500
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			500
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			92.2
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			100
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			100
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			500
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			100
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			97.9

Confidential

Attachment 18 - Native 1633 Low-Level Spike							
Source Rgt. Name	**Analyte**	**CAS#**	**Acronym**	**Conc. (ng/mL)**	**Aliquot (mL)**	**Final Volume (mL in MeOH)**	**Final Conc. (ng/mL)**
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.5	10	25.00
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			12.50
	Perfluorohexanoic acid	307-24-4	PFHxA	250			12.50
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			12.50
	Perfluorooctanoic acid	335-67-1	PFOA	250			12.50
	Perfluorononanoic acid	375-95-1	PFNA	250			12.50
	Perfluorodecanoic acid	335-76-2	PFDA	250			12.50
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			12.50
	Perfluorododecanoic acid	307-55-1	PFDoA	250			12.50
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			12.50
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			12.50
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			11.05
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			11.73
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			11.38
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			11.90
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			11.65
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			12.00
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			12.05
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			12.10
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			23.35
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			23.70
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			23.95
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			12.50
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			12.50
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			12.50
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			12.50
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			12.50
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			62.50
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			62.50
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			9.38
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	235.5			11.78
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			11.13
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			12.50
	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	250			12.50
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			12.50
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			11.65
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	235.5			11.78
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			25.00
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			62.50
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			62.50
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	230.5			11.53
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			12.50
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			12.50
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			62.50
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			12.50
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	244.75			12.24

Confidential

Attachment 19 - 1633 ICV Working Standard							
Source Rgt. Name	Analyte	CAS#	Acronym	Conc. (ng/mL)	Aliquot (mL)	Final Volume (mL	Final Conc. (ng/mL)
Native PFAS Intermediate A	Perfluorobutanoic acid	375-22-4	PFBA	500	0.050	10	2.50
	Perfluoropentanoic acid	2706-90-3	PFPeA	250			1.25
	Perfluorohexanoic acid	307-24-4	PFHxA	250			1.25
	Perfluoroheptanoic acid	375-85-9	PFHpA	250			1.25
	Perfluorooctanoic acid	335-67-1	PFOA	250			1.25
	Perfluorononanoic acid	375-95-1	PFNA	250			1.25
	Perfluorodecanoic acid	335-76-2	PFDA	250			1.25
	Perfluoroundecanoic acid	2058-94-8	PFUnA	250			1.25
	Perfluorododecanoic acid	307-55-1	PFDoA	250			1.25
	Perfluorotridecanoic acid	72629-94-8	PFTrDA	250			1.25
	Perfluorotetradecanoic acid	376-06-7	PFTeDA	250			1.25
	Perfluorobutanesulfonic acid	375-73-5	PFBS	221			1.105
	Perfluoropentansulfonic acid	2706-91-4	PFPeS	235			1.173
	Perfluorohexanesulfonic acid	355-46-4	PFHxS	228			1.138
	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	238			1.190
	Perfluorooctanesulfonic acid	1763-23-1	PFOS	233			1.165
	Perfluorononanesulfonic acid	68259-12-1	PFNS	240			1.200
	Perfluorodecanesulfonic acid	335-77-3	PFDS	241			1.205
	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	242			1.210
	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	467			2.34
	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	474			2.37
	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	479			2.40
	Perfluorooctanesulfonamide	754-91-6	PFOSA	250			1.25
	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	250			1.25
	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	250			1.25
	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	250			1.25
	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	250			1.25
	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	1250			6.25
	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	1250			6.25
	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	187.5			0.938
	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	236			1.178
	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	223			1.113
	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	250			1.25
	Perfluoro-4-methoxybutanoic acid	863090-89-6	PFMBA / PFECA A	250			1.25
	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	250			1.25
	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	233			1.165
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	236			1.178
	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	500			2.50
	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	1250			6.25
	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	1250			6.25
	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	231			1.153
	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	250			1.25
	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	250			1.25
	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	1250			6.25
	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	250			1.25
	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	245			1.224
1633 TOP SS Intermediate	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	125	0.050		0.625
	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	125			0.625
	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	125			0.625
1633 EIS Intermediate	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	400	0.050		2.00
	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	400			2.00
	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	400			2.00
	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	400			2.00
	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	400			2.00
	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	400			2.00
	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	400			2.00
	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	400			2.00
	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	400			2.00
	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	400			2.00
	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	372			1.86
	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	378			1.89
	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	382			1.91
	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	400			2.00
	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	1000			5.00
	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	1000			5.00
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	934			4.67
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	950			4.75
	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	958			4.79
	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	400			2.00
	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	1000			5.00
	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	1000			5.00
	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	400			2.00
	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	400			2.00
	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	400			2.00
1633 NIS Intermediate	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	400	0.050		2.00
	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	1000			5.00
	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	400			2.00
	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	382			1.91
	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	400			2.00
	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	1000			5.00
	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	378			1.89

Confidential

Attachment 20 - Purchased Standards					
Vendor	Cat. No.	Analyte	CAS#	Acronym	Conc. (ng/ml)
Wellington	PFBA	Perfluorobutanoic acid	375-22-4	PFBA	50000
Wellington	PFPeA	Perfluoropentanoic acid	2706-90-3	PFPeA	50000
Wellington	PFHxA	Perfluorohexanoic acid	307-24-4	PFHxA	50000
Wellington	PFHpA	Perfluoroheptanoic acid	375-85-9	PFHpA	50000
Wellington	br-PFOA	Perfluorooctanoic acid	335-67-1	PFOA	50000
Wellington	br-PFNA	Perfluorononanoic acid	375-95-1	PFNA	50000
Wellington	PFDA	Perfluorodecanoic acid	335-76-2	PFDA	50000
Wellington	PFUdA	Perfluoroundecanoic acid	2058-94-8	PFUnA	50000
Wellington	MPFDOA	Perfluorododecanoic acid	307-55-1	PFDoA	50000
Wellington	PFTrDA	Perfluorotridecanoic acid	72629-94-8	PFTrDA	50000
Wellington	PFTeDA	Perfluorotetradecanoic acid	376-06-7	PFTeDA	50000
Wellington	L-PFBS	Perfluorobutanesulfonic acid	375-73-5	PFBS	44200
Wellington	L-PFPeS	Perfluoropentansulfonic acid	2706-91-4	PFPeS	46900
Wellington	br-PFHxSK	Perfluorohexanesulfonic acid	355-46-4	PFHxS	45500
Wellington	L-PFHpS	Perfluoroheptanesulfonic acid	375-92-8	PFHpS	47600
Wellington	br-PFOSK	Perfluorooctanesulfonic acid	1763-23-1	PFOS	46600
Wellington	L-PFNS	Perfluorononanesulfonic acid	68259-12-1	PFNS	48000
Wellington	L-PFDS	Perfluorodecanesulfonic acid	335-77-3	PFDS	48200
Wellington	L-PFDoS	Perfluorododecanesulfonic acid	79780-39-5	PFDoS	48400
Wellington	4;2 FTS	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	757124-72-4	4:2-FTS	46700
Wellington	6;2 FTS	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	27619-97-2	6:2-FTS	47400
Wellington	8;2 FTS	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	39108-34-4	8:2-FTS	47900
Wellington	br-FOSA	Perfluorooctanesulfonamide	754-91-6	PFOSA	50000
Wellington	br-NMeFOSA	N-methyl perfluorooctanesulfonamide	31506-32-8	NMeFOSA / N-MePFOSA	50000
Wellington	br-NEtFOSA	N-ethyl perfluorooctanesulfonamide	4151-50-2	NEtFOSA / N-EtPFOSA	50000
Wellington	br-NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	NMeFOSAA	50000
Wellington	br-NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	NEtFOSAA	50000
Wellington	br-NMeFOSE	N-methyl perfluorooctanesulfonamidoethanol	24448-09-7	NMePFOSAE / NMeFOSE	50000
Wellington	br-NEtFOSE	N-ethyl perfluorooctanesulfonamidoethanol	1691-99-2	NEtPFOSAE / NEtFOSE	50000
Wellington	HFPO-DA	Hexafluoropropylene oxide dimer acid	13252-13-6	HFPO-DA / GenX	50000
Wellington	NaDONA	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	ADONA	47100
Wellington	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	PFEESA / PES	44500
Wellington	PF4OPeA	Perfluoro-3-methoxypropanoic acid	377-73-1	PFMPA / PFECA F	50000
Wellington	PF5OHxA	Perfluoro-4-methoxybutanoic acid	863090-89-5	PFMBA / PFECA A	50000
Wellington	3,6-OPFHpA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6	NFDHA / PFECA B	50000
Wellington	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	9Cl-PF3ONS	46600
Wellington	11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	11Cl-PF3OUdS	47100
Wellington	FPrPA	3-Perfluoropropyl propanoic acid	356-02-5	3:3 FTCA	50000
Wellington	FPePA	2H,2H,3H,3H-Perfluorooctanoic acid	914637-49-3	5:3 FTCA	50000
Wellington	FHpPA	3-Perfluoroheptyl propanoic acid	812-70-4	7:3 FTCA	50000
Wellington	PFECHS	Perfluoro-4-ethylcyclohexanesulfonate	335-24-0	PFECHS	46100
Wellington	FBSA-I	Perfluoro-1-butanesulfonamide	30334-69-1	FBSA	50000
Wellington	FHxSA-I	Perlfuoro-1-hexanesulfonamide	41997-13-1	FHxSA	50000
Wellington	PFPrA	Perfluoropropanoic acid	422-64-0	PFPrA / PPF Acid	50000
Wellington	PFODA	Perfluoro-n-octadecanoic acid	16517-11-6	PFODA	50000
AccuStandard	PFOS-030S	Bis(trifluoromethylsulfonyl)amine	82113-65-3	TFSI	97900
Wellington	MPFBA	Perfluoro-n-[13C4]butanoic acid	STL00992	$^{13}C_4$-PFBA	50000
Wellington	M5PFPeA	Perfluoro-n-[13C5]pentanoic acid	STL01893	$^{13}C_5$-PFPeA	50000
Wellington	M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	STL02577	$^{13}C_5$-PFHxA	50000
Wellington	M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	STL01892	$^{13}C_4$-PFHpA	50000
Wellington	M8PFOA	Perfluoro-n-[13C8]octanoic acid	STL01052	$^{13}C_8$-PFOA	50000
Wellington	M9PFNA	Perfluoro-n-[13C9]nonanoic acid	STL02578	$^{13}C_9$-PFNA	50000
Wellington	M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	STL02579	$^{13}C_6$-PFDA	50000
Wellington	M7PFUdA	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	STL02580	$^{13}C_7$-PFUnA	50000
Wellington	MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid	STL00998	$^{13}C_2$-PFDoA	50000
Wellington	M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid	STL02116	$^{13}C_2$-PFTeDA	50000
Wellington	M3PFBS	Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	STL02337	$^{13}C_3$-PFBS	46500
Wellington	M3PFHxS	Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	STL02581	$^{13}C_3$-PFHxS	47300
Wellington	M8PFOS	Perfluoro-1-[13C8]octanesulfonic acid	STL01054	$^{13}C_8$-PFOS	47800
Wellington	M8FOSA-I	Perfluoro-1-[13C8]octanesulfonamide	STL01056	$^{13}C_8$-PFOSA	50000
Wellington	d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	STL02118	d_3-NMeFOSAA	50000
Wellington	d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	STL02117	d_5-NEtFOSAA	50000
Wellington	M2-4;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	STL02395	$^{13}C_2$-4:2FTS	46700
Wellington	M2-6;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	STL02279	$^{13}C_2$-6:2FTS	47500
Wellington	M2-8;2FTS	1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	STL02280	$^{13}C_2$-8:2FTS	47900
Wellington	M3HFPO-DA	Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	STL02255	$^{13}C_3$-HFPO-DA	50000
Wellington	d7-N-MeFOSE-M	N-methyl-d7-perfluorooctanesulfonamidoethanol	STL02277	d_7-N-MeFOSE-M	50000
Wellington	d9-N-EtFOSE-M	N-ethyl-d9-perfluorooctanesulfonamidoethanol	STL02278	d_9-N-EtFOSE-M	50000
Wellington	d-N-MeFOSA-M	N-ethyl-d5-perfluoro-1-octanesulfonamide	STL02704	d_5-NEtPFOSA	50000
Wellington	d-N-EtFOSA-M	N-methyl-d3-perfluoro-1-octanesulfonamide	STL02705	d_3-NMePFOSA	50000
Cambridge Isotope	CLM-11324-A-1.2	Perfluoropropanoic acid (PFPrA) ($^{13}C_3$)	STL03194	$^{13}C_3$-PFPrA	50000
Wellington	M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid	STL02680	$^{13}C_3$-PFBA	50000
Wellington	MPFOA	Perfluoro-n-[1,2,3,4-13C4]octanoic acid	STL00990	$^{13}C_4$-PFOA	50000
Wellington	MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid	STL00996	$^{13}C_2$-PFDA	50000
Wellington	MPFOS	Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	STL00991	$^{13}C_4$-PFOS	47800
Wellington	MPFNA	Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	STL00995	$^{13}C_5$-PFNA	50000
Wellington	MPFHxA	Perfluoro-n-[1,2-13C2]hexanoic acid	STL00993	$^{13}C_2$-PFHxA	50000
Wellington	MPFHxS	Perfluoro-1-hexane[18O2]sulfonic acid	STL00994	$^{18}O_2$-PFHxS	47300
Wellington	M2PFOA	Perfluoro-n-(1,2-13C2)octanoic acid	STL00623	$^{13}C_2$-PFOA	50000
Wellington	MPFUdA	Perfluoro-n-(1,2-13C2)undecanoic acid	STL00997	$^{13}C_2$-PFUnA	50000
Wellington	M3PFPeA	Perfluoro-n-(3,4,5-13C3)pentanoic acid	STL03269	$^{13}C_3$-PFPeA	50000
Sigma Aldrich	T0557-500MG	Taurodeoxycholic acid	516-50-7	TDCA	neat
Sigma Aldrich	T6260-1G	Taurochenodeoxycholic acid	516-35-8	TCDCA	neat
Calbiochem	580549-1GM	Tauroursodeoxycholic acid	14605-22-2	TUDCA	neat

Confidential

Table 5. IPR/OPR/LLOPR Acceptance Limits for Target Analytes in Aqueous Matrices[1]

Target Analyte	IPR[2]		OPR/LLOPR Recovery (%)[2]
	Mean Recovery (%)	RSD (%)	
PFBA	70 - 135	21	70 - 140
PFPeA	70 - 135	23	65 - 135
PFHxA	70 - 135	24	70 - 145
PFHpA	70 - 135	28	70 - 150
PFOA	65 - 155	27	70 - 150
PFNA	70 - 140	28	70 - 150
PFDA	65 - 140	26	70 - 140
PFUnA	70 - 135	29	70 - 145
PFDoA	70 - 130	21	70 - 140
PFTrDA	60 - 145	29	65 - 140
PFTeDA	70 - 145	27	60 - 140
PFBS	70 - 140	23	60 - 145
PFPeS	70 - 135	25	65 - 140
PFHxS	70 - 135	27	65 - 145
PFHpS	70 - 140	30	70 - 150
PFOS	70 - 140	29	55 - 150
PFNS	70 - 135	29	65 - 145
PFDS	70 - 135	30	60 - 145
PFDoS	45 - 135	35	50 - 145
4:2FTS	70 - 135	27	70 - 145
6:2FTS	70 - 135	32	65 - 155
8:2FTS	70 - 140	33	60 - 150
PFOSA	70 - 135	22	70 - 145
NMeFOSA	70 - 135	30	60 - 150
NEtFOSA	70 - 130	26	65 - 145
NMeFOSAA	65 - 140	32	50 - 140
NEtFOSAA	70 - 135	28	70 - 145
NMeFOSE	70 - 135	29	70 - 145
NEtFOSE	70 - 130	21	70 - 135
HFPO-DA	70 - 135	23	70 - 140
ADONA	70 - 135	23	65 - 145
PFMPA	60 - 140	23	55 - 140
PFMBA	65 - 145	27	60 - 150
NFDHA	65 - 140	37	50 - 150
9Cl-PF3ONS	70 - 145	30	70 - 155
11Cl-PF3OUdS	50 - 150	35	55 - 160
PFEESA	70 - 135	25	70 - 140
3:3FTCA	70 - 130	23	65 - 130
5:3FTCA	70 - 130	24	70 - 135
7:3FTCA	55 - 130	34	50 - 145

[1] Limits apply to the IPR, OPR, and LLOPR analyses associated with all aqueous matrices, including wastewater, surface water, groundwater, and landfill leachates.

[2] The recovery and RSD limits apply to the target analyte results for IPR, OPR, and LLOPR samples associated with all aqueous matrices. Data were derived from the multi-laboratory validation study and are therefore the limits required for this method.

Attachment "" to "US Eurofins US Lancaster Laboratories Environmental - Aqueous PFAS Prep by SPE and Analysis by LC-MS-MS by EPA 1633 and EPA 1633A" Page 50 of 51
Printed by Lisa Cooke, d. Thu 20 Mar 2025 15:47 EDT

Table 6. Acceptance Limits for EIS and NIS Compounds in All Aqueous Matrices and Associated QC Samples		
	Aqueous Matrices Other Than Leachates[2]	Landfill Leachates[3]
EIS Compound[1]	Recovery (%)	Recovery (%)
$^{13}C_4$-PFBA	5[4] - 130	5[4] - 130
$^{13}C_5$-PFPeA	40 - 130	40 - 130
$^{13}C_5$-PFHxA	40 - 130	40 - 130
$^{13}C_4$-PFHpA	40 - 130	40 - 130
$^{13}C_8$-PFOA	40 - 130	40 - 130
$^{13}C_9$-PFNA	40 - 130	40 - 130
$^{13}C_6$-PFDA	40 - 130	40 - 130
$^{13}C_7$-PFUnA	30 - 130	40 - 130
$^{13}C_2$-PFDoA	10 - 130	35 – 130
$^{13}C_2$-PFTeDA	10 - 130	25 – 130
$^{13}C_3$-PFBS	40 - 135	40 - 130
$^{13}C_3$-PFHxS	40 - 130	40 - 130
$^{13}C_8$-PFOS	40 - 130	40 - 130
$^{13}C_2$-4:2FTS	40 - 200	40 – 220
$^{13}C_2$-6:2FTS	40 - 200	40 – 170
$^{13}C_2$-8:2FTS	40 - 300	40 – 145
$^{13}C_8$-PFOSA	40 - 130	40 – 130
D_3-NMeFOSA	10 - 130	40 – 130
D_5-NEtFOSA	10 - 130	35 - 130
D_3-NMeFOSAA	40 - 170	35 - 130
D_5-NEtFOSAA	25 - 135	30 - 130
D_7-NMeFOSE	10 - 130	20 - 130
D_9-NEtFOSE	10 - 130	20 - 130
$^{13}C_3$-HFPO-DA	40 - 130	40 - 130
$^{13}C_3$-PFBA	50 - 200	50 - 200
$^{13}C_2$-PFHxA		
$^{13}C_4$-PFOA		
$^{13}C_5$-PFNA		
$^{13}C_2$-PFDA		
$^{18}O_2$-PFHxS		
$^{13}C_4$-PFOS		

[1] The recovery limits for the EIS compounds were derived by EPA from the data from multi-laboratory validation study. To simplify laboratory operations, EPA has applied the same EIS recovery limits used for field sample analyses to the EIS recoveries in the method blank, IPR, OPR, and LLOPR samples. There are no IPR mean or RSD criteria for the EIS compounds.

[2] Limits apply to the EIS and NIS recoveries from samples of aqueous matrices, including wastewater, surface water, and groundwater, but **not** landfill leachates.

[3] Limits apply to the EIS and NIS recoveries from samples of landfill leachates, **not** other aqueous matrices.

[4] Recovery of $^{13}C_4$-PFBA can be problematic in some field samples. Although the lower limit for recovery for this EIS is set below 10%, laboratories should routinely track recovery of this EIS and take reasonable steps to ensure that recovery is at least 10% in the majority of samples.

Management

Diane Waldschmidt
Principal Consulting Chemist
dwaldschmidt@eds-us.net

Professional Experience:

Ms. Waldschmidt has over 28 years of field and analytical quality assurance experience, and is responsible for the management of Environmental Data Services' projects and staff. Ms. Waldschmidt is knowledgeable in organic and inorganic analytical methodologies, and data validation (including high resolution mass spectrometry and radiological analyses). She has validated and/or overseen validation of data analyzed according to USEPA SW-846 (RCRA), and USEPA Contract Laboratory Program (CERCLA) requirements as well as remediation support analyses inclusive of specialty analyses, such as air monitoring and radiological data collection used in sediment core dating.

Ms. Waldschmidt also has extensive experience in performing various types of audits including audits of commercial environmental laboratories; internal industrial laboratories; and field sampling activities. Ms. Waldschmidt is also knowledgeable and experienced in the preparation of analytical standard operating procedures, field sample collection standard operating procedures, Quality Assurance Project Plans, and Performance Evaluation (PE) Studies.

Education:

Ms Waldschmidt holds a Bachelor of Science in Chemistry.

© 2013 Environmental Data Services, Ltd.

Appendix C Environmental Data Services (EDS) Resume

Appendix D Health and Safety Plan (HASP) & Community Air Monitoring Plan (CAMP)



GEI Safety
EVERYONE LIVE SAFE EVERYDAY

GEI Consultants

Consulting
Engineers and
Scientists

Health and Safety Plan

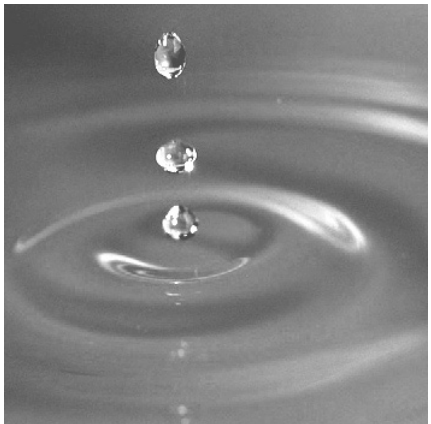
600 Food Center Drive (BCP Site No. C203104)
Bronx, New York 10474

New York City Economic Development Corporation
One Liberty Street
New York, NY 10006

Prepared by:
GEI Consultants, Inc.
530 7th Avenue, Suite 2007
New York, NY 10018
(212) 678-8282

February 2026

Project No. 2303564



Kevin P. McCarty
Senior Project Manager

Stacey Ng, P.G.
Regional Safety Manager

Table of Contents

1. Emergency Contact Information 1

2. GEI Safety Practices to Live By 2

3. Site Background 3
3.1 Site Description 3
3.2 Scope of Field Work 4

4. Potential Hazards 5
4.1 General Site Hazards 5
4.1.1 Hazard Controls 8
4.1.2 Personal Safety 8
4.1.3 Vehicle Safety 9
4.1.4 Communicable Diseases 9
4.2 Job Hazard Analysis 10
4.3 Heat and Cold Stress 11
4.3.1 Heat Stress 11
4.3.2 Cold Stress 11
4.4 Constituents of Concern 11
4.4.1 Site-Specific COC 12
4.4.2 Chemicals Brought on Site 17

5. Personal Protective Equipment 18
5.1 Respiratory PPE 18

6. Responsibilities and Lines of Authority 19
6.1 GEI Personnel Responsibilities 19
6.1.1 GEI Safety Director 19
6.1.2 GEI Project Manager 19
6.1.3 GEI Regional Safety Manager 19
6.1.4 GEI Site Safety Manager 20
6.1.5 All GEI Field Personnel 20
6.2 Lines of Authority 20
6.2.1 Stop Work Authority 21
6.3 Subcontractors 21

7. Training Requirements 23
7.1 On-Site Safety Briefings 23

8. Medical Surveillance Program 24

9. Personal/Work Zone Air Monitoring 25

9.1 Calibration 25
9.2 Action Levels 25
9.2.1 VOC Monitoring and Control 26
9.2.2 Dust Monitoring and Control 26
9.2.3 H_2S, CO, and Explosive Atmosphere Monitoring and Control 27

10. Site Control 29
10.1 Site Zones 29
10.2 Buddy System 29
10.3 Sanitation for Temporary Work Sites 29
10.4 Illumination 29
10.5 Smoking 29
10.6 Alcohol and Drug Abuse Prevention 29

11. Incident Reporting 31
11.1 Injury Triage Service 31

12. Decontamination Procedures 32
12.1 Personnel and PPE Decontamination 32
12.2 Equipment Decontamination 32

13. Emergency Response 33
13.1 Evacuation 33
13.2 Fire 33
13.3 Spills or Material Release 33
13.4 Medical Support 34
13.5 Severe Weather 34
13.6 Hazard Communication Plan 34

14. Health and Safety Plan Sign-Off 35

Tables
1. Emergency Contact Information
2. GEI Employee Site Tasks and Descriptions
3. General Site Hazards
4. Primary Constituents of Concern Data

Figure
1. Site Location and Muster Point

Appendices
A. Map to Hospital and Occupational Health Clinic
B. Job Hazard Analyses
C. Safety Data Sheets

D. Forms
E. GEI Health and Safety SOPs and Programs
F. Community Air Monitoring Plan (CAMP)

1. Emergency Contact Information

Table 1. Emergency Contact Information

Site Information	
Project Name:	600 Food Center Drive/Sultana (BCP Site No. C203104)
Project Address:	600 Food Center Drive, Bronx, New York, 10474
Project Number:	2303564
Important Phone Numbers	
Emergency (Police/Fire/Medical):	911
Local Police:	911
Fire Department:	911
Con Edison:	(800) 752-6633
Hospital and Occupational Clinic Information *(See Attached Map and Directions in Appendix A)*	
Lincoln Medical Center: 234 E 149th St Bronx, NY 10451	(718) 579-5000
Urgent Care/Occupational Health Clinic: Contact Medcor Triage	Call Medcor Triage 1-800-775-5866
Contacts	
Project Manager: Kevin McCarty	(212) 845-9965 office (917) 510-5147 cell
Safety Director: Steve Hawkins	(860) 368-5348 office (860) 916-4167 cell
Regional Safety Manager: Stacey Ng	(212) 671-1592 office (347) 514-3861 cell
Site Safety Manager: Savanna Marino	(212) 227-3200 office (347) 933-4028 cell
Medcor Triage	1-800-775-5866
Client Contact: Rasheed Lucas	(212) 312-4226 office rlucas@edc.nyc
Other Information	
Contractor Requesting/Performing Utility Clearance: TBD	Utility Clearance Ticket Number: TBD

2. GEI Safety Practices to Live By

Safety is what we do and how we do it every day. These Everyday Practices to Live Safe are simple yet concise reminders to our employees, clients, contractors, visitors of the steps that must be taken to avoid injury, illness, and incident so everyone can live safe every day. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program along with these safety practices.

1. Stop work if it is unsafe to continue, after any incident, injury, or near miss.

2. Prepare before starting work. Complete safety training and project-related safety requirements, such as preparation and review Health and Safety Plans (HASPs) as required by project or job-related duties.

3. Assess and control safety hazards/risks before starting any tasks and when previously unidentified safety hazards are observed.

4. Be attentive and aware of your environment. Constant focus and awareness will avoid complacency.

5. Properly use and maintain GEI-approved and required personal protective equipment (PPE) in all appropriate circumstances.

6. Do not work or drive impaired, including under the influence of alcohol/drugs or while fatigued.

7. Follow all safety practices when operating a vehicle. Always wear your seatbelt while in any vehicle. Do not drive distracted, including using hand-held cell phones, when operating any vehicle.

8. Use tools, equipment, and safety devices in accordance with manufacturers recommendations and GEI expectations. Never modify or override safety devices.

9. When activities involve chemicals or hazardous substances, follow GEI's hazard communication requirements, including labeling, reviewing Safety Data Sheets (SDS), and keeping proper protections in place.

10. Be aware of and keep clear of equipment moving in all work areas, at all times.

11. Follow GEI's incident reporting procedure in the event of safety incidents, including injuries, illness, near misses, or observation of unsafe behaviors.

3. Site Background

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI Consultants, Inc. (GEI) personnel from the potential hazards posed by the activities at the New York City Economic Development Corporation (NYCEDC) 600 Food Center Drive (FCD) property (site) in the Bronx, New York (Figure 1). Reading, understanding, and compliance with the contents of the HASP is required for on-site GEI personnel and will be reviewed by GEI subcontractors. Subcontractors will prepare their own site-specific HASP but may use this HASP as a guide. This HASP identifies measures to minimize accidents and injuries which may result from site conditions or activities. A copy of this HASP will be maintained on site for the duration of the work.

3.1 Site Description

The 600 FCD parcel is located in a commercial and industrial area of the Hunts Point section of the borough of the Bronx. The Site is an approximate 9.6-acre lot contained within a portion of a larger tax lot identified as New York City Tax Map Block 2781, Lot 500. The Site is currently paved, developed, and occupied by a single multiple distribution warehouse constructed in the 1970's.

The Site was historically part of a Manufactured Gas Plant (MGP) operated by Consolidated Edison Company of New York, Inc. (Con Edison) during the first half of the 20th century until its demolition in the 1960's. Gas operations included a coke/oven gas plant, a carbureted water gas plant, a light oil plant, and a liquid petroleum production area. In total, approximately 46 buildings or structures existed on the former Con Edison MGP facility that were actively involved in gas production. The MGP facility covered the entire Hunts Point peninsula area to the south of the current Hunts Point Produce Market and east of Halleck Street, known as the Hunts Point Food Distribution Center (HPFDC).

The site is bounded to the north by the Anheuser-Busch distribution facility (former Voluntary Cleanup Program [VCP] Parcel C; VCP Site No. V00412), to the east by the Bronx River, to the west by the Railroad Right-of-Way parcel (RR ROW; BCP Site No. C203104), Food Center Drive (former VCP Perimeter Site; VCP Site No. V00641), and the Hunts Point Cooperative Market (355 Food Center Drive; BCP Site No. 203099), and to the south by Farragut Street and the Hunts Point Landing park (included within the RR ROW BCP site) immediately followed by the New York City Department of Sanitation (DSNY) Marine Transfer Station (MTS) (currently listed as an "Active" site on the NYSDEC Environmental Site Remediation Database [BCP Site No. C203115], however it is understood that this Site has been removed from the BCP) and Fulton Fish Market Cooperative (former VCP Parcel B; VCP Site No. V00436).

This property is owned by New York City Small Business Services (NYCSBS) and managed by NYCEDC. The Site is relatively level, developed and occupied by a distribution warehouse leased from the NYCSBS by Sultana Distribution Services, Inc. (Sultana). The Site is zoned as M3-1 (Manufacturing).

3.2 Scope of Field Work

The goal of the Site investigation is to identify and characterize potential soil, groundwater, and soil vapor impacts in the subsurface, present within the 600 FCD property from former MGP operations. Proposed investigation activities at the Site include installing soil borings, groundwater wells, and soil vapor points to allow the collection of respective samples. Soil borings, soil vapor points, and groundwater monitoring wells will be installed by a subcontractor under their own HASP. Air monitoring will be performed during all ground intrusive and dust-generating activities, as described in the Community Air Monitoring Plan (CAMP) included in Appendix F.

Table 2. GEI Employee Site Tasks and Descriptions

Task Number	Task Titles	Task Descriptions
1.	Driving – Site Mobilization	Mobilize to Site. Park onsite and/or along roadside as needed
2.	Site Surveying	Perform site walk; collect GPS points
3.	Oversee GPR/Utility Mark-out	Mark-out boring locations; oversee GPR contractor
4.	Perimeter Air Monitoring	Mobilize air monitoring equipment. Perform air monitoring for dust, VOCs, and H_2S via CAMP tripod stations. Perform colorimetric tube monitoring.
5.	Drilling Oversight	Oversee drilling subcontractor (soil boring, monitoring well, and soil vapor point installation, and site cover restoration)
6.	Soil Sampling – Drill Rig	Oversee drilling operations as performed by a subcontractor, perform soil classification, and collect soil samples
7.	Groundwater Sampling	Gauge groundwater levels and collect samples from permanent monitoring wells
8.	Soil Vapor Sampling	Collect samples from soil vapor points via Summa canisters.

Notes:
Task Titles correlate to a prepared site-specific JHAs.
Task Descriptions are a brief summary of the task being performed by GEI.

4. Potential Hazards

The potential hazards associated with site conditions and activity hazards related to GEI on-site activities have been identified in this section. Detailed information for these hazards and their control methods are discussed further in the Table 3 and the job hazard analysis (JHAs) included in Appendix B.

4.1 General Site Hazards

General hazards and control measures that are applicable to all site activities have been identified in Table 3.

Table 3. General Site Hazards

General Hazards These Hazards Apply to All Site Activities	Control Measure
Cell Phone Use - On Project Site	• Look and listen for potential hazards while using a cell phone for work related activities. • Limit your cell phone use for personal calls or other activities to non-working hours in areas free of hazards. • Do not use your cell phone when safety hazards are present. • Do not use headphones or ear buds while performing work related activities. Headphone or ear bud use can prevent you from hearing hazards around you. • Noise canceling headphones or earbuds are not to be used in place of hearing protection. • Never use a cell phone while operating any equipment or vehicle. • Consider using the "do not disturb" or "silent" functions to allow you to focus on your task.
Cold Stress – Hypothermia, Frostbite	• Take breaks in heated shelters when working in extremely cold temperatures. • Drink warm liquids to reduce the susceptibility to cold stress. • Wear protective clothing (recommended three layers: an outside layer to break the wind, a middle layer to provide insulation, and an inner layer of cotton of synthetic weave to allow ventilation). • Wear a hat and insulated boots. • Keep a change of dry clothing available in case clothes become wet. • Do heavy work during the warmer parts of the day and take breaks from the cold. • If possible, shield work areas from drafts of wind and use insulating material on equipment handles when temperatures are below 30°F • Watch for symptoms of cold stress and initiate first aid procedures (Section 4.3.2).

General Hazards These Hazards Apply to All Site Activities	Control Measure
Heat stress – Fainting, Fatigue, Heat Stroke	• Increase water intake while working. • Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. • Watch for signs and symptoms of heat exhaustion and fatigue. Plan work for early morning or evening during hot months. Use ice vests when necessary. • Watch for symptoms of heat stress and initiate first aid procedures (Section 4.3.1).
Heavy Equipment – Working Near Struck-by, caught-in-between equipment, crushing, pinch points	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or (electrical hazard) EH-rated safety boots with composite toe and shank; safety glasses; nitrile/neoprene gloves; and earplugs. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Wear a high-visibility, reflective vest when working near equipment or motor vehicle traffic. • Position yourself in a safe location when filling out logs or talking with the contractor. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation. • See SOP HS-018
Inclement Weather	• Listen to local forecasts for warnings about specific weather hazards such as tornados, thunderstorms, and flash floods. • If storms produce thunder and/or lightning, leave the work area immediately and move to a safe area. • Discuss an action plan prior to the severe weather. • Wear appropriate PPE for the type of weather that could be encountered. • Stop work until conditions are suitable. Take cover in vehicles or shelter as appropriate. • See SOP HS-010

General Hazards These Hazards Apply to All Site Activities	Control Measure
Insects – Bites, Stings, Allergic Reactions	• Apply insect repellent prior to performing field work and as often as needed throughout the work shift. • Wear proper protective clothing (work boots, socks, and light-colored clothing) • Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for extended periods of time, or when many insects are most active (between dawn and dusk). • When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible • Field personnel who may have insect allergies will have allergy medication on site and will provide this information to the SSM prior to commencing work. • Field personnel will perform a self-check at the end of the day for ticks. • See SOP HS-001
Physical Injury – Slips, Trips and Falls	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Maintain weed growth in sampling areas, especially on slopes. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed.
Repetitive Motion Injury - Standing, Squatting, and Bending Over	• Take regular breaks and do not work in unusual positions for extended periods of time. • Walk and stretch between tasks. • See SOP HS-025
Unsecured or High Crime Areas	• Be aware of your surroundings. • Use the buddy system. Do not remain on site alone. Accompany or be accompanied by others to vehicles. • Request police detail when appropriate. • Let the SSM know when you begin work in these areas and when you leave. • Call in regularly. • If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly but safely.

General Hazards These Hazards Apply to All Site Activities	Control Measure
Vehicular Traffic – Struck by injury, crushing	• Increase visibility of the work area to others by using cones, flags, barricades, proper lighting, and caution tape to define work area. • Use a "spotter" to locate oncoming vehicles. • Use vehicle to block work area. • Engage police detail for all work conducted in appropriate areas. • Wear high-visibility, reflective vest at all times. • Maintain minimum DOT defined distances to other traffic lanes. • See SOP HS-016.

4.1.1 Hazard Controls

On-site safety equipment to control the hazards listed above will include:

Site-Specific Safety Equipment *(check all that apply)*		
☒ Drinking water/electrolyte fluids	☒ Hand cleaner/sanitizer	☐ Tick removal kit
☒ Eye wash bottles	☒ Insect repellent	☐ Other:
☒ Fire extinguisher	☒ Phone charger	☐ Other:
☒ First aid kit	☐ Poison ivy/oak cleanser	☐ Other:
☐ Flashlight/head lamp	☒ Sunscreen	

PPE is discussed in further detail in Section 5.

4.1.2 Personal Safety

Field activities have the potential to take employees into areas which may pose a risk to personal safety. The following websites have been researched to identify potential crime activity in the area of the project:

- https://communitycrimemap.com/: No crimes identified in the past 30 days within a mile of the work area(s).
- www.cityrating.com/crimestatistics.asp: Crime in New York is higher than the national and state crime rate.
- www.crimemapping.com: No crimes identified in the past 30 days within a mile of the work area(s)
- www1.nyc.gov/site/nypd/stats/crime-statistics/borough-and-precinct-crime-stats.page#bronx: New York City's 40th Precinct, the location of the work area(s), identifies 2,649 incidents that have occurred this calendar year, accessed October 13th, 2025.

Employees must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If employees encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the Site Safety Manager (SSM) and Safety Team (Safety Director and Regional Safety Managers – Safety_Team@geiconsultants.com)of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders are essential. At least one charged and functioning cell phone to enable emergency communications will be on site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

4.1.3 Vehicle Safety

Mobilization to and from the field will likely require the use of a personal, GEI fleet, or rental vehicle. When operating a vehicle while conducting business on behalf of GEI, employees must follow safe driving practices as outlined in the GEI Safe Driving SOP.

In conjunction with the hazard controls listed in the Site Mobilization JHA, GEI employees should follow these guidelines to operate a vehicle safely:

- Do not drive distracted, including using hand-held cell phones, when operating any vehicle.
- Complete a 360° inspection of the vehicle and surrounding area to identify vehicle safety issues and hazards that could be within the travel path.
- Confirm cell phones, tablets, or other potentially distracting equipment are safely secured and put away prior to operating the vehicle.
- Park in designated areas or a safe area away from heavy equipment.
- When parking a vehicle at a job site, the employee should make an effort to position the vehicle in a manner which reduces or eliminates the need to operate the vehicle in reverse.
- Use a spotter whenever possible.

GEI personnel will follow the GEI Incident Reporting (and client specific reporting) procedures if a vehicle accident occurs involving another vehicle, results in injury, or the damage to property.

4.1.4 Communicable Diseases

Communicable diseases are illnesses caused by viruses or bacteria that people spread to one another through contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through the air. Examples of communicable diseases include influenza, coronavirus

2019, hepatitis B, salmonella, measles, and blood-borne illnesses. Most common forms of spread include food, insect bites, droplets, or skin contact. Infections may range in severity from asymptomatic (without symptoms) to severe and fatal. Transmission of these biologic agents can occur in a variety of ways including airborne (inhalation), direct physical contact with an infectious person, consuming contaminated foods or beverages, contact with contaminated body fluids, contact with contaminated inanimate objects, or being bitten by an infected insect or tick. Below are ways to prevent the infection or spread of communicable diseases:

1. Distancing - Maintain distance from others when possible. Minimize the number of employees in one location to the extent possible.
2. Wash Hands Often - Frequent hand washing with soap and warm water for 20 seconds. If soap and water are not readily available, use hand sanitizer (containing 60% alcohol) until soap and water can be used.
3. Clean and Disinfect Commonly Used Surfaces - Wipe down surfaces with disinfectant on a routine basis. This includes field equipment and other items that may have previously been used by others. This is especially important while working in construction trailers. When using company and personal vehicles, wipe surfaces including the steering wheel, gear shifter, controls, and door handles before and after use.
4. Use Good Hygiene Practices – These include washing hands frequently, avoid touching your eyes, nose, and mouth, and cover coughs and sneezes.
5. Get Vaccinated - Vaccines can prevent many infectious diseases. There are also vaccines that are recommended or required for travel to certain parts of the world.
6. Avoid Touching Wild Animals - Be cautious around wild animals as they can spread infectious diseases.
7. Stay home when you are sick.

4.2 Job Hazard Analysis

The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in step-by-step JHAs included in Appendix B. Prior to the start of work, project team members will determine what tasks are covered in the scope of work (Table 2) and then develop a JHA for each of these tasks and have them reviewed by the Project Manager (PM) or their designee and approved by a member of the Safety Team. Indicated in each JHA are the specific PPE, training, equipment, health and safety SOPs and programs that apply to each task. Additional information on hazard controls can be found in GEI's SOPs and programs that apply to this project which are indicated in Appendix E.

4.3 Heat and Cold Stress

4.3.1 Heat Stress

Employees may be exposed to the hazards associated with heat stress when ambient temperatures exceed 80ºF. To prevent heat-related illness, Project Managers (PMs) should plan for proper hydration (drinking plenty of water), acclimatization (getting used to weather conditions), and schedules that alternate work with rest. Employees should also be trained to recognize the symptoms of heat related illnesses and know how to administer first aid for heat-related illnesses and activate emergency medical services quickly when needed. Water and shade will be available to all project employees and located as close as practicable to the work areas when temperatures exceed 80°F.

CDC Heat Planning Tool
For the most recent details and tools for heat stress, use your smart phone to access the Centers for Disease Control for the latest information. Additional details can be found in GEI's Heat Stress Program located on the Safety Resources page of GEI Connections.

Prior to each workday, the forecasted temperature and humidity for the worksite will be reviewed and will be compared against the National Weather Service Heat Index to evaluate the risk level for heat illness. When the temperature equals or exceeds 95°F, or during a heat wave, high heat procedures will be used which include additional preventive measures including pre-shift meetings to encourage employees to drink plenty of water, working in the buddy system or regular communication so observations can be made for heat related illness, and to remind employees of their right to take a cool-down rest when necessary.

4.3.2 Cold Stress

Employees may be exposed to the hazards associated with cold stress when working in cold, wet, and/or windy conditions. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, and poor judgment.

CDC Cold Stress Info
For the most recent details and tools for cold stress, use your smart phone to access the Centers for Disease Control for the latest information. Additional details can be found in GEI's Cold Stress Program located on the Safety Resources page of GEI Connections.

4.4 Constituents of Concern

The characteristics of constituents of concern (COC) at the site are discussed below for safety information purposes. A COC is any substance classified or defined as hazardous, extremely hazardous, toxic, or dangerous. The COC included in this health and safety plan will be the primary constituents that have been detected, are anticipated to be detected, or are being evaluated for the presence of, on the project site. These COC will be used to determine the action levels and PPE necessary for site personnel. Adherence to the safety and health

guidelines in this HASP should reduce the potential for exposure to the COC discussed below.

4.4.1 Site-Specific COC

The characteristics of compounds that may be present at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the compounds discussed below.

Volatile Organic Compounds

Volatile organic compounds (VOCs), such as benzene, toluene, ethyl benzene, and xylene (BTEX) are present as soil and groundwater contaminants, and in some cases chemical components in non-aqueous phase liquids (NAPL) such as oil or tar within soils and abandoned pipelines. These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. These compounds generally have a depressant effect on the Central Nervous System (CNS), may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and therefore respiratory protection is the primary control against exposure to VOCs.

Heavy Metals

Heavy metals such as arsenic, chromium, and mercury have been detected in site samples. Exposure to high concentrations of arsenic can cause dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyper pigmentation of skin. Chronic exposure to arsenic has resulted in lung cancer in humans. Arsenic is regulated by specific OSHA standards. They are 29 CFR 1910.1025/1926.52 and 29 CFR 1910.1018/1926.1118, respectively. These standards include specific requirements for air monitoring, signs and labels, training and medical surveillance.

Exposure to chromium can cause acute symptoms such as irritation of the eyes, nose and throat as well as wheezing and coughing. Chronic effects include nosebleeds, nasal congestion, dermatitis, and loss of sight. Exposure to mercury can cause dizziness, salivation nausea, vomiting, diarrhea, constipation, emotional disturbance, and kidney injury. Chronic exposure to mercury can cause CNS damage.

These metals are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. As with semi-volatile organic compounds (SVOCs), the primary route of exposure is through inhalation of dust particles when soil is disturbed and becomes airborne.

Purifier Waste

There are two typical byproducts which resulted from MGP processes, purifier waste and coal tar. Manufactured gas had to be cooled, purified, and a number of other impurities had to be removed prior to use. Sulfur and cyanide compounds were removed by passing the gas through "purifier beds" made up of either lime or wood chips permeated with iron filings. The beds of purifier material would eventually load up with tar and other materials and become unusable. Purifier waste is typically found as a dark mixture of wood chips with a strong burnt odor. Once exposed at the ground surface, the waste often developed an iridescent blue color known as "Prussian Blue."

Cyanide

Cyanide compounds are common by-products of manufactured gas production. Hydrogen cyanide is toxic because it is a chemical asphyxiant. It replaces the oxygen in the blood and thereby suffocates the cells. Ferro cyanides are not considered toxic because the hydrogen cyanide ion is bound too tightly to the iron and cannot therefore replace the oxygen. It takes a great amount of heat and/or acid to release cyanide gas from the ferro cyanide molecule; therefore, hydrogen cyanide is not a concern at this Site. GEI plans to monitor for hydrogen cyanide (HCN) during remedial investigation activities when significant deposits of purifier bed material are identified. Monitoring will be conducted using colorimetric tubes and is detailed further in Section 9.2.3.

Coal Tar and Coal Tar Products

Coal tar products, which are SVOCs consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluorethene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3cd)pyrene, 2-methyl naphthalene, naphththalene, phenanthrene, phenols, pyrene.

Some coal tar products and other SVOCs are present at the Site within impacted soil and groundwater and as a dense non-aqueous phase liquid (DNAPL) by-product of gas production within soils, former MGP structures, and abandoned pipelines.

Coal tar products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action Levels for VOCs and associated contingency plans for the work zone are discussed within Section 9 of this HASP.

Exposure to organic vapors will be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 5 will be worn for activities where contact with potential contaminated media or materials are expected.

SDSs for decontamination chemicals and laboratory reagents that may be used on Site are included in Appendix B. Specific chemical hazards information from the occupational health sources are summarized in Table 4.

Table 4. Primary Constituents of Concern Data

Compound	Exposure Limit	Route of Exposure	Primary Hazard/Symptoms of Exposure
Arsenic	0.01 mg/m^3 A.L. 0.005mg/m^3	Inhalation, skin absorption, ingestion, skin contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen
Benzene	1 ppm TWA 5 ppm STEL	Inhalation, skin absorption, ingestion skin contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, potential carcinogen
Carbon Disulfide	OSHA PEL: 20 ppm NIOSH REL TWA: 1 ppm	Inhalation Ingestion Skin Contact	Toxic, irritates eyes, mucous membranes, and skin; dizziness, poor sleep, headache, anxiety, anorexia, weight loss, and vision changes
Chromium (Chromic Acid and Chromates)	ACGIH TLV: 0.05 mg/m^3 OSHA PEL: 0.1 mg/m^3	Inhalation Ingestion Skin Contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leucocytosis (increased blood leucocytes), leukopenis (reduced blood leucocytes), moncytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinogen
Coal tar pitch volatiles	TWA 0.2 mg/m^3	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]
Ethylbenzene	100 ppm	Inhalation, ingestion, skin contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma
Hydrogen cyanide	10 ppm (11 mg/m^3) [skin]	Inhalation, ingestion, absorption, skin/eye contact	Asphyxia; weakness, headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; thyroid, blood changes
Hydrogen sulfide (H2S)	20 ppm C 50 ppm [10-min. Maximum peak]	Inhalation, skin/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, fatigue, irritability, insomnia; gastrointestinal disturbance; liquid: frostbite
Lead	0.05 mg/m^3 A.L. 0.03 mg/m^3	Inhalation, ingestion, skin contact	Weakness, insomnia; facial pallor; pal eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritates eyes, hypo tension

Compound	Exposure Limit	Route of Exposure	Primary Hazard/Symptoms of Exposure
Mercury	0.10 mg/m^3	Inhalation, ingestion, skin contact, skin absorption	Irritates eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, Gastrointestinal disturbance, weight loss, proteinuria
Naphthalene	10 ppm (50 mg/m^3) TWA	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
Toluene	200 ppm	Inhalation, skin absorption, ingestion, skin contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis
1,2,4-Trimethyl-benzene	None	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)
1,3,5 – Trimethylbenzene	NA	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)
Xylene	100 ppm	Inhalation, skin absorption, ingestion, skin contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis

Notes:
A.L. - Action Level
mg/m^3 - micrograms per cubic meter
mppcf – millions of particulates per cubic foot of air
ppm - parts per million
PCB - Polychlorinated Biphenyls
PEL - Permissible exposure limit
ppm - parts per million
STEL - Short-term exposure limit (15 minutes)
TWA - Time-weighted average (8 hours)

4.4.2 Chemicals Brought on Site

Potential hazards associated with chemicals brought on site (e.g., decontamination chemicals, sample preservatives, fuels, calibration fluids) for the work will be mitigated through training, administrative controls (e.g., proper labeling and storage), and proper use of PPE. SDSs for all chemicals brought on site shall be maintained by the SSM and are included in Appendix C.

5. Personal Protective Equipment

The PPE required to be worn on the project site is listed in the table below. Additional PPE required for the tasks to be performed is listed on the JHAs in Appendix B.

Site Required PPE *(check all that apply)*		
☒ Hard Hat	☐ Respirator	☐ Tyvek clothing/boots
☒ Safety Glasses	☐ Flame Resistant Clothing	☒ Hearing Protection
☒ Safety Boots	☐ Personal Flotation Device	☐ Long Sleeve Shirt
☒ Gloves (nitrile, cut resistant)	☐ Snake Chaps	☐ Other:
☒ High Visibility Safety Vest	☐ EH-Rated Boots	☐ Other:

If site conditions suggest the existence of a situation more hazardous than anticipated, the site personnel will evacuate the area to a safe distance. The hazard, the level of precautions, and the PPE will then be reevaluated with the assistance and approval of the Safety Director and the PM. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the site and notify the PM or a member of the Safety Team. GEI's PPE Program can be found on the Safety Resources page of GEI Connections.

5.1 Respiratory PPE

GEI personnel who have the potential to don a respirator must have a valid fit test certification and medical clearance. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency (less than 20.7%).
- Imminent Danger to Life and Health (IDLH) concentrations.
- If contaminant levels exceed designated use concentrations.

Upgrades to respiratory protection may be required based on the designated Action Levels found in Section 9.

6. Responsibilities and Lines of Authority

6.1 GEI Personnel Responsibilities

The implementation of health and safety at this project location will be the shared responsibility of the Safety Director, Regional Safety Director, PM, the Site Safety Manager (SSM), and each GEI personnel implementing the proposed scope of work.

6.1.1 GEI Safety Director

The Safety Director is responsible for the overall management of GEI's safety programs, policies, and procedures. Modifications to this HASP which may result in the reduction in the identification, evaluation, and control of safety and health hazards cannot be undertaken by the project team without the approval of the Safety Director.

6.1.2 GEI Project Manager

The PM is responsible for confirming that the requirements of this HASP are implemented. The PM's specific responsibilities include:

- Conducting and documenting the Project Safety Briefing.
- Verifying that the GEI staff and subcontractors selected to work on this program are sufficiently trained for site activities and have reviewed this HASP.
- Maintaining regular communications with the SSM and, if necessary, the Safety Director.

6.1.3 GEI Regional Safety Manager

The RSM is responsible for supporting the safety needs and requirements specified in this HASP. The RSM's specific responsibilities include:

- Reviewing and approving the HASP and applicable JHAs.
- Working with the PM and SSM to meet client safety requirements.
- Providing approval for fall protection plans and confined space entries (permit numbers), as applicable.
- Providing safety support regarding safety programs and procedures as applicable to the project.

6.1.4 GEI Site Safety Manager

The SSM is responsible for implementing and enforcing the safety requirements specified in this HASP and will be on-site during activities covered in the HASP. The SSM's specific responsibilities include:

- Enforcing the requirements of this HASP and notify the PM of noncompliance.
- Conduct daily Safety Tailgate meetings for site-related work.
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities.
- Procuring the air monitoring instrumentation, PPE, and safety equipment needed for GEI project employees and verifying that each is in good working order.
- Verifying that GEI subcontractors are utilizing the correct PPE and safety equipment.

6.1.5 All GEI Field Personnel

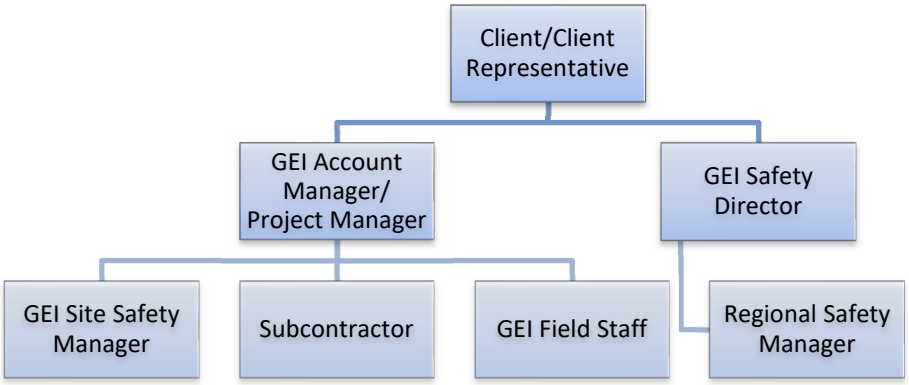
All GEI field personnel (including the PM and SSM) covered by this HASP are responsible for following the health and safety procedures in this HASP and for performing their work in a safe and responsible manner. The specific responsibilities that apply to all field personnel include:

- Reading and signing the HASP prior to the start of on-site work.
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSM.
- Attending and actively participating in the required Project Safety Briefing prior to beginning on-site work and any subsequent safety meetings.
- Complying with the requirements of this HASP and the requests of the SSM.
- Stopping work in the event that an immediate danger situation is perceived.
- Reporting accidents, injuries, and illnesses, regardless of their severity by following GEI's incident reporting procedures.

6.2 Lines of Authority

GEI will have responsibility for safety of its employees during the work performed at the site. GEI's SSM will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's SSM will be available for communication with the GEI PM and with the Client's representative.

Project Lines of Authority



6.2.1 Stop Work Authority

GEI employees have the authority to stop work activities if an unanticipated hazard is encountered or a potential unsafe condition is observed. The GEI employee should contact the Safety Director and the Project Manager to discuss the stop work conditions and potential control methods that can be implemented.

6.3 Subcontractors

GEI has subcontracted the following firms to assist in performing work on this project:

Subcontractor Information	
Company Name/Address: GPR/Utility Markout (TBD)	
Contact Name: TBD	Cell: TBD
Scope of Work: Perform utility mark-out and GPR survey	

Subcontractor Information	
Company Name/Address: Driller (TBD)	
Contact Name: TBD	Cell: TBD
Scope of Work: Perform drilling; monitoring well and soil vapor point installation	

GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors hired by GEI are required to submit documentation of their safety practices as part of GEI's Subcontractor Safety Prequalification for evaluation and approval before the start of work. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but, at a minimum, must adhere to applicable requirements set forth in this HASP. The PM will obtain applicable safety certifications and training records from the subcontractor's site supervisor prior to the initiation of work.

7. Training Requirements

Prior to commencement of field activities, the PM or their designee will verify GEI field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the site operations. This training will be documented on the applicable JHAs (Appendix B). Personnel that have not received project-specific training will not be allowed on site.

Applicable Site-Specific Training Requirements *(check all that apply)*		
✔ HAZWOPER (8Hr Refresher)	☐ Railroad Specific Training	☐ Other:
☐ HAZWOPER (Site Supervisor)	☐ Transportation Worker Identification Credential (TWIC)	☐ Other:
✔ First Aid/CPR	☐ MSHA (Mine Safety and Health Administration)	☐ Other:

7.1 On-Site Safety Briefings

GEI personnel will be given health and safety briefings daily (or as frequently as needed) by the SSM or their designee to plan for conducting work activities safely. The briefing will include GEI subcontractors and others as appropriate. The briefings can include information on:

- Applicable JHAs
- Changes in work practices
- Changes in environmental conditions
- Anticipated weather
- Evacuation/emergency procedures
- Air monitoring results
- Safety inspection results

Documentation of these briefings will be recorded in the GEI field book or the Tailgate Safety Briefing Form (Appendix D). For long-term projects, the Tailgate Safety Briefing Form is preferred.

8. Medical Surveillance Program

GEI maintains a medical surveillance program under the supervision of the Safety Director that includes a plan designed specifically for field personnel engaged in work at sites where hazardous materials may be present. Field personnel undergo an initial physical examination, including a detailed medical and occupational history before they are able to engage in work at hazardous waste sites. Upon successful completion of the examination, personnel are provided a medical clearance from an occupational health physician stating their fitness to perform the specified work activities. Employees who are part of this program will schedule and attend annual exams 12 months from the date of their previous exam.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be seen by a doctor, GEI will consult with their third-party medical administrator and provide access to the nearest area hospital or medical facility.

GEI subcontractor personnel that will enter any hazardous waste sites must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). A copy of their medical clearance will be submitted to the GEI PM or SSM prior to the start of field activities.

9. Personal/Work Zone Air Monitoring

Personal/Work Zone Air Monitoring Required?	
☒ Yes	☐ No

Air monitoring, in the form of personal or work zone monitoring, will be performed to identify and quantify airborne levels of hazardous substances and atmospheric hazards to determine the appropriate level of worker protection needed on-site.

Work on this project requiring air monitoring includes:

Personal/Work Zone Air Monitoring Tasks *(check all that apply)*		
☐ Excavation	☐ Confined Space Entry	☐ Other:
☒ Soil Sampling	☐ Indoor Drilling	☐ Other:
☒ GW Monitoring Well Headspace	☐ Product Sampling	☐ Other:

The following air monitoring equipment will be on site:

Personal/Work Zone Air Monitoring Equipment *(check all that apply)*	
☒ PID with 10.6 eV lamp or equivalent	☒ Particulate Meter (PM-10 capable)
☐ Drager Chip Measurement System (CMS) with appropriate gas detection chips	☒ Multi-gas meter: lower explosive limit (LEL) / oxygen (O_2) / hydrogen sulfide (H_2S) / hydrogen cyanide (HCN) or carbon monoxide (CO) meter
☒ Sensidyne Gas Detection Pump with appropriate gas detector tubes (or equivalent colorimetric tube)	☐ Other:

GEI will conduct and document on-site work zone monitoring and will inform GEI employees of the results. ***If Action Levels are exceeded, immediately implement site action(s) according to Action Table below and notify the PM***.

9.1 Calibration

Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's requirements. Calibrations will be recorded in the project notes daily or on a daily calibration form.

9.2 Action Levels

The tables below provide a summary of real time air monitoring Action Levels and contingency plans for work zone activities. The below Action Levels are determined by halving the Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) as set

forth by OSHA and the American Conference of Government Industrial Hygienists (ACGIH).

9.2.1 VOC Monitoring and Control

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Based on the VOCs listed in Table 4, determine which constituent has the lowest permissible exposure limit (PEL). This data is used to determine the action levels needed including respiratory protection at the project site. GEI's action level is half of the PEL listed in Table 4 (exception is made for benzene).

Exposure to organic COC can be evaluated and/or controlled by:

- Monitoring worker breathing zone atmospheric concentrations for organic COC in the breathing zone with a PID.
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are 15-minute time weighted averages (TWA), not a single exceedance.		
PID (Monitoring for VOCs)	0.0 – 50 ppm	No respiratory protection is required if VOCs are not present. (If benzene or naphthalene are constituents of interest at this site, follow the action levels below for benzene and/or naphthalene.)
	> 50 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, upgrade to Level C. Notify PM and Safety Team.

9.2.2 Dust Monitoring and Control

Some COC hazards may become hazardous when they are associated with dust/particles and become airborne. For worker safety, dust levels must be managed to eliminate this hazard. Dust generated during activities can cause irritation to the respiratory system and eyes. Contaminants can also be carried in airborne dust causing potential exposure to workers through skin contact and inhalation. Constituent concentrations on site are expected to be

low therefore the exposure hazard through inhalation should be minimal; however, contaminant contact through skin and clothing can introduce additional exposures.

*Personal/work zone monitoring for dust/particulate matter is not anticipated to be needed at this time due to limited ground disturbing activities that would generate a significant amount of dust (e.g. saw-cutting of asphalt and/or concrete, air-rotary drilling, open excavations/test pits). However, dust monitoring will be performed at perimeter CAMP stations as further detailed in Appendix F. If the scope of work is adjusted to include one or more of the aforementioned activities, this HASP will be updated.

For dust generated during site activities which exceed site-specific limits, engineering controls such as water application will be used to control dust concentrations. However, if excessive dust concentrations cannot to be handled through engineering controls, then respirators will be required to be worn.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are 15-minute time weighted averages (TWA), not a single exceedance.		
Particulate Meter	150 µg/m^3	Implement work practices to reduce/minimize airborne dust generation, e.g., spray/misting of soil with water. Don respirator with particulate filters if action levels remain in exceedance.

9.2.3 H_2S, CO, and Explosive Atmosphere Monitoring and Control

The SSM will monitor operational areas for hydrogen sulfide (H_2S) and Hydrogen Cyanide (HCN) prior to the start of work each day. Oxygen (O_2) values are based on the maximum use limits of a full-face respirator if a chemical was displacing oxygen. Results will be compared to the published exposure limits/action levels listed below.

Air Monitoring Instrument	Action Level (above background)	Site Action
Action Levels for the following parameters are real time and should not be exceeded at any point.		
O_2 Meter	< 20.7%	Stop work, withdraw from work area, ventilate area, notify PM and Safety Team.
	> 21.1%	Stop work, withdraw from work area, notify PM and Safety Team.
H_2S Meter	< 5.0 ppm	No respiratory protection is required.
	> 5.0 ppm	Stop work, cover excavation, withdraw from work area, institute engineering controls, notify PM and Safety Team.

Air Monitoring Instrument	Action Level (above background)	Site Action
HCN Meter	< 1.0 ppm	Run colorimetric tube or CMS Drager chip. Continue monitoring with real-time meter and continue work if colorimetric tube or CMS Drager chip reading is less than 2.0 ppm.
	> 1.0 ppm HCN Concentrations < 2.0 ppm	Run colorimetric tube or CMS Drager chip and confirm concentration is less than 2.0 ppm, notify PM and Safety Team. Run colorimetric tube or CMS Drager chip for hydrogen sulfide for interferences. Continue to monitor with real-time meter.
	> 2.0 ppm	Stop work and move (with continuous HCN monitoring meter) at least 25 feet upwind of the excavation until continuous meter reads less than 1 ppm, notify PM and Safety Team. Run colorimetric tube or CMS Drager hydrogen cyanide chip and re-evaluate activity, continue monitoring with a real-time meter, resume work if concentrations read less than 1.0 ppm.

10. Site Control

10.1 Site Zones

Site zones are intended to control the potential spread of contamination and to assure that only authorized individuals are permitted into potentially hazardous areas. This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to site contaminants exists, will only be allowed access after proper training and medical documentation.

10.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site person should be aware of his or her role as a "buddy" and be able to help in the event of an emergency. Some projects may not support the need for the buddy system to be implemented. If this is the case, the PM is required to conduct regular check-ins with the employee on site.

10.3 Sanitation for Temporary Work Sites

Sanitation requirements identified in the OSHA Standard 29 CFR 1926.51 "Sanitation" specifies that employees working at temporary project sites have at least one sanitary facility available to them on-site. Sanitary facilities are available within the warehouse building.

10.4 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Activities planned for the site are anticipated to occur outside during daylight hours. However, if work areas do not meet illumination requirements, they will be equipped with appropriate illumination that meets or exceeds requirements specified in OSHA Standard 29 CFR 1926.56. Employees will not work on sites that are not properly lighted.

10.5 Smoking

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles will be provided for smoking materials.

10.6 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the site. All GEI employees must comply with

GEI's Controlled Substance Use & Alcohol Misuse Policy found on the Safety Resources page of GEI Connections. Employees may be subject to random drug and/or alcohol testing if required by a client at a project site.

11. Incident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, chemical spills, vehicle accidents, and property damage. The following steps must be followed when an incident occurs:

1. For incidents involving life-threatening situations or serious injury that require emergency response personnel (Police, Fire, EMS), call 9-1-1 from a safe area.
2. **Stop work** activity to address any injury, illness, property damage, spill, or other emergency.
3. Call Medcor Triage at 1-800-775-5866 to speak with a medical professional following any injury or illness.
4. Notify your Supervisor/Project Manager of the incident or injury.
5. Complete an incident report using the GEI Incident Report Form located on the GEI Safety Smartphone App, GEI Connections intranet page, or in the project HASP.
6. Resume work activity if all steps above have been completed and it is safe to do so.

For vehicle accidents involving another vehicle or damage to property, the employee will take pictures of each vehicle or property involved in the incident and obtain a police report. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

The Incident Report Form and the Near Miss Reporting Form can be found in Appendix D, on the GEI Health and Safety smartphone app, or on the Safety Resources page of GEI Connections. To report subcontractor injuries or incidents, follow the same verbal reporting procedures and submit an email describing the event to the PM and the Safety Team.

11.1 Injury Triage Service

If a GEI employee experiences a work-related injury that is not life-threatening, the employee will initiate a call to Medcor Triage at 1-800-775-5866. The injured employee will detail any medical symptoms or complaints which will be evaluated by a Registered Nurse (RN) specially trained to perform telephonic triage. The RN will recommend first aid self-treatment or refer the injured employee for an off-site medical evaluation by a health professional at a clinic within GEI's workers compensation provider network. GEI employees are still required to follow our Accident Reporting procedures as listed above.

12. Decontamination Procedures

Site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may come in contact with personnel or equipment. These procedures minimize contact with contaminants and protect against the transfer of contaminants to clean areas. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. This project is being conducted under the requirements of 29 CFR 1910.120(k), and any personnel or equipment that are exposed to site contaminants will follow applicable decontamination procedures.

12.1 Personnel and PPE Decontamination

A decontamination station where employees can drop equipment and remove PPE will be set up to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities. It will be equipped with basins for water and detergent, and trash bag(s), or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate containers) and disposed of in an approved facility. Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

12.2 Equipment Decontamination

All tools, equipment, and machinery that have come into contact with contaminated media, will be decontaminated on site prior to departure. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities. If your project has equipment decontamination specification refer to where those can be found (work plan, specs, etc.)

13. Emergency Response

13.1 Evacuation

Prior to the start of work, emergency procedures must be identified and communicated to workers on site. This includes evacuation routes, safe areas, and/or muster points (Figure 1). Also communicate how employees will be notified that an emergency or evacuation of the site is occurring (audio alarms, visible (light) alarms, radios, sirens, etc.) Upon discovering an emergency situation, personnel will notify the SSM, who will initiate an appropriate response. Once the scene is safe, use the incident report procedures to report the evacuation to the PM and Safety Team.

13.2 Fire

In the event of a fire personnel will evacuate the area to the muster point located on Figure 1. GEI's SSM will contact the local fire department and report the fire. The SSM will account for GEI personnel and subcontractor personnel and report their status to the PM. Incident reporting procedures will be followed once the scene is safe.

13.3 Spills or Material Release

If a hazardous waste spill or material release occurs, if safe, the SSM or their representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS for the material spilled or released.
- Source of the release or spillage of hazardous material.
- An estimate of the quantity released and the rate at which it is being released.
- The direction in which the spill or air release is moving.
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result.
- Potential for fire and/or explosion resulting from the situation; and
- Estimates of area under influence of release.

If the spill or release is determined to be within the on-site emergency response capabilities, the SSM will verify implementation of the necessary remedial action. If the release is beyond the capabilities of the site personnel, personnel will be evacuated from the immediate area and the fire department will be contacted. The SSM will notify the PM and follow the incident reporting procedures.

13.4 Medical Support

In case of minor injuries, on-site care will be administered with the site first aid kit. A GEI employee certified by the American Red Cross or other American Health & Safety Institute (ASHI) will be on-site at all times. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved unless they are in immediate danger. Notify the PM of the emergency and follow incident reporting procedures.

In the event of an emergency, prompt communications with local emergency responders are essential. At least one charged and functioning cell phone to enable emergency communications will be on site. Confirmation of cellular phone operation will be confirmed at the start of each working day.

Table 1 of this HASP contains detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. In addition, Appendix A includes a map to the local hospital/emergency room and Figure 1 indicates the evacuation route (including muster point).

13.5 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 40 miles per hour (mph), heavy rains or snow squalls, thunderstorms, tornados, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the site will be the responsibility of GEI's SSM. Notification of evacuation will be made to the PM. The SSM will account for GEI personnel and subcontractor personnel and report their status to the PM. If safe, work can resume 30 minutes after the last clap of thunder or flash of lightning.

13.6 Hazard Communication Plan

GEI personnel have received hazard communication (HAZCOM) training as part of their annual safety training and new employee safety orientation training. Hazardous materials brought on site will be properly labeled, stored, and handled. SDSs for each chemical will be included in this HASP in Appendix C. GEI's HAZCOM program can be found on the Safety Resources page of GEI Connections (Appendix E).

14. Health and Safety Plan Sign-Off

GEI personnel conducting site activities will be familiar with the information in this HASP. After reviewing this plan, please sign the copy in the project files, and bring a copy of the plan with you to the site. By signing this site-specific HASP, you are agreeing that you have read, understand, and will adhere to the provisions described in this plan while working on the site below.

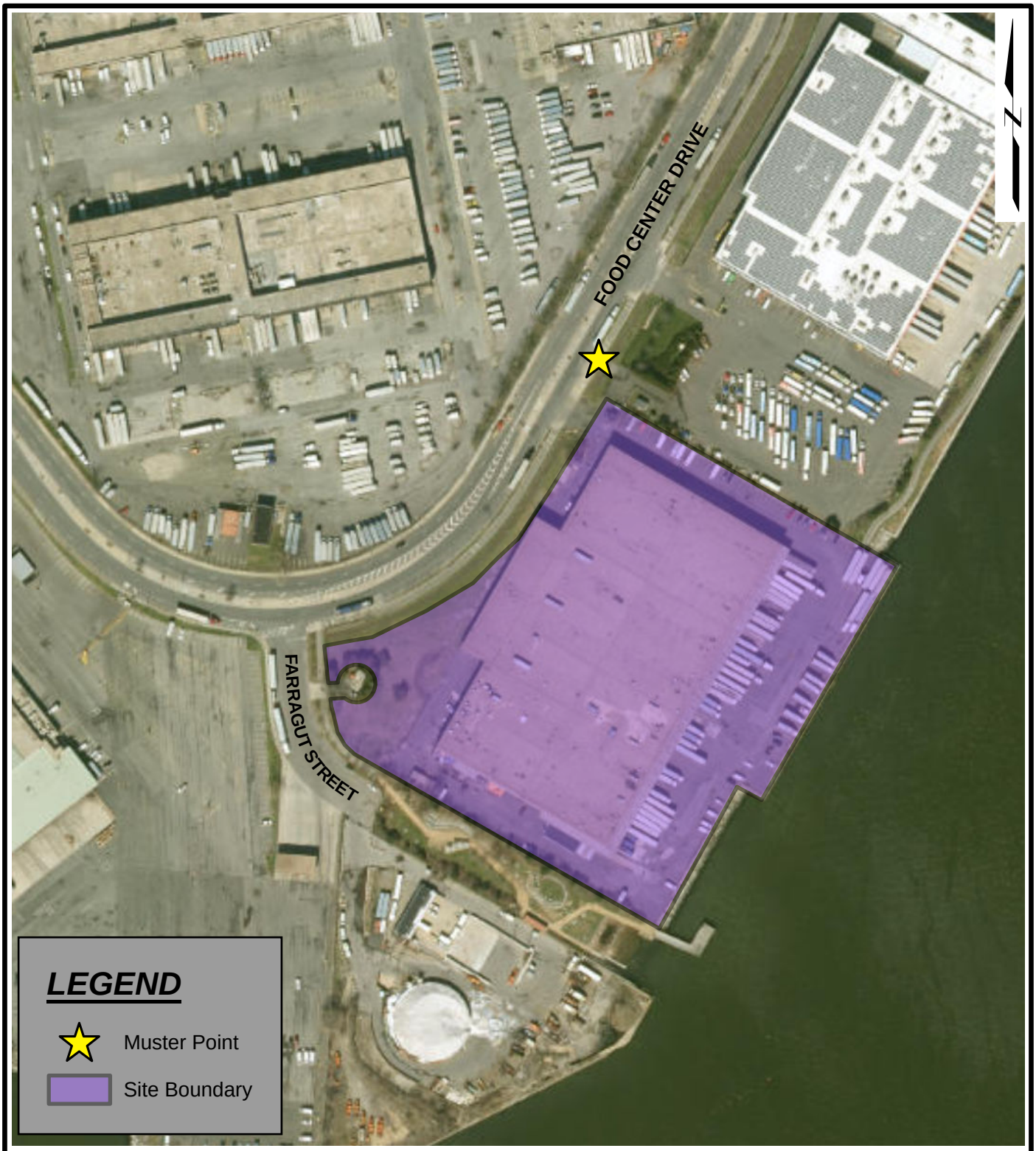
Site Name: 600 Food Center Drive (BCP Site No. C203104)

GEI Project No: 2303564

Print Name	Signature
Project Manager: Kevin McCarty	

Figure

Figure 1. Site Location and Muster Point



SOURCE:
1. ESRI WORLD IMAGERY

0 150 300
SCALE: 1:3,600

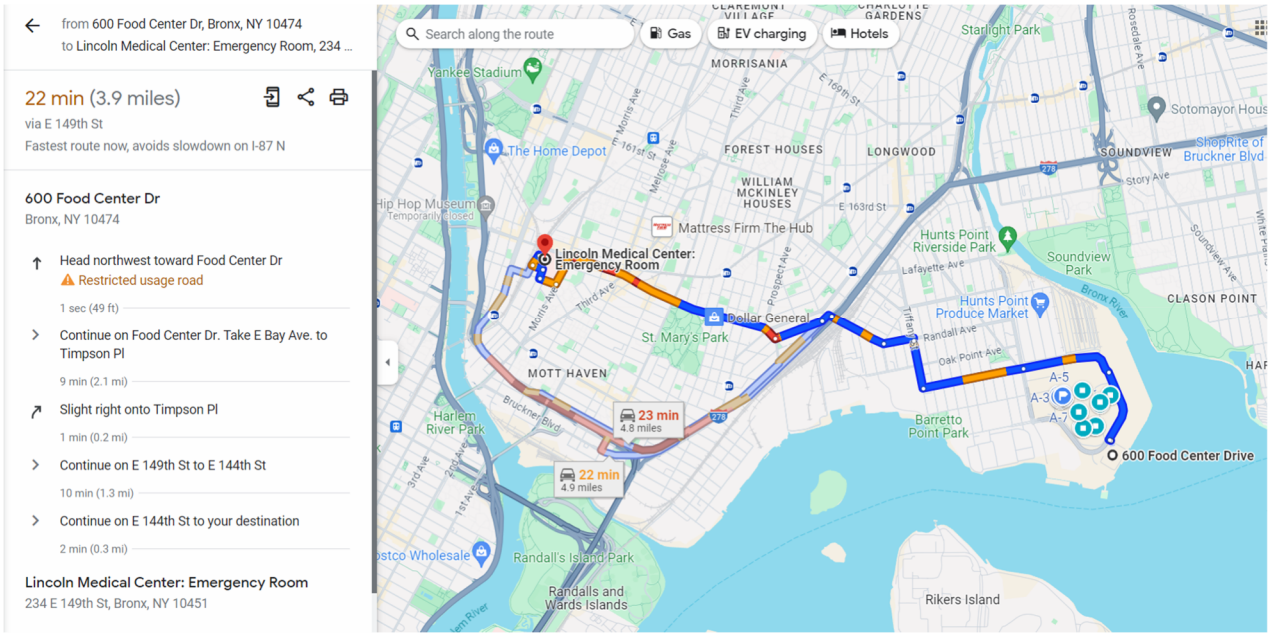
Health and Safety Plan 600 Food Center Drive (BCP No. C203104) Bronx, New York	GEI	SITE LOCATION AND MUSTER POINT
New York City Economic Development Corporation (NYCEDC) New York, New York	Project 2303564	November 2025 Fig. 1

\\geiconsultants.com\Data\Data_Storage\Working\NYCEDC\2303564 600 FCD RIWP\05_GIS\600 FCD.aprx

Appendix A

Hospital Directions

Hospital Information	
Lincoln Medical Center: 234 E. 149th Street Bronx, NY 10451	(718) 579-5000



Scan this QR code or click the link for access to Google Maps to type in the address of your local hospital.

Appendix B

Job Hazard Analyses

Job Hazard Analysis

Task	**Driving – Site Mobilization (parking along roadsides)**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	GEI fleet vehicle, rental vehicle, or personal vehicle		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☐Safety Glasses ☐Safety-Toed Boots ☐ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Inspect Vehicle	Slips/trips/falls	Hazard Identification HS-026 Driver Safety HS-004	• Walk around vehicle to inspect for any vehicle safety issues or hazards that could be within the travel path. • Adjust mirrors and seats prior to driving. • Becoming familiar with dashboard, center console, and steering controls. • Locate the turn signals, windshield wipers, lights, emergency flashers, and the heating, air conditioning, and defrost controls. • Use a spotter if needed when backing up.
2. Driving	Struck by/crushing hazards	Driver Safety SOP HS-004	• Employees must wear their safety belt while in a moving vehicle. • Employees will follow safe driving behaviors, which include limiting distractions such as manipulating radios or other equipment that may cause a distraction. Employees will not exceed the posted speed limit and will maintain a safe distance between other vehicles. • Use defensive driving techniques. • Avoid driving during hazardous weather conditions.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Driving distance and time after a 12-hour shift will not exceed 30 miles or 30 minutes (whichever is greater). • Vehicle accidents will be reported in accordance with GEI's accident reporting procedures.
3. Parking Vehicle	Struck by, crushing hazards, security	Driver Safety SOP HS-004	• Be aware of surrounding conditions. Park in designated areas or a safe area away from heavy equipment. • Position the vehicle in a manner which reduces or eliminates the need to operate the vehicle in reverse. Choose an easy-exit parking space, like pull-through or where no one else is parked. • Don't crowd neighboring vehicles; be sure to park your vehicle in the middle of your space. • Secure equipment and supplies in the trunk or where they cannot be seen. Or take items with you if they cannot be hidden. • If at night, park in well-lit areas.
4. Parking Along Roadsides	Struck by, crushing hazards, security	Driver Safety SOP HS-004 Hazard Identification HS-026	• Do not park along blind corners or in areas where oncoming traffic cannot see your vehicle. • Exit on the right side of the vehicle, when possible, to avoid exiting into traffic. If you must exit from the left side of the vehicle, use mirrors and spotters, when possible, to check for oncoming traffic. • Use cones and signs to alert other drivers of your parked vehicle • Obtain the proper permissions when necessary. • Be careful when parking on road shoulders as they can be soft and slippery. • Park as far off the road as possible after taking in other factors such as ditches, property boundaries, and soil types. • Maintain situational awareness. • Do not stage any equipment or work in the roadway unless it is required for the job.
5. Site Entry	Slips/trips/falls, struck by, crushing	Working Around Heavy Equipment HS-018 Hazard Identification HS-026	• Don appropriate PPE prior to walking on site. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Avoid distractions like using cell phones while traversing the site.
6. Backing Up Vehicle	Struck by, crushing	Driver Safety HS-004	• Before entering your vehicle do a walk-around. Check for fences, poles, drop-offs, buildings, etc. • Know your clearances. While performing your walk-around also

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			check for obstructions, low hanging eaves and tree limbs, wires, and any other potential clearance-related obstacles. • Use a spotter. Do not allow the spotter to be positioned directly behind your vehicle or walk backwards behind you while giving instructions. They should be off to the driver's side where you can see them in your side mirror.

Job Hazard Analysis

Task	**Site Surveying**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	GPS receiver, level, rod, measuring tape, total station, notepad/camera/tablet		
Task Specific Training	Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☐Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves Enter Type(s) - e.g., Nitrile, Cut Resistant, Latex ☐Respirator Enter Type/Cartridges - (e.g., Half-face, P-100) ☐Other		
JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Carrying Equipment/Site Setup	Heavy lifting, strains/sprains, slip/trips/falls, pinch points	Non-Powered Hand Tools HAS-008a Manual Lifting HS-025 GEI Ergonomic Program	• Use proper lifting techniques. • Check route for clearance of trip hazards. • Wear appropriate footwear and gloves to protect hands against sharp edges and soft tissue injuries. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Take breaks when carrying items frequently and/or for long distances. • Do not overreach when picking up or placing items. • Use the buddy system when necessary.
3. Site Walk/Survey	Slip/trips/falls, repetition, heat stress, cold stress, biological hazards	Biological Hazards HS-001 Inclement Weather HS-010 Manual Lifting HS-025 Hazard Identification HS-026	• Wear steel-toed boots and high visibility reflective vest when traversing work areas. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Discuss action plan prior to severe weather. • Apply insect repellent and poisonous plant barrier cream prior to the start of any field work and as needed throughout the workday. • Use the buddy system and have a check in plan with project team and/or project manager. • Bring adequate hydration for the workday (water, fluids with electrolytes). • Apply sunscreen regularly or wear a hat and long sleeve to reduce sun exposure. • Plan an area to take breaks with natural shade or provided by pop up structure. • Bring backpack to carry your fluids, snacks, first aid kits, etc. for larger project sites.
4. Demobilize from Site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	GPR/Utility Mark-out Oversight		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Ground Penetrating Radar Unit (utilized by subcontractor), Marking paint		
Task Specific Training	GEI Annual Safety Training (Field or HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves leather or other mechanics gloves ☐Respirator ☐Other		

JHA Prepared By: Savanna Marino	Date: 02/03/2026	Approved by: Stacey Ng	Date: 02/03/2026

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries. • Wear appropriate footwear. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Take breaks when carrying items frequently and/or for long distances. • Do not overreach when picking up or placing items. • Use the buddy system when necessary.
3. Site Walk/Survey	Slip/trips/falls, repetition, heat stress, cold stress, biological hazards	Biological Hazards HS-001 Inclement Weather HS-010 Manual Lifting HS-025 Hazard Identification HS-026	• Wear steel-toed boots and high visibility reflective vest when traversing work areas. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Discuss action plan prior to severe weather. • Apply insect repellent and poisonous plant barrier cream prior to the start of any field work and as needed throughout the workday. • Use the buddy system and have a check in plan with project team and/or project manager. • Bring adequate hydration for the workday (water, fluids with electrolytes). • Apply sunscreen regularly or wear a hat and long sleeve to reduce sun exposure. • Plan an area to take breaks with natural shade or provided by pop up structure. a. Bring backpack to carry your fluids, snacks, first aid kits, etc. for larger project sites.
4. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	a. Confirm all materials/equipment are secured. b. Clean all equipment/tools prior to leaving. c. Secure any gates/locks. d. Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	Perimeter Air Monitoring		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Pelican cases, tripods, multi-gas meters, particulate matter meter, regulator, air calibration canister, hand tools, field book		
Task Specific Training	Annual Safety Training (HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves ☐Respirator ☐Other		

JHA Prepared By: Savanna Marino	Date: 02/03/2026	Approved by: Stacey Ng	Date: 02/03/2026

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carrying Equipment/Site Setup	Heavy lifting, strains/sprains, slip/trips/falls, pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 GEI Ergonomic Program	• Use proper lifting techniques. • Check route for clearance of trip hazards. • Wear appropriate footwear and gloves to protect hands against sharp edges and soft tissue injuries. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Take breaks when carrying items frequently and/or for long distances. • Do not overreach when picking up or placing items. • Use the buddy system when necessary.
2. Calibrate Air Monitoring Equipment/Handling Compressed Gas Cylinders	Cuts/Scrapes, pinch points	GEI Ergonomic Program Hazard Identification HS-026	• Wear appropriate gloves to protect hands against sharp edges and soft tissue injuries. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Do not stage/store incompatible materials in the same area (e.g.: oxidizers and flammables).

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Make sure valves are properly closed when not in use. • Only approved and properly labeled containers should be used. • SDSs should be with the cylinders at all times. • Place cylinders on even surfaces. • Keep cylinders away from high heat and spark/flame sources. • When transporting, the safety dome cap needs to be securely in place and cylinder should be secured in place.
3. Install Perimeter Monitoring Equipment	Slip/trips/falls, cuts/lacerations, heat stress, cold stress, biological hazards	Non-Powered Hand Tools HS-008a Biological Hazards HS-001 Inclement Weather HS-010 Manual Lifting HS-025 Hazard Identification HS-026 GEI Ergonomic Program	• Maintain good housekeeping in the work area to prevent slips, trips, and falls. • Maintain situational awareness and a high level of communication with others on site. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries.
4. Site Walk/Collect Readings/samples	Slip/trips/falls, repetition, heat stress, cold stress, biological hazards	Biological Hazards HS-001 Inclement Weather HS-010 Manual Lifting HS-025 Hazard Identification HS-026 GEI Ergonomic Program	• Wear steel-toed boots and high visibility reflective vest when traversing work areas. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Discuss action plan prior to severe weather. • Apply insect repellent and poisonous plant barrier cream prior to the start of any field work and as needed throughout the workday. • Use the buddy system and have a check in plan with project team and/or project manager. • Bring adequate hydration for the workday (water, fluids with electrolytes). • Apply sunscreen regularly or wear a hat and long sleeve to reduce sun exposure. • Plan an area to take breaks with natural shade or provided by pop up structure. • Bring backpack to carry your fluids, snacks, first aid kits, etc. for larger project sites.
5. Remove Air Monitoring Equipment	Slip/trips/falls, cuts/lacerations, heat stress, cold stress, biological hazards	Biological Hazards HS-001 Inclement Weather HS-010 Manual Lifting HS-025 Hazard Identification HS-026	• Maintain good housekeeping in the work area to prevent slips, trips, and falls. • Maintain situational awareness and a high level of communication with others on site. • Wear the proper type of glove to protect hands against sharp

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			edges and skin/soft tissue injuries.
6. Demobilize from Site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Drilling Oversight**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Drill rig and hammer drill (operated by subcontractor), field book, measuring tape, camera		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile ☐Respirator ☐Other		

JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize on site	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Utility survey/clearance	Shock, Explosion, Fire	Utility Mark-Out HS-014	• Confirm that all utilities have been properly marked prior to beginning work. • If a utility strike occurs, call the appropriate authorities immediately. Clear the area and do not delay. • Confirm adequate clearance from overhead utilities. • Do not stand or sit under suspended loads or near any pressurized equipment lines.
3. Observe contractor activities	Struck by/crushing hazards	Working Around Heavy Equipment HS-018	• Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Confirm equipment inspection has been completed. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Position yourself in a safe location. • Notify the contractor immediately if any problems arise. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
4. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Soil Sampling – Drill Rig**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Geoprobe Drill Rig (operated by subcontractor), PID, measuring tape, metal spoon/spatula		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☒ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☒Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile, Cut resistant ☒Respirator if action levels are exceeded ☐Other		

JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Mobilize On Site/Equipment Setup	Slips/trips/falls, stuck by, crushing hazards	Hazard Identification HS-026	• Wear PPE that properly fits, is in good condition, and is appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped, or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to work areas, on steeply sloped areas, or where steep areas must be traversed to reach work areas.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
2. Utility survey	Shock, Explosion, Fire	Utility Mark Out HS-014	• Confirm that all utilities have been properly marked prior to beginning work. • If a utility strike occurs, call the appropriate authorities. immediately. Clear the area and do not delay.
3. Observe contractor activities	Struck by/crushing hazards	Working Around Heavy Equipment HS-018	• Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Confirm equipment inspection has been completed. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Position yourself in a safe location. • Confirm adequate clearance from overhead utilities. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation.
4. Cutting Soil Core Liners	Cuts/lacerations, contaminant exposure	Non-Powered Hand Tools HS-008a Ergonomic Program	• Eliminate the hazard by having the drillers open the cores/liners for you. o Keep a safe distance from the core while they are cutting the liner (hands, face, and body). o Do not stand on either side of the core in the direction they are cutting. o Make sure your safety glasses are on, in case of material splatter. • If you are cutting the liner, use a liner cutting tool, safety shears, or at a minimum hooked blades on a self-retracting knife. • When using cutting tools, follow these safety precautions: o Wear cut resistant gloves. o Keep free hand out of the way. o Secure the liner if cutting through thick material. o Use only sharp blades; dull blades require more force that results in less control. o Do not put the sharp cutting tool in your pocket. • Use care when evaluating cores, as the plastic that has been cut can be sharp.
5. Sample Soil	Contaminant Exposure, Cuts/Scrapes, Repetition,	Hazard Identification HS-026/Container Management HS-003	• Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
	Slips/Trips/Falls		shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
6. Drum Soil Cuttings	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
7. Pack Soil Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Confirm that the lids on all bottles are tight (will not leak). • Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers. • Use proper dollies or other lifting tools. • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • If glassware breaks, dispose of in puncture-resistant containers. Use cut resistant gloves to handle any broken glass.
8. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
9. Demobilize from site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Job Hazard Analysis

Task	**Groundwater Sampling – (Low Flow)**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Hand tools, pump, water level meter, battery		
Task Specific Training	GEI Annual Safety Training (HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☒ Gloves Nitrile/Cut resistant ☐Respirator ☐Other		

JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carry Equipment and Set-up	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries. • Wear appropriate footwear. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Take breaks when carrying items frequently and/or for long distances. • Do not overreach when picking up or placing items. • Use the buddy system when necessary.
2. Open Monitoring Well	Cuts/Scrapes, Insect Bites	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries. • Use proper tools to open monitoring wells.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Open casings slowly in case insects inhabit the area. • If insect nest is inside casing, open protective casing and see if insects will leave the nest. Once free of insects, proceed with work. If not, contact project manager if problem persists. • If severely allergic to insects, have appropriate epinephrine on hand. • Remain calm and still if a single stinging insect is flying around. (Swatting at an insect may cause it to sting.) • If you are attacked by several stinging insects at once, run to get away from them. (Bees release a chemical when they sting, which may attract other bees.) • Follow incident reporting procedures if first aid is needed.
3. Cut Tubing/String	Cuts/Scrapes, pinch points	Non-Powered Hand Tools HS-008a	• Wear cut resistant gloves. • Using safe cutting tools such as safety scissors or snips are best practices. • Keep free hand out of the way. • Secure the item being cut. • Use only sharp blades; dull blades require more force that results in less control. • Do not put the sharp cutting tool in your pocket.
4. Deploy Water Level Meter	Awkward position, contaminant exposure	Hazard Identification HS–026 Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep control of the reel when deploying the probe. Avoid letting the probe drop quickly into the well. • Reel the probe up slowly to avoid splashes from contaminated groundwater or sediment. • Keep trafficked areas free from slip/trip/fall hazards.
5. Collect GW Reading/Samples	Awkward position, contaminant exposure	Hazard Identification HS–026 Ergonomic Program	• Wear Nitrile/neoprene gloves and dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
6. Pack Groundwater Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Confirm that the lids on all bottles are tight (will not leak). • Place cushioning/absorbent material in the bottom of the cooler and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Use proper dollies or other lifting tools. • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • If glassware breaks, dispose of in puncture-resistant containers. Use cut resistant gloves to handle any broken glass.
7. Drum Purge Water	Contaminant Contact, Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	Container Management HS–003 Manual Lifting HS–025 Ergonomic Program	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards.
8. Equipment Decontamination	Contaminant Contact, Cuts or Abrasions, Slips/Trips/Falls	Hazard Identification HS–026 Ergonomic Program	• Wear nitrile gloves and glasses to provide eye protection from splashing. • Wash hands immediately after use. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
9. Equipment Demobilization	Heavy lifting, Cuts/Scrapes, Slips/Trips/Falls, Pinch points	Non-Powered Hand Tools HS-008a Manual Lifting HS-025 Ergonomic Program	• User proper lifting techniques. • Keep trafficked areas free from slip/trip/fall hazards. • Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries. • Wear appropriate footwear. • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions. • Take breaks when carrying items frequently and/or for long distances. • Do not overreach when picking up or placing items. • Use the buddy system when necessary.

Job Hazard Analysis

Task	**Soil Vapor Sampling – Summa Canisters**		
Project Name/Number	600 Food Center Drive (BCP Site No. C203104)/2303564	**Client Name**	New York City Economic Development Corporation (NYCEDC)
GEI Project Manager	Kevin McCarty	**PM Review Date**	02/03/2026
Tools/Equipment Used	Hand tools, summa canisters, gauge/flow controller		
Task Specific Training	Annual Safety Training (HAZWOPER), First Aid/CPR		
Personal Protective Equipment (PPE)	☐ Hard Hat ☒Safety Glasses ☒Safety-Toed Boots ☒ Reflective Vest ☐Hearing Protection ☐ Personal Flotation Device (PFD) ☐ Face Shield ☐ Chaps ☐ Tyvek clothing/boots ☐ Flame Resistant Clothing ☐ Gloves ☐Respirator ☐Other		
JHA Prepared By: Savanna Marino	**Date: 02/03/2026**	**Approved by: Stacey Ng**	**Date: 02/03/2026**

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
1. Carrying Equipment/Site Setup	Heavy lifting, strains/sprains, slip/trips/falls, pinch points	Non-Powered Hand Tools HS-008a, Manual Lifting HS-025, GEI Ergonomic Program	• Use proper lifting techniques • Check route for clearance of trip hazards • Wear appropriate footwear and gloves to protect hands against sharp edges and soft tissue injuries • Be aware of hard to grip and hold items that may force your hand or wrist into awkward, stressful positions • Take breaks when carrying items frequently and/or for long distances • Do not overreach when picking up or placing items • Use the buddy system when necessary
2. Site Walk	Slip/trips/falls, repetition	Hazard Identification HS-026, GEI Ergonomic Program	• Wear steel-toed boots and high visibility reflective vest when traversing work areas • Maintain good housekeeping in the work area to prevent slips, trips, and falls. • Maintain situational awareness and a high level of communication with others on site.

[1] Use the hierarchy of controls to determine applicable hazard controls for the task in order of most effective to least effective: Elimination (physically remove the hazard), Substitution (replace the hazard), Engineering Controls (Isolate the team from the hazard), Administrative Controls (change the way people work), PPE (personal protective equipment).

Task Steps	Potential Hazards	GEI SOP or Program	Hazard Controls[1]
			• Wear the proper type of glove to protect hands against sharp edges and skin/soft tissue injuries
3. Summa Cannister Sampling	Cuts/scrapes, slips/trips/falls,	Hazard Identification HS-026	• Inspect cannister before use. • Use appropriate tools for the job. • Do not overtighten valves/nuts. • Protect equipment by adequately marking work zone around the cannister.
4. Pack Air Samples	Heavy lifting, cuts, or abrasions	Manual Lifting HS–025 Ergonomic Program	• Place cushioning material in the top/bottom of the container • Use proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time
5. Demobilize from Site	Personal/material security, slips/trips/falls	Hazard Identification HS-026	• Confirm all materials are secured/labeled, including drums and any equipment left on site. • Confirm that any open trenches/pits are properly marked or barricaded. • Clean all equipment/tools prior to leaving. • Secure any gates/locks. • Notify project manager (or designee) you are leaving the site.

Appendix C

Safety Data Sheets

- 4-Gas Mix Calibration Gas
- Alconox
- Hydrogen Cyanide Calibration Gas
- Isobutylene Calibration Gas
- Liquinox
- Methanol
- Rust-Oleum Inverted Marking Paint
- Arsenic
- Carbon Disulfide
- Chromium
- Ethylbenzene
- Hydrogen Cyanide
- Hydrogen Sulfide
- Lead
- Mercury
- Naphthalene
- Toluene
- Xylenes

Oxygen (0.0015-19.49%), Methane (0.0005-2.5%), Carbon Monoxide (0.001-0.09%), Hydrogen Sulfide (0.001-0.025%) in Nitrogen Balance

Safety Data Sheet 50018

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 03/12/2015 Revision date: 12/19/2017 Supersedes: 07/20/2016 Version: 1.4

SECTION 1: Identification

1.1. Identification

Product form : Mixtures

Product name : Oxygen (0.0015-19.49%), Methane (0.0005-2.5%), Carbon Monoxide (0.001-0.09%), Hydrogen Sulfide (0.001-0.025%) in Nitrogen Balance

1.2. Recommended use and restrictions on use

Use of the substance/mixture : Test gas/Calibration gas.

1.3. Supplier

Calgaz, division of Airgas USA LLC
821 Chesapeake Drive
Cambridge, 21613 - USA
T 1-410-228-6400 - F 1-410-228-4251
info@Calgaz.com - www.Calgaz.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300
Internationally: 1-703-527-3887

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Gases under pressure Compressed gas	H280	Contains gas under pressure; may explode if heated

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS04

Signal word (GHS-US) : Warning

Hazard statements (GHS-US) : H280 - Contains gas under pressure; may explode if heated
OSHA-H01 - May displace oxygen and cause rapid suffocation
CGA-HG16 - Extended exposure to gas reduces the ability to smell sulfides.

Precautionary statements (GHS-US) : P202 - Do not handle until all safety precautions have been read and understood.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective gloves, protective clothing.
P308+P313 - If exposed or concerned: Get medical advice/attention.
P403 - Store in a well-ventilated place.
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C/125 °F
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG06 - Close valve after each use and when empty
CGA-PG10 - Use only with equipment rated for cylinder pressure
CGA-PG14 - Approach suspected leak area with caution
CGA-PG21 - Open valve slowly
CGA-PG29 - Do not depend on odor to detect presence of gas

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	GHS-US classification
Nitrogen	(CAS-No.) 7727-37-9	77.895 - 99.9965	Press. Gas (Comp.), H280
Oxygen	(CAS-No.) 7782-44-7	0.0015 - 19.49	Ox. Gas 1, H270 Press. Gas (Comp.), H280
Methane	(CAS-No.) 74-82-8	0.0005 - 2.5	Flam. Gas 1, H220 Press. Gas (Comp.), H280
Carbon monoxide	(CAS-No.) 630-08-0	0.0005 - 0.09	Flam. Gas 1, H220 Press. Gas (Comp.), H280 Acute Tox. 3 (Inhalation:gas), H331 Repr. 1A, H360 STOT RE 1, H372
Hydrogen Sulfide	(CAS-No.) 7783-06-4	0.001 - 0.025	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Acute Tox. 2 (Inhalation:gas), H330 STOT SE 3, H335 Aquatic Acute 1, H400

Full text of hazard classes and H-statements : see section 16

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If you feel unwell, seek medical advice.

First-aid measures after skin contact : Adverse effects not expected from this product.

First-aid measures after eye contact : Adverse effects not expected from this product.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects after inhalation : May displace oxygen and cause rapid suffocation.

Symptoms/effects after skin contact : Adverse effects not expected from this product.

Symptoms/effects after eye contact : Adverse effects not expected from this product.

Symptoms/effects after ingestion : Ingestion is not considered a potential route of exposure.

Symptoms/effects upon intravenous administration : Not known.

Chronic symptoms : Adverse effects not expected from this product.

Most important symptoms and effects, both acute and delayed : No effect on living tissue. Refer to section 11.

4.3. Immediate medical attention and special treatment, if necessary

If you feel unwell, seek medical advice. If breathing is difficult, give oxygen.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

Unsuitable extinguishing media : Do not use water jet to extinguish.

5.2. Specific hazards arising from the chemical

Fire hazard : The product is not flammable.

Explosion hazard : Product is not explosive. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries.

Reactivity : None known.

Hazardous combustion products : Carbon monoxide. Sulphur dioxide.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions : In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire.

Protection during firefighting : Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Do not enter fire area without proper protective equipment, including respiratory protection.

Specific methods : Exposure to fire may cause containers to rupture/explode. If possible, stop flow of product. Continue water spray from protected position until container stays cool. Move containers away from the fire area if this can be done without risk.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Ensure adequate ventilation.

6.1.1. For non-emergency personnel

Protective equipment : Wear protective equipment consistent with the site emergency plan.

Emergency procedures : Evacuate personnel to a safe area. Close doors and windows of adjacent premises. Keep containers closed. Mark the danger area. Seal off low-lying areas. Keep upwind.

6.1.2. For emergency responders

Protective equipment : Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Equip cleanup crew with proper protection.

Emergency procedures : Evacuate and limit access. Ventilate area.

6.2. Environmental precautions

Try to stop release if without risk.

6.3. Methods and material for containment and cleaning up

For containment : Try to stop release if without risk.

Methods for cleaning up : Dispose of contents/container in accordance with local/regional/national/international regulations.

Methods and material for containment and cleaning up : None.

6.4. Reference to other sections

See also Sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed : Pressurized container: Do not pierce or burn, even after use. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty.

Precautions for safe handling : Do not handle until all safety precautions have been read and understood. Use only outdoors or in a well-ventilated area.

Safe handling of the gas receptacle : Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents.

Safe use of the product : The product must be handled in accordance with good industrial hygiene and safety procedures. Only experienced and properly instructed persons should handle gases under pressure. Consider pressure relief device(s) in gas installations. Ensure the complete gas system was (or is regularily) checked for leaks before use. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Contact your gas supplier if in doubt.

Hygiene measures : Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations.

Storage conditions : Do not expose to temperatures exceeding 52 °C/ 125 °F. Keep container closed when not in use. Protect cylinders from physical damage; do not drag, roll, slide or drop. Store in well ventilated area.

Incompatible products : None known.

Incompatible materials : None known.

Conditions for safe storage, including any incompatibilities	:	Observe all regulations and local requirements regarding storage of containers. Containers should not be stored in conditions likely to encourage corrosion. Container valve guards or caps should be in place. Containers should be stored in the vertical position and properly secured to prevent them from falling over. Stored containers should be periodically checked for general condition and leakage. Keep container below 50°C in a well ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Keep away from combustible materials.
Storage area	:	Store away from heat. Store in a well-ventilated place.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Nitrogen (7727-37-9)
Not applicable

Methane (74-82-8)
Not applicable

Hydrogen Sulfide (7783-06-4)		
ACGIH	ACGIH TWA (ppm)	1 ppm
ACGIH	ACGIH STEL (ppm)	5 ppm
OSHA	OSHA PEL (Ceiling) (ppm)	20 ppm
OSHA	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	50 ppm Peak (10 minutes once, only if no other measurable exposure occurs)
IDLH	US IDLH (ppm)	100 ppm
NIOSH	NIOSH REL (ceiling) (mg/m³)	15 mg/m³
NIOSH	NIOSH REL (ceiling) (ppm)	10 ppm

Oxygen (7782-44-7)
Not applicable

Carbon monoxide (630-08-0)		
ACGIH	ACGIH TWA (ppm)	25 ppm
OSHA	OSHA PEL (TWA) (mg/m³)	55 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	50 ppm
IDLH	US IDLH (ppm)	1200 ppm
NIOSH	NIOSH REL (TWA) (mg/m³)	40 mg/m³
NIOSH	NIOSH REL (TWA) (ppm)	35 ppm
NIOSH	NIOSH REL (ceiling) (mg/m³)	229 mg/m³
NIOSH	NIOSH REL (ceiling) (ppm)	200 ppm

8.2. Appropriate engineering controls

Appropriate engineering controls	:	Ensure exposure is below occupational exposure limits (where available). Provide adequate general and local exhaust ventilation. Systems under pressure should be regularly checked for leakages. Oxygen detectors should be used when asphyxiating gases may be released. Consider the use of a work permit system e.g. for maintenance activities.
Environmental exposure controls	:	Refer to local regulations for restriction of emissions to the atmosphere. See section 13 for specific methods for waste gas treatment.

8.3. Individual protection measures/Personal protective equipment

Hand protection:

Wear working gloves when handling gas containers. 29 CFR 1910.138: Hand protection

Eye protection:

Wear safety glasses with side shields. 29 CFR 1910.133: Eye and Face Protection

Skin and body protection:

Wear suitable protective clothing, e.g. lab coats, coveralls or flame resistant clothing.

Respiratory protection:

None necessary during normal and routine operations. See Sections 5 & 6.

Thermal hazard protection:

None necessary during normal and routine operations.

Other information:

Wear safety shoes while handling containers. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Gas
Appearance	:	Clear, colorless gas.
Color	:	Colorless
Odor	:	Rotten eggs
Odor threshold	:	No data available
pH	:	No data available
Melting point	:	No data available
Freezing point	:	No data available
Boiling point	:	No data available
Flash point	:	No data available
Relative evaporation rate (butyl acetate=1)	:	No data available
Flammability (solid, gas)	:	Non flammable.
Vapor pressure	:	No data available
Relative vapor density at 20 °C	:	No data available
Relative density	:	No data available
Relative gas density	:	Similar to air
Solubility	:	Water: No data available
Log Pow	:	Not applicable for gas-mixtures. Not applicable for gas-mixtures.
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	No data available
Explosive properties	:	Not applicable (non-flammable gas).
Oxidizing properties	:	None.

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

None known.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

None known.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

None known.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Nitrogen (7727-37-9)	
LC50 inhalation rat (ppm)	820000 ppm/4h
ATE US (gases)	820000.000 ppmV/4h

Methane (74-82-8)	
LC50 inhalation rat (ppm)	820000 ppm/4h
ATE US (gases)	820000.000 ppmV/4h

Hydrogen Sulfide (7783-06-4)	
LC50 inhalation rat (mg/l)	700 mg/m³ (Exposure time: 4 h)
LC50 inhalation rat (ppm)	356 ppm/4h
ATE US (gases)	356.000 ppmV/4h
ATE US (vapors)	0.990 mg/l/4h
ATE US (dust, mist)	0.990 mg/l/4h

Oxygen (7782-44-7)	
LC50 inhalation rat (ppm)	800000 ppm/4h
ATE US (gases)	800000.000 ppmV/4h

Carbon monoxide (630-08-0)	
LC50 inhalation rat (ppm)	1880 ppm/4h
ATE US (gases)	1880.000 ppmV/4h

Skin corrosion/irritation : Not classified

Serious eye damage/irritation : Not classified

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity – single exposure : Not classified

Specific target organ toxicity – repeated exposure : Not classified

Aspiration hazard : Not classified

Symptoms/effects after inhalation : May displace oxygen and cause rapid suffocation.

Symptoms/effects after skin contact : Adverse effects not expected from this product.

Symptoms/effects after eye contact : Adverse effects not expected from this product.

Symptoms/effects after ingestion : Ingestion is not considered a potential route of exposure.

Symptoms/effects upon intravenous administration : Not known.

Chronic symptoms : Adverse effects not expected from this product.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

Methane (74-82-8)	
LC50-96 h - fish [mg/l]	147.5 mg/l
EC50 48h - Daphnia magna [mg/l]	69.4 mg/l
EC50 72h Algae [mg/l]	19.4 mg/l

Hydrogen Sulfide (7783-06-4)	
LC50 fish 1	0.0448 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [flow-through])
LC50 fish 2	0.016 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
LC50-96 h - fish [mg/l]	0.007 - 0.019 mg/l
EC50 48h - Daphnia magna [mg/l]	0.12 mg/l
EC50 72h Algae [mg/l]	1.87 mg/l

Carbon monoxide (630-08-0)	
LC50-96 h - fish [mg/l]	Study scientifically unjustified.
EC50 48h - Daphnia magna [mg/l]	Study scientifically unjustified.
EC50 72h Algae [mg/l]	Study scientifically unjustified.

12.2. Persistence and degradability

Oxygen (0.0015-19.49%), Methane (0.0005-2.5%), Carbon Monoxide (0.001-0.09%), Hydrogen Sulfide (0.001-0.025%) in Nitrogen Balance	
Persistence and degradability	No data available.

Nitrogen (7727-37-9)	
Persistence and degradability	No ecological damage caused by this product.

Methane (74-82-8)	
Persistence and degradability	The substance is readily biodegradable. Unlikely to persist.

Hydrogen Sulfide (7783-06-4)	
Persistence and degradability	Not applicable for inorganic gases.

Oxygen (7782-44-7)	
Persistence and degradability	No ecological damage caused by this product.

Carbon monoxide (630-08-0)	
Persistence and degradability	Will not undergo hydrolysis. Not readily biodegradable. Not applicable for inorganic gases.

12.3. Bioaccumulative potential

Oxygen (0.0015-19.49%), Methane (0.0005-2.5%), Carbon Monoxide (0.001-0.09%), Hydrogen Sulfide (0.001-0.025%) in Nitrogen Balance	
Log Pow	Not applicable for gas-mixtures.
Log Kow	Not applicable for gas-mixtures.
Bioaccumulative potential	No data available.

Nitrogen (7727-37-9)	
Log Pow	Not applicable for inorganic gases.
Bioaccumulative potential	No ecological damage caused by this product.

Methane (74-82-8)	
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

Hydrogen Sulfide (7783-06-4)	
BCF fish 1	(no bioaccumulation expected)
Log Pow	Not applicable for inorganic gases.
Bioaccumulative potential	No data available.

Oxygen (7782-44-7)	
Log Pow	Not applicable for inorganic gases.
Bioaccumulative potential	No ecological damage caused by this product.

Carbon monoxide (630-08-0)	
Log Pow	1.78

Carbon monoxide (630-08-0)	
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

12.4. Mobility in soil

Oxygen (0.0015-19.49%), Methane (0.0005-2.5%), Carbon Monoxide (0.001-0.09%), Hydrogen Sulfide (0.001-0.025%) in Nitrogen Balance	
Mobility in soil	No data available

Nitrogen (7727-37-9)	
Ecology - soil	No ecological damage caused by this product.

Methane (74-82-8)	
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

Hydrogen Sulfide (7783-06-4)	
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

Oxygen (7782-44-7)	
Ecology - soil	No ecological damage caused by this product.

Carbon monoxide (630-08-0)	
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Disposal methods

Waste treatment methods : Contact supplier if guidance is required. Do not discharge into any place where its accumulation could be dangerous. Ensure that the emission levels from local regulations or operating permits are not exceeded.

Product/Packaging disposal recommendations : Refer to the CGA Pamphlet P-63 "Disposal of Gases" available at www.cganet.com for more guidance on suitable disposal methods.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1956 Compressed gas, n.o.s. (Nitrogen, Oxygen), 2.2

UN-No.(DOT) : UN1956

Proper Shipping Name (DOT) : Compressed gas, n.o.s.

Class (DOT) : 2.2 - Class 2.2 - Non-flammable compressed gas 49 CFR 173.115

Hazard labels (DOT) : 2.2 - Non-flammable gas



DOT Packaging Non Bulk (49 CFR 173.xxx) : 302;305

DOT Packaging Bulk (49 CFR 173.xxx) : 314;315

DOT Symbols : G - Identifies PSN requiring a technical name

DOT Packaging Exceptions (49 CFR 173.xxx) : 306;307

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 75 kg

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 150 kg

DOT Vessel Stowage Location : A - The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel.

Other information : No supplementary information available.

Special transport precautions	:	Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transportation of Dangerous Goods

Transport document description	:	UN1956 Compressed gas, n.o.s., 2.2
UN-No. (TDG)	:	UN1956
Proper Shipping Name	:	Compressed gas, n.o.s.
TDG Primary Hazard Classes	:	2.2 - Class 2.2 - Non-Flammable, Non-Toxic Gas.
TDG Special Provisions	:	16 - (1) The technical name of at least one of the most dangerous substances that predominantly contributes to the hazard or hazards posed by the dangerous goods must be shown, in parentheses, on the shipping document following the shipping name in accordance with clause 3.5(1)(c)(ii)(A) of Part 3 (Documentation). The technical name must also be shown, in parentheses, on a small means of containment or on a tag following the shipping name in accordance with subsections 4.11(2) and (3) of Part 4 (Dangerous Goods Safety Marks). (2) Despite subsection (1), the technical name for the following dangerous goods is not required to be shown on a shipping document or on a small means of containment when Canadian law for domestic transport or an international convention for international transport prohibits the disclosure of the technical name: (a)UN1544, ALKALOID SALTS, SOLID, N.O.S. or ALKALOIDS, SOLID, N.O.S; (b)UN1851, MEDICINE, LIQUID, TOXIC, N.O.S; (c)UN3140, ALKALOID SALTS, LIQUID, N.O.S. or ALKALOIDS, LIQUID, N.O.S; (d)UN3248, MEDICINE, LIQUID, FLAMMABLE, TOXIC, N.O.S; or (e)UN3249, MEDICINE, SOLID, TOXIC, N.O.S. An example in Canada is the “Food and Drugs Act”. (3) Despite subsection (1), the technical name for the following dangerous goods is not required to be shown on a small means of containment: (a)UN2814, INFECTIOUS SUBSTANCE, AFFECTING HUMANS; or (b)UN2900, INFECTIOUS SUBSTANCE, AFFECTING ANIMALS. SOR/2014-306,148 - (1) Part 5 (Means of Containment) does not apply to radiation detectors that contain these dangerous goods in non-refillable pressure receptacles if (a)the working pressure in each receptacle is less than 5 000 KPa; (b)the capacity of each receptacle is less than 12 L; (c)each receptacle has a minimum burst pressure of (i)at least 3 times the working pressure, when the receptacle is fitted with a relief device, or (ii)at least 4 times the working pressure, when the receptacle is not fitted with a relief device; (d)each receptacle is manufactured from material that will not fragment upon rupture; (e)each detector is manufactured under a quality assurance program; ISO 9001:2008 is an example of a quality assurance program. (f)the detectors are transported in strong outer means of containment; and (g)a detector in its outer means of containment is capable of withstanding a 1.2 m drop test without breakage of the detector or rupture of the outer means of containment. (2)Part 5 (Means of Containment) does not apply to radiation detectors that contain these dangerous goods in non-refillable pressure receptacles and that are included in equipment, if (a)the conditions set out in paragraphs (1)(a) to (e) are met; and (b)the equipment is contained in a strong outer means of containment or the equipment affords the detectors with protection that is equivalent to that provided by a strong outer means of containment. (3)These Regulations, except for Part 1 (Coming into Force, Repeal, Interpretation, General Provisions and Special Cases) and Part 2 (Classification), do not apply to radiation detectors that contain these dangerous goods in non-refillable pressure receptacles, including detectors in radiation detection systems, if the detectors meet the requirements of subsection (1) or (2), as applicable, and the capacity of the receptacles that contain the detectors is less than 50 mL. SOR/2014-306
Explosive Limit and Limited Quantity Index	:	0.125 L
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index	:	75 L

Transport by sea

Transport document description (IMDG)	:	UN 1956 COMPRESSED GAS, N.O.S., 2
UN-No. (IMDG)	:	1956
Proper Shipping Name (IMDG)	:	COMPRESSED GAS, N.O.S.
Class (IMDG)	:	2 - Gases
Limited quantities (IMDG)	:	120 ml

Air transport

Transport document description (IATA)	:	UN 1956 COMPRESSED GAS, N.O.S., 2.2

UN-No. (IATA)	:	1956
Proper Shipping Name (IATA)	:	COMPRESSED GAS, N.O.S.
Class (IATA)	:	2

SECTION 15: Regulatory information

15.1. US Federal regulations

Nitrogen (7727-37-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	

Methane (74-82-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	

Hydrogen Sulfide (7783-06-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on the United States SARA Section 302 Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	100 lb
Section 302 EPCRA Reportable Quantity (RQ)	100 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	500 lb
SARA Section 313 - Emission Reporting	1 %

Oxygen (7782-44-7)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

Carbon monoxide (630-08-0)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

15.2. International regulations

CANADA

Nitrogen (7727-37-9)
Listed on the Canadian DSL (Domestic Substances List)

Methane (74-82-8)
Listed on the Canadian DSL (Domestic Substances List)

Hydrogen Sulfide (7783-06-4)
Listed on the Canadian DSL (Domestic Substances List)

Oxygen (7782-44-7)
Listed on the Canadian DSL (Domestic Substances List)

Carbon monoxide (630-08-0)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Nitrogen (7727-37-9)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

Methane (74-82-8)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

Hydrogen Sulfide (7783-06-4)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

Oxygen (7782-44-7)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

Carbon monoxide (630-08-0)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

National regulations

Nitrogen (7727-37-9)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

Methane (74-82-8)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on CICR (Turkish Inventory and Control of Chemicals) Listed on the TCSI (Taiwan Chemical Substance Inventory)

Hydrogen Sulfide (7783-06-4)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on the Canadian IDL (Ingredient Disclosure List) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

Oxygen (7782-44-7)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

Carbon monoxide (630-08-0)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on the Canadian IDL (Ingredient Disclosure List) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Carbon monoxide (630-08-0)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significant risk level (NSRL)
No	Yes	No	No	

Nitrogen (7727-37-9)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

Methane (74-82-8)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List

Hydrogen Sulfide (7783-06-4)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
U.S. - Pennsylvania - RTK (Right to Know) List

Oxygen (7782-44-7)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List

Carbon monoxide (630-08-0)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Revision date : 12/19/2017

Other information : This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product.

Full text of H-phrases:

H220	Extremely flammable gas
H270	May cause or intensify fire; oxidizer
H280	Contains gas under pressure; may explode if heated
H330	Fatal if inhaled
H331	Toxic if inhaled
H335	May cause respiratory irritation
H360	May damage fertility or the unborn child
H372	Causes damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life

SDS US (GHS HazCom 2012)

This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this gas mixture. To the best of Calgaz's knowledge, the information contained herein is reliable and accurate as of this date; however, accruacy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Alconox®
Product number: 1101, 1103, 1104, 1104-1, 1112, 1112-1, 1125, 1150

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 – 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:
Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:
ChemTel Inc
North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Eye damage, category 1.

Skin irritation, category 2.

Product at recommended dilution:
Eye irritation, category 2B

Hazard pictograms:



Signal word: Danger

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:
P264 Wash skin thoroughly after handling.

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

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.

Hazardous Elements at Use Dilution:

Hazard Pictograms:



Signal Word: Warning
Hazard Statements:
H320 Causes eye irritation

Precautionary statements:
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.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery if wet. Use caution in areas of foot traffic if on floors.

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, 29CFR1910/1200 and GHS Requirements, 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: Not determined or not available.

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 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2; H315 Eye Dam. 1; H318	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	2-16

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

Hazardous components at use dilution (percentages by weight):

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Eye Irrit. 2; H319	0.12 - 0.28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irrit. 2; H319	0.08 – 0.22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Eye Irrit. 2; H319	0.02 – 0.16

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.

First aid measure at recommended dilution:

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.

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.

After swallowing:

Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

5 Firefighting measures

Safety Data Sheet

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:

No expected hazards under normal use condition.

Avoid breathing mist or vapor if aerosolized.
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.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

8 Exposure controls/personal protection





8.1 Control parameters:

a) 7722-88-5, Tetrasodium Pyrophosphate, ACGIH TWA 10 mg/m3
b) 7758-29-4, Sodium Tripolyphosphate, ACGIH TWA 10 mg/m3
c) Dusts, non-specific OEL, Irish Code of Practice
   (i) Total inhalable 10 mg/m3 (8hr)
   (ii) Respirable 4 mg/m3 (8hr)
   (iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

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 use conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or notavailable. Not determined or notavailable.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or notavailable.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or notavailable.
pH-value:	9.5 (1% aqueous solution)	**Relative density**:	Not determined or notavailable.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or notavailable.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or notavailable.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or notavailable.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or notavailable.

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: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

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 damage.

Tetrasodium Pyrophosphate: Risk of serious damage to eyes.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

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.

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

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 2.9 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:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Non Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

	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 as active.
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.
EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts
EC 551/2009 – This is not a laundry or dishwasher detergent
EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

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.
H318 Causes serious eye damage.

NFPA: 1-0-0
HMIS: 1-0-0

At recommended dilution:
NFPA: 1-0-0
HMIS: 1-0-0

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.

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

* 1 Identification

· **Product identifier**

· **Trade name: Precision Calibration Gas Mixture**
· **Product number:** G-3915
· **Relevant identified uses of the substance or mixture and uses advised against**
Used for calibration of gas measuring devices. Not suitable for human consumption.
· **Product description** Calibration gas mixture consisting of Hydrogen Cyanide and Nitrogen.

· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Gasco Affiliates, LLC
320 Scarlett Blvd.
Oldsmar, Fl 34677

TELEPHONE NUMBER: (800) 910-0051
FAX NUMBER: (866) 755-8920
E-MAIL: info@gascogas.com
· **Emergency telephone number:**
Inside the US: 1-800-424-9300 (CHEMTREC, 24 hours)
Outside the US: 1-703-527-3887 (CHEMTREC, 24 hours)

* 2 Hazard(s) identification

· **Classification of the substance or mixture**


GHS04 Gas cylinder

Press. Gas	H280	Contains gas under pressure; may explode if heated.


GHS07

Acute Tox. 4	H312	Harmful in contact with skin.
Acute Tox. 4	H332	Harmful if inhaled.
Skin Irrit. 2	H315	Causes skin irritation.
Eye Irrit. 2B	H320	Causes eye irritation.
Simple Asphyxiant		May displace oxygen and cause rapid suffocation.

· **Label elements**
· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**


GHS04 GHS07

· **Signal word** Warning
· **Hazard statements**
Contains gas under pressure; may explode if heated.
Harmful in contact with skin or if inhaled.

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

Causes skin and eye irritation.
May displace oxygen and cause rapid suffocation.

· ***Precautionary statements***
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves.
Wear protective gloves / protective clothing.
Wash thoroughly after handling.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see supplementary first aid instructions on this Safety Data Sheet).
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Call a poison center/doctor if you feel unwell.
If skin irritation occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
If on skin: Wash with plenty of water.
Take off contaminated clothing and wash it before reuse.
Protect from sunlight. Store in a well-ventilated place.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· ***Unknown acute toxicity:***
100 percent of the mixture consists of ingredient(s) of unknown toxicity.

· ***Classification system:***

· ***NFPA ratings (scale 0 - 4)***



Health = 2
Fire = 0
Reactivity = 0

· ***HMIS-ratings (scale 0 - 4)***



Health = 2
Fire = 0
Reactivity = 0

· ***Hazard(s) not otherwise classified (HNOC):*** None known

* 3 Composition/information on ingredients

· ***Chemical characterization: Mixtures***
· ***Description:*** Mixture of substances listed below with nonhazardous additions.

· ***Dangerous Components:***

CAS: 7727-37-9 RTECS: QW 9700000	Nitrogen Press. Gas, H280; Simple Asphyxiant	99.98 - 99.9999%
CAS: 74-90-8 RTECS: MW 6825000	Hydrogen Cyanide Flam. Liq. 1, H224; Acute Tox. 2, H300; Acute Tox. 1, H310; Acute Tox. 2, H330; Aquatic Acute 1, H400; Aquatic Chronic 1, H410	0.0001 - 0.02%

* 4 First-aid measures

· ***Description of first aid measures***
· ***General information:***
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

· ***After inhalation:***
Get medicall attention immediately. Move person to fresh air. If it is expected that fumes are still present, the rescuer should wear an appropraiate mask or self-contained breathin apparatus.
In case of unconsciousness, place patient securely on side position for transportation.
· ***After skin contact:***
Immediately wash skin with soap and plenty of water for at least 20 minutes.
In cases of contact with liquified material, frostbite may occur. Immerse frostbite in cool-warm water and seek medical attention.
If skin irritation occurs, consult a doctor.
· ***After eye contact:***
Rinse opened eye for at least 15 minutes under running water. If symptoms persist, consult a doctor.
· ***After swallowing:*** Not a normal route of entry.
· ***Information for doctor:***
· ***Most important symptoms and effects, both acute and delayed:*** No further relevant information available.
· ***Indication of any immediate medical attention and special treatment needed***
No further relevant information available.

* 5 Fire-fighting measures

· ***Extinguishing media***
· ***Suitable extinguishing agents:***
Use fire fighting measures that suit the environment.
Use water spray to cool fire-exposed containers.
· ***Special hazards arising from the substance or mixture***
Closed containers may explode when exposed to extreme heat.
If incinerated, product will release the following toxic fumes: Oxides of Nitrogen (NOx) and Hydrogen Cyanide gas.
· ***Advice for firefighters***
This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.
· ***Protective equipment:***
As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

* 6 Accidental release measures

· ***Personal precautions, protective equipment and emergency procedures***
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
Keep people at a distance and stay upwind.
Treat any fumes as toxic.
· ***Environmental precautions:*** Inform authorities in case of gas release.
· ***Methods and material for containment and cleaning up:***
Dispose contaminated material as waste according to section 13.
Ensure adequate ventilation.
Dispose of the collected material according to regulations.
· ***Reference to other sections***
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

(Contd. on page 4)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

* 7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms due to the potential for oxygen deficiency (simple asphyxiation). Do not attempt to adjust, repair or in any other way modify the cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.
· **Information about protection against explosions and fires:**
Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50 °C, i.e. electric lights. Do not pierce or burn, even after use.
Do not cut, grind or weld on container that contains or contained product.
Do not spray on a naked flame or any incandescent material.

· **Conditions for safe storage, including any incompatibilities**
Store away from strong acids, strong bases, strong oxidizing agents and amines.
· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Store in a cool location.
Cylinders should be firmly secured to prevent falling or being knocked over. Cylinders must be protected from the environment, and preferably kept at room temperature. Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage. Full and empty cylinders should be segregated. Use a "first-on, first-out" inventory system to prevent full containers from being stored for long periods of time.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Store in cool, dry conditions in well sealed receptacles.
· **Specific end use(s)** No further relevant information available.

* 8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see section 7.

· **Control parameters**
All ventilation should be designed in accordance with OSHA standard (29 CFR 1910.94). Use mechanical (general) ventilation for storage areas. Use appropriate ventilation as required to keep Exposure Limits in Air below TLV & PEL limits.

· **Components with occupational exposure limits:**	
7727-37-9 Nitrogen	
TLV	withdrawn TLV, see App. F; simple asphyxiant
74-90-8 Hydrogen Cyanide	
PEL	Long-term value: 11 mg/m³, 10 ppm Skin
REL	Short-term value: 5 mg/m³, 4.7 ppm Skin
TLV	Ceiling limit value: 5 mg/m³, 4.7 ppm as CN; Skin

· **Additional information:** The lists that were valid during the creation of this SDS were used as basis.

(Contd. on page 5)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing and wash before reuse.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
· **Breathing equipment:**



Suitable respiratory protective device recommended.

· **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Select glove material based on penetration times, rates of diffusion and degradation.
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break-through time has to be determined and observed by the manufacturer of the protective gloves.
· **Eye protection:**



Tightly sealed goggles

· **Body protection:**



Protective work clothing

* 9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Gaseous
Color:	Clear, colorless
· **Odor:**	Bitter almonds
· **Odor threshold:**	Not determined.

(Contd. on page 6)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

· **pH-value:**	Not determined.
· **Change in condition**	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Not determined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Product is not flammable.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Not determined.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not determined.
· **Density:**	
Relative density	Not determined.
Vapor density	Not determined.
Evaporation rate	Not applicable.
· **Solubility in / Miscibility with**	
Water:	Not miscible or difficult to mix.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not determined.
Kinematic:	Not determined.
· **Solvent content:**	
Organic solvents:	0.0 %
· **Other information**	No further relevant information available.

* 10 Stability and reactivity

· **Reactivity** No further relevant information available.
· **Chemical stability** Stable under normal conditions.
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** Strong acids, strong bases, strong oxidizing agents and amines.
· **Hazardous decomposition products:** Nitrogen Oxides (NOx) and Hydrogen Cyanide gas.

* 11 Toxicological information

· **Information on toxicological effects** The toxicity of this product is unknown.
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** Irritant to skin and mucous membranes.
· **on the eye:**
Irritating effect.

(Contd. on page 7)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

Causes serious eye irritation.

· ***Additional toxicological information:***
The product shows the following dangers according to internally approved calculation methods for preparations:
Harmful
Irritant

· ***Carcinogenic categories***
· ***IARC (International Agency for Research on Cancer)***
Group 1 - Carcinogenic to humans
Group 2A - Probably carcinogenic to humans
Group 2B - Possibly carcinogenic to humans
Group 3 - Not classifiable as to its carcinogenicity to humans
Group 4 - Probably not carcinogenic to humans

None of the ingredients are listed.

· ***NTP (National Toxicology Program)***

None of the ingredients are listed.

· ***OSHA-Ca (Occupational Safety & Health Administration)***

None of the ingredients are listed.

* 12 Ecological information

· ***Toxicity*** The hazards for the aquatic environment are unknown.
· ***Aquatic toxicity:*** No further relevant information available.
· ***Persistence and degradability*** No further relevant information available.
· ***Behavior in environmental systems:***
· ***Bioaccumulative potential*** No further relevant information available.
· ***Mobility in soil*** No further relevant information available.
· ***Additional ecological information:***
· ***General notes:*** Not known to be hazardous to water.
· ***Results of PBT and vPvB assessment***
· ***PBT:*** Not applicable.
· ***vPvB:*** Not applicable.
· ***Other adverse effects*** No further relevant information available.

* 13 Disposal considerations

· ***Waste treatment methods***
· ***Recommendation:***
Release all residual gas pressure in a well ventilated area. Verify the cylinder is completely empty (0 PSIG). Remove or cover any hazard labels. Return empty cylinder for recycling.
NOTE: Check with the local easte authority before placing any gas cylinder into waste container for pickup. GASCO encourages the consumer to return all cylinders.
· ***Waste disposal key:***
The U.S. EPA has not published waste disposal numbers for this product's components.

· ***Uncleaned packagings:***
· ***Recommendation:*** Return cylinder and unused product to supplier.

* 14 Transport information

· ***UN-Number***
· ***DOT, ADR, IMDG, IATA*** UN1956

(Contd. on page 8)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

· **UN proper shipping name**
· **DOT** Compressed gas, n.o.s.
· **ADR** UN1956 Compressed gas, n.o.s.
· **IMDG, IATA** COMPRESSED GAS, N.O.S.
· **Transport hazard class(es)**

· **DOT**



· **Class** 2.2
· **Label** 2.2

· **ADR**



· **Class** 2.2 1A
· **Label** 2.2

· **IMDG, IATA**



· **Class** 2.2
· **Label** 2.2
· **Packing group**
· **DOT, ADR, IMDG, IATA** Non-Regulated Material
· **Environmental hazards:** Not applicable.
· **Special precautions for user** Not applicable.
· **Danger code (Kemler):** 20
· **EMS Number:** F-C,S-V
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.

· **Transport/Additional information:**

· **DOT**
· **Quantity limitations** On passenger aircraft/rail: 75 kg
On cargo aircraft only: 150 kg

· **ADR**
· **Excepted quantities (EQ)** Code: E1
Maximum net quantity per inner packaging: 30 ml
Maximum net quantity per outer packaging: 1000 ml

· **IMDG**
· **Limited quantities (LQ)** 120 ml
· **Excepted quantities (EQ)** Code: E1
Maximum net quantity per inner packaging: 30 ml
Maximum net quantity per outer packaging: 1000 ml

(Contd. on page 9)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 Reviewed on 06/25/2015

Trade name: Precision Calibration Gas Mixture

· **UN "Model Regulation":** UN1956, Compressed gas, n.o.s., 2.2

* 15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**

· **Section 355 (extremely hazardous substances):**

74-90-8	Hydrogen Cyanide

· **Section 313 (Specific toxic chemical listings):**

74-90-8	Hydrogen Cyanide

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **California Proposition 65**

· **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:**

74-90-8	Hydrogen Cyanide

· **Chemicals known to cause developmental toxicity:**
None of the ingredients are listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

74-90-8	Hydrogen Cyanide	II

· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients are listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients are listed.

· **GHS label elements**
The substance is classified and labeled according to the Globally Harmonized System (GHS).
· **Hazard pictograms**



GHS04 GHS07

· **Signal word** Warning
· **Hazard statements**
Contains gas under pressure; may explode if heated.
Harmful in contact with skin or if inhaled.
Causes skin and eye irritation.
May displace oxygen and cause rapid suffocation.
· **Precautionary statements**
Avoid breathing dust/fume/gas/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.
Wear protective gloves.

(Contd. on page 10)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 *Reviewed on 06/25/2015*

Trade name: Precision Calibration Gas Mixture

Wear protective gloves / protective clothing.
Wash thoroughly after handling.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Specific treatment (see supplementary first aid instructions on this Safety Data Sheet).
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
Call a poison center/doctor if you feel unwell.
If skin irritation occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
If on skin: Wash with plenty of water.
Take off contaminated clothing and wash it before reuse.
Protect from sunlight. Store in a well-ventilated place.
Dispose of contents/container in accordance with local/regional/national/international regulations.

· ***National regulations:***

The product is subject to be classified according with the latest version of the regulations on hazardous substances.

· ***State Right to Know***

CAS: 7727-37-9 RTECS: QW 9700000	Nitrogen Press. Gas, H280; Simple Asphyxiant	99.98 - 99.9999%
CAS: 74-90-8 RTECS: MW 6825000	Hydrogen Cyanide Flam. Liq. 1, H224; Acute Tox. 2, H300; Acute Tox. 1, H310; Acute Tox. 2, H330; Aquatic Acute 1, H400; Aquatic Chronic 1, H410	0.0001 - 0.02%

All ingredients are listed.

· ***Chemical safety assessment:*** A Chemical Safety Assessment has not been carried out.

* 16 Other information

· ***Relevant phrases***
Gasco Affiliates, LLC, makes not express or implied warranties, guarantees or representations regarding the product of the information herein, including but not limited to any implied warranty or merchantability or fitness for use. Gasco Affilitates, LLC shall not be liable for any personal injury, property or other damages of any nature, whether compensatory, consequential, exemplary, or otherwise, resulting from any publication, use of reliance upon the information herein.

· ***Date of preparation / last revision*** 06/25/2015 / -

· ***Abbreviations and acronyms:***
ADR: The European Agreement concerning the International Carriage of Dangerous Goods by Road
ADN: The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
Press. Gas: Gases under pressure: Compressed gas
Flam. Liq. 1: Flammable liquids, Hazard Category 1
Acute Tox. 2: Acute toxicity, Hazard Category 2
Acute Tox. 1: Acute toxicity, Hazard Category 1
Acute Tox. 4: Acute toxicity, Hazard Category 4
Skin Irrit. 2: Skin corrosion/irritation, Hazard Category 2
Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B

(Contd. on page 11)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 06/25/2015 *Reviewed on 06/25/2015*

Trade name: Precision Calibration Gas Mixture

Aquatic Acute 1: Hazardous to the aquatic environment - AcuteHazard, Category 1
Aquatic Chronic 1: Hazardous to the aquatic environment - Chronic Hazard, Category 1

· **** Data compared to the previous version altered.***

SDS created by MSDS Authoring Services www.msdsauthoring.com +1-877-204-9106

SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

CAS number/other identifiers

CAS number : 115-11-7

Product code : 001031

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color : Colorless.

Molecular weight : 56.12 g/mole

Molecular formula : C4-H8

Boiling/condensation point : -6.9°C (19.6°F)

Melting/freezing point : -140.7°C (-221.3°F)

Critical temperature : 144.75°C (292.6°F)

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Closed cup: -76.1°C (-105°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.6845

Gas Density (lb/ft ^{3}) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.263 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

SADT : Not available.

Section 9. Physical and chemical properties

Viscosity : Not applicable.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Isobutylene	2.34	-	low

Section 12. Ecological information

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 19, T50	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 29	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 150 kg

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 14. Transport information

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Isobutylene	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : This material is listed or exempted.

Malaysia : Not determined.

Section 15. Regulatory information

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Canada

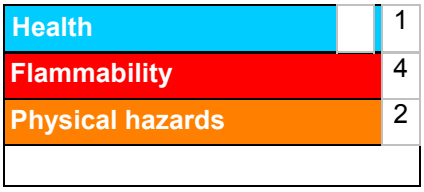
WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Flam. Gas 1, H220 Press. Gas Liq. Gas, H280	Expert judgment Expert judgment

History

Date of printing : 7/11/2016

Date of issue/Date of revision : 7/11/2016

Date of previous issue : No previous validation

Section 16. Other information

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Liquinox®
Product number: 1201, 1201-1, 1205, 1215, 1230, 1232, 1232-1, 1255

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 - 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:

Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:
ChemTel Inc
North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:
Alcohol ethoxylate
Sodium alkylbenzene sulfonate
Sodium xylenesulphonate
Lauramine oxide

2.2 Label elements:

Eye damage, category 1.
Skin irritation, category 2.

Product at recommended dilution:

Eye irritation, category 2B

Hazard pictograms:



Signal word: Danger

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

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.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P501 Dispose of contents and container as instructed in Section 13.

Hazardous Elements at Use Dilution:

Hazard pictograms:



Signal word: Warning

Hazard statements:

H320 Causes eye irritation

Precautionary statements:

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.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery. Use caution in areas of foot traffic if on floors.

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, 29CFR1910/1200 and GHS, 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: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Dam. 1; H318	10-25
CAS number: 1300-72-7	Sodium Xylenesulphonate	Eye Irrit. 2;H319	2.5-10
CAS number: 84133-50-6	Alcohol Ethoxylate	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	2.5-10
CAS number: 1643-20-5	Lauramine oxide	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	1-2

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

At use dilution:

CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irr. 2B; H319	0.1-0.25

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.

First aid measure at recommended dilution:

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.

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.

After swallowing:
Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

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 :

25322-68-3, Poly(ethylene oxide), AIHA TWA 10 mg/m3 (<0.15% present in concentrate)

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

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.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	Pale yellow liquid	**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:	8.5 (as is)	**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 flammable	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	1.08 g/mL		

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

10 Stability and reactivity

10.1 Reactivity: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

11 Toxicological information

11.1 Information on toxicological effects:

Acute Toxicity:

Oral:

: LD50 >5000 mg per kg (Rat, Oral) - product.

Chronic Toxicity: No additional information.

Skin corrosion/irritation (raw materials):

Alcohol Ethoxylate: May cause mild to moderate skin irritation.

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Lauramine oxide: Causes skin irritation.

Serious eye damage/irritation (raw materials):

Sodium Alkylbenzene Sulfonate: Causes serious eye damage.

Alcohol Ethoxylate: Causes moderate to severe eye irritation and conjunctivitis.

Sodium xylenesulphonate: irritating to eyes.

Lauramine oxide: Causes serious eye damage.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

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.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.9 mg/l, 48 hours. Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Lauramine oxide: Fish, LC50 24.3 mg/l, 96h [Killifish (Cyprinodontidae)]
Lauramine oxide: Aquatic invertebrates, (LC50): 3.6 mg/l 96 hours [Daphnia (Daphnia)].
Lauramine oxide: Aquatic plants, EC50 Algae 0.31 mg/l 72 hours [Algae]
Alcohol Ethoxylate: Aquatic invertebrates, (LC50): 4.01 mg/l 48 hours [Daphnia (daphnia)].

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: None
ADR, ADN, DOT, IMDG, IATA

14.2 UN Proper shipping name: None
ADR, ADN, DOT, IMDG, IATA

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class: None
Label: None
LTD. QTY: None

US DOT
Limited Quantity Exception: None

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

Bulk: **RQ (if applicable):** None **Proper shipping Name:** None **Hazard Class:** None **Packing Group:** None **Marine Pollutant (if applicable):** No additional information. **Comments:** None	**Non Bulk:** **RQ (if applicable):** None **Proper shipping Name:** None **Hazard Class:** None **Packing Group:** None **Marine Pollutant (if applicable):** No additional information. **Comments:** None
14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards:	None
14.6 Special precautions foruser:	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 as active.
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.

Safety Data Sheet

Effective date: 11 May 2020 **Revision** : 11 May 2020

Trade Name: Liquinox®

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.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H318 Causes serious eye damage.

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.
P332+P313 If skin irritation occurs: Get medical advice/attention.
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

At recommended dilution:

NFPA: 1-0-0
HMIS: 1-0-0

SAFETY DATA SHEET

Creation Date 27-Apr-2009 **Revision Date** 26-Dec-2021 **Revision Number** 9

1. Identification

Product Name **Methanol**

Cat No. : **AC423950000; AC423950010; AC423950025; AC423950040; AC423950200; AC423950250; AC423955000**

CAS No 67-56-1
Synonyms Methyl alcohol

Recommended Use Laboratory chemicals.
Uses advised against .

Details of the supplier of the safety data sheet

Company

Fisher Scientific Company
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute oral toxicity	Category 3
Acute dermal toxicity	Category 3
Acute Inhalation Toxicity - Vapors	Category 3
Specific target organ toxicity (single exposure)	Category 1
Target Organs - Optic nerve, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Kidney, Liver, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Causes damage to organs
Causes damage to organs through prolonged or repeated exposure
Toxic if swallowed, in contact with skin or if inhaled



Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Response
IF exposed: Call a POISON CENTER or doctor/physician
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician
Skin
Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Rinse mouth
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)

Other hazards
Poison, may be fatal or cause blindness if swallowed. Vapor harmful. CANNOT BE MADE NON-POISONOUS.
WARNING. Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS No	Weight %
Methyl alcohol	67-56-1	>95

4. First-aid measures

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion Do NOT induce vomiting. Call a physician or poison control center immediately.

Most important symptoms and effects Difficulty in breathing. May cause blindness: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Water spray, carbon dioxide (CO2), dry chemical, alcohol-resistant foam. Water mist may be used to cool closed containers.

Unsuitable Extinguishing Media Water may be ineffective

Flash Point 9.7 °C / 49.5 °F

Method - No information available

Autoignition Temperature 455 °C / 851 °F

Explosion Limits

Upper 31.00 vol %

Lower 6.0 vol %

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air.

Hazardous Combustion Products

Carbon monoxide (CO). Formaldehyde.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
1	3	0	N/A

6. Accidental release measures

Personal Precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Use

personal protective equipment as required. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions Should not be released into the environment. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment/face protection. Do not breathe mist/vapors/spray. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not ingest. If swallowed then seek immediate medical assistance. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage. Keep container tightly closed in a dry and well-ventilated place. Keep away from open flames, hot surfaces and sources of ignition. Flammables area. Incompatible Materials. Strong oxidizing agents. Strong acids. Acid anhydrides. Acid chlorides. Strong bases. Metals. Peroxides.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Methyl alcohol	TWA: 200 ppm STEL: 250 ppm Skin	(Vacated) TWA: 200 ppm (Vacated) TWA: 260 mg/m^3 (Vacated) STEL: 250 ppm (Vacated) STEL: 325 mg/m^3 Skin TWA: 200 ppm TWA: 260 mg/m^3	IDLH: 6000 ppm TWA: 200 ppm TWA: 260 mg/m^3 STEL: 250 ppm STEL: 325 mg/m^3	TWA: 200 ppm STEL: 250 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: NIOSH - National Institute for Occupational Safety and Health

Engineering Measures Use only under a chemical fume hood. Use explosion-proof electrical/ventilating/lighting equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures When using do not eat, drink or smoke. Provide regular cleaning of equipment, work area and clothing.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Alcohol-like
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	-98 °C / -144.4 °F
Boiling Point/Range	64.7 °C / 148.5 °F @ 760 mmHg
Flash Point	9.7 °C / 49.5 °F
Evaporation Rate	5.2 (ether = 1)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	31.00 vol %
Lower	6.0 vol %
Vapor Pressure	128 hPa @ 20 °C
Vapor Density	1.11
Specific Gravity	0.791
Solubility	Miscible with water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	455 °C / 851 °F
Decomposition Temperature	No information available
Viscosity	0.55 cP at 20 °C
Molecular Formula	C H4 O
Molecular Weight	32.04
VOC Content(%)	100
Surface tension	0.02255 N/m @ 20°C

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Heat, flames and sparks. Keep away from open flames, hot surfaces and sources of ignition.

Incompatible Materials Strong oxidizing agents, Strong acids, Acid anhydrides, Acid chlorides, Strong bases, Metals, Peroxides

Hazardous Decomposition Products Carbon monoxide (CO), Formaldehyde

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Methyl alcohol	LD50 = 1187 – 2769 mg/kg (Rat)	LD50 = 17100 mg/kg (Rabbit)	LC50 = 128.2 mg/L (Rat) 4 h

Toxicologically Synergistic Products Carbon tetrachloride

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation May cause skin and eye irritation

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS No	IARC	NTP	ACGIH	OSHA	Mexico
Methyl alcohol	67-56-1	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects Component substance is listed on California Proposition 65 as a developmental hazard.

Teratogenicity No information available.

STOT - single exposure Optic nerve Central nervous system (CNS)
STOT - repeated exposure Kidney Liver spleen Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed May cause blindness: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Methyl alcohol	Not listed	Pimephales promelas: LC50 > 10000 mg/L 96h	EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min	EC50 > 10000 mg/L 24h

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Methyl alcohol	-0.74

13. Disposal considerations

Waste Disposal Methods Should not be released into the environment.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Methyl alcohol - 67-56-1	U154	-

14. Transport information

DOT

UN-No UN1230
Proper Shipping Name METHANOL
Hazard Class 3
Packing Group II

TDG

UN-No UN1230
Proper Shipping Name METHANOL
Hazard Class 3
Subsidiary Hazard Class 6.1

Packing Group II

IATA

UN-No UN1230
Proper Shipping Name METHANOL
Hazard Class 3
Subsidiary Hazard Class 6.1
Packing Group II

IMDG/IMO

UN-No UN1230
Proper Shipping Name METHANOL
Hazard Class 3
Subsidiary Hazard Class 6.1
Packing Group II

15. Regulatory information

United States of America Inventory

Component	CAS No	TSCA	TSCA Inventory notification - Active-Inactive	TSCA - EPA Regulatory Flags
Methyl alcohol	67-56-1	X	ACTIVE	-

Legend:
TSCA US EPA (TSCA) - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Japan (ISHL), Australia (AICS), China (IECSC), Korea (KECL).

Component	CAS No	DSL	NDSL	EINECS	PICCS	ENCS	ISHL	AICS	IECSC	KECL
Methyl alcohol	67-56-1	X	-	200-659-6	X	X	X	X	X	KE-23193

KECL - NIER number or KE number (http://ncis.nier.go.kr/en/main.do)

U.S. Federal Regulations

SARA 313

Component	CAS No	Weight %	SARA 313 - Threshold Values %
Methyl alcohol	67-56-1	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Methyl alcohol	X		-

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Methyl alcohol	5000 lb	-

California Proposition 65 This product contains the following Proposition 65 chemicals.

Component	CAS No	California Prop. 65	Prop 65 NSRL	Category
Methyl alcohol	67-56-1	Developmental	-	Developmental

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Methyl alcohol	X	X	X	X	X

U.S. Department of Transportation
Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

Authorisation/Restrictions according to EU REACH

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Methyl alcohol	-	Use restricted. See item 69. (see link for restriction details)	-

https://echa.europa.eu/substances-restricted-under-reach

Safety, health and environmental regulations/legislation specific for the substance or mixture

Component	CAS No	OECD HPV	Persistent Organic Pollutant	Ozone Depletion Potential	Restriction of Hazardous Substances (RoHS)
Methyl alcohol	67-56-1	Listed	Not applicable	Not applicable	Not applicable

Component	CAS No	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Major Accident Notification	Seveso III Directive (2012/18/EC) - Qualifying Quantities for Safety Report Requirements	Rotterdam Convention (PIC)	Basel Convention (Hazardous Waste)
Methyl alcohol	67-56-1	500 tonne	5000 tonne	Not applicable	Not applicable

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 27-Apr-2009
Revision Date 26-Dec-2021
Print Date 26-Dec-2021
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally

Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

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 a 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

End of SDS

Safety Data Sheet

RUST-OLEUM CORPORATION
* Trusted Quality Since 1921 *
www.rustoleum.com

1. Identification

Name on Label: Inverted Marking Paint White

Product Name: PRO LSPR 6PK WB MARK WHITE

Revision Date: 3/13/2025

Product Identifier: 2592838

Supercedes Date: 12/11/2021

Recommended Use: Marking Paint/Aerosols

Supplier:
Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Manufacturer:
Rust-Oleum Corporation
11 Hawthorn Parkway
Vernon Hills, IL 60061
USA

Preparer: Regulatory Department

Emergency Telephone: 24 Hour Hotline: 847-367-7700

2. Hazard Identification

Classification

Symbol(s) of Product



Signal Word
Danger

Possible Hazards
27% of the mixture consists of ingredient(s) of unknown acute toxicity.

GHS Hazard Statements

Aerosol, category 1	H222	Extremely flammable aerosol.
	H229	Pressurized container: may burst if heated.
Carcinogenicity, category 2	H351	Suspected of causing cancer.
STOT, Repeated Exposure, category 2	H373	May cause damage to organs through prolonged or repeated exposure.

GHS Label Precautionary Statements

P201	Obtain special instructions before use.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P211	Do not spray on an open flame or other ignition source.
P251	Do not pierce or burn, even after use.
P260	Do not breathe dust, fumes, gas, mist, vapours, or spray.
P280	Wear protective gloves, protective clothing, eye protection, and face protection.
P308+P313	IF exposed or concerned: Get medical advice.
P314	Get medical advice or attention if you feel unwell.
P405	Store locked up.

P410+P412	Protect from sunlight. Do not expose to temperatures exceeding 50°C / 122°F.
P501	Dispose of contents and container in accordance with local, regional and national regulations.

3. Composition / Information on Ingredients

HAZARDOUS SUBSTANCES

Chemical Name	CAS-No.	Wt.% Range	GHS Symbols	GHS Statements
Propane	74-98-6	7.0-13	GHS04	H280
Titanium Dioxide	13463-67-7	7.0-13	Not Available	Not Available
Naphtha, Petroleum, Hydrotreated Light	64742-49-0	5.0-10	GHS08	H304
Xylenes (o-, m-, p- Isomers)	1330-20-7	3.0-7.0	GHS02-GHS07	H226-315-319-332
n-Butane	106-97-8	1.0-5.0	GHS04	H280
Petroleum Resin	64742-16-1	1.0-5.0	GHS06	H331
Hydrous Magnesium Silicate	14807-96-6	1.0-5.0	Not Available	Not Available
Propylene Glycol	57-55-6	1.0-5.0	Not Available	Not Available
n-Butyl Acetate	123-86-4	1.0-5.0	GHS02-GHS07	H226-336
Ethylbenzene	100-41-4	0.5-1.5	GHS02-GHS07-GHS08	H225-304-332-351-373
Octane	111-65-9	0.1-1.0	GHS02-GHS07-GHS08	H225-304-315-336
n-Heptane	142-82-5	0.1-1.0	GHS02-GHS07-GHS08	H225-304-315-336

Actual concentrations of ingredients are withheld as trade secret.

4. First Aid Measures

First Aid - Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids open. Get medical attention. Do NOT allow rubbing of eyes or keeping eyes closed. Remove contact lenses, if present and easy to do. Continue rinsing.

First Aid - Skin Contact: Wash skin with soap and water. Remove contaminated clothing. Get medical attention if irritation develops or persists.

First Aid - Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention. Do NOT use mouth-to-mouth resuscitation. If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately.

First Aid - Ingestion: If swallowed, do not induce vomiting. If victim is conscious and alert, give 2 to 4 cupfuls of water or milk. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person. Treat symptomatically and supportively.

5. Fire-Fighting Measures

EXTINGUISHING MEDIA: Aqueous Film Forming Foam, Carbon Dioxide, Dry Chemical, Dry Sand, Water Fog

Unusual Fire and Explosion Hazards: FLASH POINT IS LESS THAN -7°C (20°F). EXTREMELY FLAMMABLE LIQUID AND VAPOR!Water spray may be ineffective. Closed containers may explode when exposed to extreme heat. Vapors may form explosive mixtures with air. Vapors can travel to a source of ignition and flash back. Isolate from heat, electrical equipment, sparks and open flame. Perforation of the pressurized container may cause bursting of the can.

Special Fire Fighting Procedures: Water may be used to cool closed containers to prevent buildup of steam. If water is used, fog nozzles are preferred. Evacuate area and fight fire from a safe distance. Use water spray to keep fire-exposed containers cool. Containers may explode when heated.

Special Fire and Explosion Hazard (Combustible Dust): Not a combustible dust.

6. Accidental Release Measures

Steps to Be Taken If Material Is Released or Spilled: If spilled, contain spilled material and remove with inert absorbent. Dispose of contaminated absorbent, container, and unused contents in accordance with local, state, and federal regulations. Do not incinerate closed containersRemove all sources of ignition, ventilate area and remove with inert absorbent and non-sparking tools. Dispose of according to local, state (provincial) and federal regulations. Do not incinerate closed containers.

7. Handling and Storage

Handling: Wash thoroughly after handling. Wash hands before eating. Remove contaminated clothing and launder before reuse. Use only with adequate ventilation. Follow all SDS and label precautions even after container is emptied because it may retain product residues. Avoid breathing fumes, vapors, or mist. Avoid contact with eyes, skin and clothing. Do not puncture or incinerate (burn) container, even after use.

Storage: Contents under pressure. Do not store above 120°F (49°C). Store large quantities in buildings designed and protected for storage of flammable aerosols. Keep away from heat, sparks, flame and sources of ignition.

Advice on Safe Handling of Combustible Dust: No Information

8. Exposure Controls / Personal Protection

Chemical Name	CAS-No.	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL-CEILING
Propane	74-98-6	15.0	N.E.	N.E.	1000 ppm	N.E.
Titanium Dioxide	13463-67-7	15.0	0.2 mg/m3	N.E.	15 mg/m3	N.E.
Naphtha, Petroleum, Hydrotreated Light	64742-49-0	10.0	100 ppm	N.E.	N.E.	N.E.
Xylenes (o-, m-, p- Isomers)	1330-20-7	10.0	20 ppm	N.E.	100 ppm	N.E.
n-Butane	106-97-8	5.0	N.E.	1000 ppm	N.E.	N.E.
Petroleum Resin	64742-16-1	5.0	N.E.	N.E.	N.E.	N.E.
Hydrous Magnesium Silicate	14807-96-6	5.0	2 mg/m3	N.E.	20 mppcf	N.E.
Propylene Glycol	57-55-6	5.0	N.E.	N.E.	N.E.	N.E.
n-Butyl Acetate	123-86-4	5.0	50 ppm	150 ppm	150 ppm	N.E.
Ethylbenzene	100-41-4	5.0	20 ppm	N.E.	100 ppm	N.E.
Octane	111-65-9	1.0	300 ppm	N.E.	500 ppm	N.E.
n-Heptane	142-82-5	1.0	400 ppm	500 ppm	500 ppm	N.E.

PERSONAL PROTECTION

Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof ventilation equipment. Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation.

Respiratory Protection: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 (U.S.) and/or SOR/86-304 Part XII 12.13 and CSA Standard Z180.1 (Canada) requirements must be followed whenever workplace conditions warrant a respirator's use. A NIOSH/MSHA approved air purifying respirator with organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.

Skin Protection: Use gloves to prevent prolonged skin contact. Nitrile or Neoprene gloves may afford adequate skin protection.

Eye Protection: Use safety eyewear designed to protect against splash of liquids.

Other Protective Equipment: Refer to safety supervisor or industrial hygienist for further guidance regarding types of personal protective equipment and their applications.

Hygienic Practices: Wash thoroughly with soap and water before eating, drinking or smoking. Remove contaminated clothing immediately and launder before reuse.

Engineering Measures for Combustible Dust: No Information

9. Physical and Chemical Properties

Physical State	Liquid	**Decomposition Temperature, °C**	N.D.
Color	White	**pH**	NE
Odor	Solvent Like	**Kinematic Viscosity**	N.D.
Odor Threshold	N.E.	**Solubility in Water**	
Freezing Point / Melting Point, °C	ND	**Partition Coefficient, n-octanol/water**	N.D.
Boiling Range, °C	-37 - 537	**Vapor Pressure**	N.D.
Flammability	Supports Combustion	**Evaporation Rate**	Faster than Ether
Lower Explosion Limit, vol%	0.9	**Specific Gravity**	0.971
Upper Explosion Limit, vol%	12.6	**Vapor Density**	
Flash Point, °C	-96	**Particle Characteristics**	N.A.
Auto-Ignition Temperature, °C	N.D.		

(See "Other information" Section for abbreviation legend)

10. Stability and Reactivity

Conditions to Avoid: Avoid temperatures above 120°F (49°C). Avoid all possible sources of ignition. Avoid excess heat.

Incompatibility: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

Hazardous Decomposition: When heated to decomposition, it emits acrid smoke and irritating fumes. Contains solvents which may form carbon monoxide, carbon dioxide, and formaldehyde.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

11. Toxicological Information

Effects of Overexposure - Eye Contact: Irritating, and may injure eye tissue if not removed promptly.

Effects of Overexposure - Skin Contact: Low hazard for usual industrial handling or commercial handling by trained personnel.

Effects of Overexposure - Inhalation: High gas, vapor, mist or dust concentrations may be harmful if inhaled. Avoid breathing fumes, spray, vapors, or mist. Constituents of this product include crystalline silica dust which, if inhalable, may cause silicosis, a form of progressive pulmonary fibrosis. Inhalable crystalline silica is listed by IARC as a group I carcinogen (lung) based on sufficient evidence in occupationally exposed humans and sufficient evidence in animals. Crystalline silica is also listed by the NTP as a known human carcinogen. Constituents may also contain asbestiform or non-asbestiform tremolite or other silicates as impurities, and above de minimus exposure to these impurities in inhalable form may be carcinogenic or cause other serious lung problems.

Effects of Overexposure - Ingestion: Substance may be harmful if swallowed.

Effects of Overexposure - Chronic Hazards: High concentrations may lead to central nervous system effects (drowsiness, dizziness, nausea, headaches, paralysis, and blurred vision) and/or damage. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Overexposure to xylene in laboratory animals has been associated with liver abnormalities, kidney, lung, spleen, eye and blood damage as well as reproductive disorders. Effects in humans, due to chronic overexposure, have included liver, cardiac abnormalities and nervous system damage. IARC lists Ethylbenzene as a possible human carcinogen (group 2B). Contains Titanium Dioxide. Titanium Dioxide is listed as a Group 2B-"Possibly carcinogenic to humans" by IARC. No significant exposure to Titanium Dioxide is thought to occur during the use of products in which Titanium Dioxide is bound to other materials, such as in paints during brush application or drying. Risk of overexposure depends on duration and level of exposure to dust from repeated sanding of surfaces or spray mist and the actual concentration of Titanium Dioxide in the formula. (Ref: IARC Monograph, Vol. 93, 2010)

PRIMARY ROUTE(S) OF ENTRY: Eye Contact, Ingestion, Inhalation, Skin Absorption, Skin Contact

ACUTE TOXICITY VALUES

The acute effects of this product have not been tested. Data on individual components are tabulated below:

CAS-No.	Chemical Name	Oral LD50	Dermal LD50	Vapor LC50
13463-67-7	Titanium Dioxide	>2000 mg/kg Rat	6000	N.E.
64742-49-0	Naphtha, Petroleum, Hydrotreated Light	>5000 mg/kg Rat	>3160 mg/kg Rabbit	>4951 mg/L Rat
1330-20-7	Xylenes (o-, m-, p- Isomers)	3500 mg/kg Rat	>4350 mg/kg Rabbit	29.08 mg/L Rat
106-97-8	n-Butane	N.E.	N.E.	658 mg/L Rat

64742-16-1	Petroleum Resin	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.28 mg/L (Rat)
14807-96-6	Hydrous Magnesium Silicate	6000	>2000 mg/kg Rabbit	30
57-55-6	Propylene Glycol	20000 mg/kg Rat	20800 mg/kg Rabbit	>20 mg/L
123-86-4	n-Butyl Acetate	10768 mg/kg Rat	>17600 mg/kg Rabbit	> 21 mg/L Rat
100-41-4	Ethylbenzene	3500 mg/kg Rat	15400 mg/kg Rabbit	17.4 mg/L Rat
111-65-9	Octane	N.E.	N.E.	>24.88 mg/L Rat
142-82-5	n-Heptane	N.E.	3000 mg/kg Rabbit	>29.29 mg/L Rat

N.E. - Not Established

12. Ecological Information

Ecological Information: No ecotoxicity data was found for this product.

13. Disposal Considerations

Disposal: Do not incinerate closed containers. Dispose of material in accordance to local, state, and federal regulations and ordinances. This product as supplied is a US EPA defined ignitable hazardous waste. Dispose of unusable product as a hazardous waste (D001) in accordance with local, state, and federal regulation.

14. Transport Information

	Domestic (USDOT)	International (IMDG)	Air (IATA)	TDG (Canada)
UN Number:	N.A.	1950	1950	1950
Proper Shipping Name:	Paint and Related Spray Products in Ltd Qty	Aerosols	Aerosols, flammable	AEROSOLS, flammable
Hazard Class:	N.A.	2	2.1	2.1
Packing Group:	N.A.	N.A.	N.A.	N.A.
Limited Quantity:	Yes	Yes	Yes	Yes

15. Regulatory Information

U.S. Federal Regulations:

CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Carcinogenicity, Specific target organ toxicity (single or repeated exposure)

SARA Section 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS-No.
Xylenes (o-, m-, p- Isomers)	1330-20-7
Ethylbenzene	100-41-4

Toxic Substances Control Act

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(b) if exported from the United States:

No TSCA 12(b) components exist in this product.

U.S. State Regulations:

California Proposition 65

WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

16. Other Information

HMIS RATINGS

Health: **Flammability:** 4 **Physical Hazard:** **Personal Protection:**

NFPA RATINGS

Health: N.E. **Flammability:** 4 **Instability:** 0

Maximum Incremental Reactivity: 0.84

SDS REVISION DATE: 3/13/2025

REASON FOR REVISION:

Product Composition Changed
Substance Hazard Threshold % Changed
Substance and/or Product Properties Changed in Section(s):
01 - Identification
02 - Hazard Identification
03 - Composition / Information on Ingredients
05 - Fire-Fighting Measures
08 - Exposure Controls / Personal Protection
09 - Physical & Chemical Properties
11 - Toxicological Information
14 - Transport Information
15 - Regulatory Information
16 - Other Information
Substance Hazardous Flag Changed
Revision Statement(s) Changed

Legend: N.A. - Not Applicable, N.D. - Not Determined, N.E. - Not Established

Rust-Oleum Corporation believes, to the best of its knowledge, information and belief, the information contained herein to be accurate and reliable as of the date of this safety data sheet. However, because the conditions of handling, use, and storage of these materials are beyond our control, we assume no responsibility or liability for personal injury or property damage incurred by the use of these materials. Rust-Oleum Corporation makes no warranty, expressed or implied, regarding the accuracy or reliability of the data or results obtained from their use. All materials may present unknown hazards and should be used with caution. The information and recommendations in this material safety data sheet are offered for the users' consideration and examination. It is the responsibility of the user to determine the final suitability of this information and to comply with all applicable international, federal, state, and local laws and regulations.

SAFETY DATA SHEET

Version 6.4
Revision Date 01/28/2022
Print Date 02/26/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Arsenic

Product Number : 267961
Brand : Aldrich
Index-No. : 033-001-00-X
CAS-No. : 7440-38-2

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 Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 3), H301
Acute toxicity, Inhalation (Category 3), H331
Skin irritation (Category 2), H315
Serious eye damage (Category 1), H318
Carcinogenicity (Category 1A), H350
Short-term (acute) aquatic hazard (Category 1), H400
Long-term (chronic) aquatic hazard (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Pictogram	
Signal word	Danger

Hazard statement(s)

H301 + H331	Toxic if swallowed or if inhaled.
H315	Causes skin irritation.
H318	Causes serious eye damage.
H350	May cause cancer.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER/ doctor. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/ doctor.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	As
Molecular weight	:	74.92 g/mol
CAS-No.	:	7440-38-2
EC-No.	:	231-148-6
Index-No.	:	033-001-00-X

Component	Classification	Concentration
arsenic		
	Acute Tox. 3; Skin Irrit. 2;	<= 100 %

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

	Eye Dam. 1; Carc. 1A; Aquatic Acute 1; Aquatic Chronic 1; H301, H331, H315, H318, H350, H400, H410 M-Factor - Aquatic Acute: 10 M-Factor - Aquatic Chronic: 1	

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
First aiders need to protect themselves. Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Immediately call in physician. If breathing stops: immediately apply artificial respiration, if necessary also oxygen.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Immediately call in ophthalmologist. Remove contact lenses.

If swallowed
If swallowed: give water to drink (two glasses at most). Seek medical advice immediately. In exceptional cases only, if medical care is not available within one hour, induce vomiting (only in persons who are wide awake and fully conscious), administer activated charcoal (20 - 40 g in a 10% slurry) and consult a doctor as quickly as possible.

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

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

5.2 Special hazards arising from the substance or mixture
Nature of decomposition products not known.
Not combustible.
Ambient fire may liberate hazardous vapours.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Avoid generation and inhalation of dusts in all circumstances. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry. Keep in a well-ventilated place. Keep locked up or in an area accessible only to qualified or authorized persons.

Storage class
Storage class (TRGS 510): 6.1A: Combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
arsenic	7440-38-2	TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Lung cancer Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed human carcinogen		
		C	0.0020 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 15 minute ceiling value		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
arsenic	7440-38-2	inorganic arsenic plus methylated metabolites	35µg As/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of the workweek (After four or five consecutive working days with exposure)			

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

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). Tightly fitting safety goggles

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Color: gray
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 817 °C (1503 °F) - lit.
f)	Initial boiling point and boiling range	613 °C 1135 °F - lit.
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Density	5.727 g/mL at 25 °C (77 °F) - lit.
	Relative density	5.622.4 °C - OECD Test Guideline 109
n)	Water solubility	ca.0.0106 g/l at 20 °C (68 °F) - OECD Test Guideline 105 - slightly soluble
o)	Partition coefficient: n-octanol/water	Not applicable for inorganic substances

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

p)	Autoignition temperature	> 430 °C (> 806 °F)does not ignite
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
Exothermic reaction with:
Aluminum
Bromine
bromates
chlorates
iodates
Nitric acid
Risk of ignition or formation of inflammable gases or vapours with:
nitrates
Alkali metals
Zinc
Reducing agents
Strong oxidizing agents
Risk of explosion with:
potassium permanganate
azides
halogen-halogen compounds
Peroxides
nitrogen trichloride

10.4 Conditions to avoid
Heat. Exposure to air may affect product quality.
no information available

10.5 Incompatible materials
No data available

10.6 Hazardous decomposition products
In the event of fire: see section 5

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Mouse - 145 mg/kg
Remarks: Behavioral:Ataxia.
Diarrhea
(RTECS)
Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)
Inhalation: No data available
Dermal: No data available
No data available

Skin corrosion/irritation
Skin - In vitro study
Result: Irritating to skin. - 15 min
Remarks: (ECHA)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Causes serious eye damage. - 24 h
(OECD Test Guideline 405)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Test Type: Ames test
Test system: Escherichia coli
Result: negative
Remarks: (ECHA)

Carcinogenicity
May cause cancer. Positive evidence from human epidemiological studies.

IARC:	1 - Group 1: Carcinogenic to humans (arsenic)
NTP:	No ingredient 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 on OSHA's list of regulated carcinogens.

Reproductive toxicity
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

11.2 Additional Information

RTECS: CG0525000

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

The following applies to arsenic and its compounds in general: they take effect as capillary and enzyme toxins. Symptoms of arsenic poisoning: acute: after inhalation, mucosal irritations with coughing, dyspnoea, pain in the thorax. Perforations within the respiratory tract are possible. After oral uptake, gastrointestinal disorders with vomiting, diarrhoea, and spasms, CNS disorders with headache, confusion, shaking fits and disturbed consciousness, cardiovascular disorders all the way to circulatory collapse. Chronic: exanthema, dermal lesions in the form of hyperkeratosis and hypermelanosis, loss of hair, conjunctivitis and polyneuropathy, impaired hepatic function, and renal damage. After accumulation in the liver, kidneys, and skin, arsenic is eliminated from the organism only slowly. Experience has shown arsenic compounds to be carcinogenic in man.

Other dangerous properties can not be excluded.

This substance should be handled with particular care.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Oreochromis mossambicus (Mozambique tilapia) - 28.68 mg/l - 96 h Remarks: (ECHA)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Bosmina longirostris (water flea) - 0.85 mg/l - 48 h Remarks: (ECHA)
Toxicity to algae	static test NOEC - Macrocystis pyrifera (brown algae) - 0.04 mg/l - 42 h Remarks: (ECHA)
Toxicity to bacteria	static test EC50 - activated sludge - 10.6 mg/l - 10 Days Remarks: (ECHA)

12.2 Persistence and degradability

The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)

UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic
Reportable Quantity (RQ): 1 lbs
Reportable Quantity (RQ): 1 lbs
Poison Inhalation Hazard: No

IMDG

UN number: 1558 Class: 6.1 Packing group: II EMS-No: F-A, S-A
Proper shipping name: ARSENIC
Marine pollutant : yes

IATA

UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic

SECTION 15: Regulatory information

SARA 302 Components

This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
arsenic	7440-38-2	2015-11-23

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

:

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Reportable Quantity D004 lbs

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

SECTION 16: Other information

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.

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.4 Revision Date: 01/28/2022 Print Date: 02/26/2022

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Carbon Disulfide

Safety Data Sheet 900001

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 10/08/2015 Version: 2.0

SECTION 1: Identification

1.1. Identification

Product form : Substance

Substance name : Carbon Disulfide

CAS-No. : 75-15-0

Product code : SG-1001-00054

Formula : CS2

1.2. Recommended use and restrictions on use

Use of the substance/mixture : Laboratory chemicals

1.3. Supplier

Air Liquide USA LLC and its affiliates
9811 Katy Freeway, Suite 100
Houston, TX 77024 - USA
T 1-800-819-1704
www.us.airliquide.com

1.4. Emergency telephone number

Emergency number : Chemtrec: 1-800-424-9300

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Flammable liquids Category 2	H225	Highly flammable liquid and vapour
Acute toxicity (inhalation:gas) Category 4	H332	Harmful if inhaled
Skin corrosion/irritation Category 2	H315	Causes skin irritation
Serious eye damage/eye irritation Category 2A	H319	Causes serious eye irritation
Reproductive toxicity Category 2	H361	Suspected of damaging fertility or the unborn child
Specific target organ toxicity (repeated exposure) Category 1	H372	Causes damage to organs (central nervous system, peripheral nervous system, cardiovascular system, kidneys, liver) through prolonged or repeated exposure (Inhalation)
Aspiration hazard Category 1	H304	May be fatal if swallowed and enters airways

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02 GHS07 GHS08

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H225 - Highly flammable liquid and vapour
H304 - May be fatal if swallowed and enters airways
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H332 - Harmful if inhaled
H361 - Suspected of damaging fertility or the unborn child
H372 - Causes damage to organs (central nervous system, peripheral nervous system, cardiovascular system, kidneys, liver) through prolonged or repeated exposure (Inhalation)
CGA-HG04 - May form explosive mixtures with air
CGA-HG16 - Extended exposure to gas reduces the ability to smell sulfides.

Precautionary statements (GHS-US) : P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking.
P260 - Do not breathe gas.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective gloves, protective clothing.
P301+P310 - If swallowed: Immediately call a doctor
P302+P352 - If on skin: Wash with plenty of 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
P308+P313 - If exposed or concerned: Get medical advice/attention.
P331 - Do NOT induce vomiting.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P403 - Store in a well-ventilated place.
P405 - Store locked up.
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P362 - Take off contaminated clothing and wash before reuse.
P381 - Eliminate all ignition sources if safe to do so.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C/125 °F
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG14 - Approach suspected leak area with caution
CGA-PG29 - Do not depend on odor to detect presence of gas

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Substance type : Mono-constituent

Name	Product identifier	%	GHS-US classification
Carbon Disulfide (Main constituent)	(CAS-No.) 75-15-0	> 99.9	Flam. Liq. 2, H225 Acute Tox. 4 (Inhalation:gas), H332 Skin Irrit. 2, H315 Eye Irrit. 2A, H319 Repr. 2, H361 STOT RE 1, H372 Asp. Tox. 1, H304

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If you feel unwell, seek medical advice.

First-aid measures after skin contact : Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention.

First-aid measures after eye contact : Rinse immediately with plenty of water for 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation occurs, seek medical attention.

First-aid measures after ingestion : Do NOT induce vomiting. Immediately call a poison center or doctor/physician.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects after inhalation : Harmful if inhaled.

Symptoms/effects after skin contact : Causes skin irritation.

Symptoms/effects after eye contact : Causes serious eye irritation.

Symptoms/effects after ingestion : May be fatal if swallowed and enters airways.

Symptoms/effects upon intravenous administration : Not known.

Chronic symptoms : Suspected of damaging fertility. Suspected of damaging the unborn child. Causes damage to organs (central nervous system, peripheral nervous system, cardiovascular system, kidneys, liver) through prolonged or repeated exposure (Inhalation).

4.3. Immediate medical attention and special treatment, if necessary

If you feel unwell, seek medical advice. If breathing is difficult, give oxygen.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

Unsuitable extinguishing media : Do not use water jet to extinguish.

5.2. Specific hazards arising from the chemical

Fire hazard : This product is flammable.

Explosion hazard : Product is not explosive. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries.

Reactivity : None known.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions : In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire.

Protection during firefighting : Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Ensure adequate ventilation.

6.1.1. For non-emergency personnel

Protective equipment : Wear protective equipment consistent with the site emergency plan.

Emergency procedures : Evacuate personnel to a safe area. Close doors and windows of adjacent premises. Keep containers closed. Mark the danger area. Seal off low-lying areas. Keep upwind.

6.1.2. For emergency responders

Protective equipment : Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Equip cleanup crew with proper protection.

Emergency procedures : Evacuate and limit access. Ventilate area. Remove ignition sources. Monitor concentration of released product. Consider the risk of potentially explosive atmospheres. Wear self-contained breathing apparatus when entering atmospheres of unknown contaminant concentration until proven to be safe.

6.2. Environmental precautions

Try to stop release if without risk.

6.3. Methods and material for containment and cleaning up

For containment : Try to stop release if without risk.

Methods for cleaning up : Dispose of contents/container in accordance with local/regional/national/international regulations.

6.4. Reference to other sections

See also Sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed : Handle empty containers with care because residual vapors are flammable. In use, may form flammable vapor-air mixture.

Precautions for safe handling : Do not handle until all safety precautions have been read and understood. Use only outdoors or in a well-ventilated area. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Use only non-sparking tools.

Hygiene measures : Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.

Storage conditions : Keep container closed when not in use. Keep cool. Store in well ventilated area. Store locked up.

Incompatible products : None known.

Incompatible materials : Oxidizing agent. Air. Alkali metals. Amines.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Carbon Disulfide (75-15-0)		
ACGIH	ACGIH TWA (ppm)	1 ppm
OSHA	OSHA PEL (TWA) (ppm)	20 ppm
OSHA	OSHA PEL (Ceiling) (ppm)	30 ppm
OSHA	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	100 ppm Peak (30 minutes)
IDLH	US IDLH (ppm)	500 ppm
NIOSH	NIOSH REL (TWA) (mg/m³)	3 mg/m³
NIOSH	NIOSH REL (TWA) (ppm)	1 ppm
NIOSH	NIOSH REL (STEL) (mg/m³)	30 mg/m³
NIOSH	NIOSH REL (STEL) (ppm)	10 ppm
NIOSH	US-NIOSH chemical category	Potential for dermal absorption

8.2. Appropriate engineering controls

Appropriate engineering controls : Ensure exposure is below occupational exposure limits (where available). Provide adequate general and local exhaust ventilation. Systems under pressure should be regularly checked for leakages. Oxygen detectors should be used when asphyxiating gases may be released. Consider the use of a work permit system e.g. for maintenance activities.

Environmental exposure controls : Refer to local regulations for restrictions on release of emissions to the atmosphere.

8.3. Individual protection measures/Personal protective equipment

Hand protection:

Wear chemically resistant protective gloves. 29 CFR 1910.138: Hand protection

Eye protection:

Wear safety glasses with side shields. 29 CFR 1910.133: Eye and Face Protection

Skin and body protection:

Wear suitable protective clothing, e.g. lab coats, coveralls or flame resistant clothing.

Respiratory protection:

None necessary during normal and routine operations. See Sections 5 & 6.

Thermal hazard protection:

None necessary during normal and routine operations.

Other information:

Wear safety shoes while handling containers. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Appearance : Clear liquid.

Color : Colorless to pale yellow

Odor : Sulfide-like Stench.

Odor threshold : No data available

pH : No data available

Melting point : -111.6 °C

Freezing point	:	No data available
Boiling point	:	46.85 °C
Critical temperature	:	279.85 °C
Flash point	:	-30 °C
Relative evaporation rate (butyl acetate=1)	:	22.6
Flammability (solid, gas)	:	See Section 2.1 and 2.2
Vapor pressure	:	410 mbar (5.9508 psi)
Relative vapor density at 20 °C	:	2.67
Relative density	:	No data available
Specific gravity / density	:	1.26 g/cm³ (at 20 °C)
Molecular mass	:	76.13 g/mol
Relative gas density	:	Heavier than air
Solubility	:	Water: 2.1 g/l (at 20 °C)
Log Pow	:	No data available
Auto-ignition temperature	:	90 °C
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	1.3 vol %
Explosive properties	:	Without adequate ventilation formation of explosive mixtures may be possible.
Oxidizing properties	:	None.

9.2. Other information

Additional information : Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level

SECTION 10: Stability and reactivity

10.1. Reactivity

None known.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Can form explosive mixture with air.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

Oxidizing agent. Air. Alkali metals. Amines.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Inhalation:gas: Harmful if inhaled.

Carbon Disulfide (75-15-0)	
LD50 oral rat	1200 mg/kg
LC50 inhalation rat (ppm)	5676.52 ppm/4h
ATE US (oral)	500.000 mg/kg body weight
ATE US (gases)	5676.520 ppmV/4h

Skin corrosion/irritation	:	Causes skin irritation.
Serious eye damage/irritation	:	Causes serious eye irritation.
Respiratory or skin sensitization	:	Not classified
Germ cell mutagenicity	:	Not classified

Carcinogenicity	:	Not classified
Reproductive toxicity	:	Suspected of damaging fertility or the unborn child.
Specific target organ toxicity – single exposure	:	Not classified
Specific target organ toxicity – repeated exposure	:	Causes damage to organs (central nervous system, peripheral nervous system, cardiovascular system, kidneys, liver) through prolonged or repeated exposure (Inhalation).
Aspiration hazard	:	May be fatal if swallowed and enters airways.
Symptoms/effects after inhalation	:	Harmful if inhaled.
Symptoms/effects after skin contact	:	Causes skin irritation.
Symptoms/effects after eye contact	:	Causes serious eye irritation.
Symptoms/effects after ingestion	:	May be fatal if swallowed and enters airways.
Symptoms/effects upon intravenous administration	:	Not known.
Chronic symptoms	:	Suspected of damaging fertility. Suspected of damaging the unborn child. Causes damage to organs (central nervous system, peripheral nervous system, cardiovascular system, kidneys, liver) through prolonged or repeated exposure (Inhalation).

SECTION 12: Ecological information

12.1. Toxicity

Carbon Disulfide (75-15-0)	
LC50 fish 1	3 - 5.8 mg/l (Exposure time: 96 h - Species: Poecilia reticulata [semi-static])
EC50 Daphnia 1	2.1 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 fish 2	4 mg/l (Exposure time: 96 h - Species: Poecilia reticulata [static])

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

Carbon Disulfide (75-15-0)	
BCF fish 1	4.3 - 8

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on ozone layer : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Disposal methods

Waste treatment methods : Contact supplier if guidance is required. Disposal through controlled incineration or authorized waste dump. Ensure that the emission levels from local regulations or operating permits are not exceeded.

Product/Packaging disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1131 Carbon disulfide, 3, I

UN-No.(DOT) : UN1131
Proper Shipping Name (DOT) : Carbon disulfide
Class (DOT) : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120
Packing group (DOT) : I - Great Danger

Hazard labels (DOT)	:	3 - Flammable liquid 6.1 - Poison inhalation hazard



DOT Packaging Non Bulk (49 CFR 173.xxx)	:	201
DOT Packaging Bulk (49 CFR 173.xxx)	:	243
DOT Special Provisions (49 CFR 172.102)	:	B16 - The lading must be completely covered with nitrogen, inert gas or other inert materials. T14 - 6 6 mm Prohibited 178.275(g)(3). TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and a is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively. TP7 - The vapor space must be purged of air by nitrogen or other means. TP13 - Self-contained breathing apparatus must be provided when this hazardous material is transported by sea.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	None
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	Forbidden
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	Forbidden
DOT Vessel Stowage Location	:	D - The material must be stowed ‘‘on deck only’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers or one passenger per each 3 m of overall vessel length, but the material is prohibited on passenger vessels in which the limiting number of passengers is exceeded.
DOT Vessel Stowage Other	:	40 - Stow ‘‘clear of living quarters’’,78 - Stow ‘‘separated longitudinally by an intervening complete compartment or hold from’’ explosives,115 - If packaged in glass or earthenware inner packaging in wooden or fiberboard outer packaging, the maximum quantity on any vessel is 500 kg (equivalent to 450 L)
Emergency Response Guide (ERG) Number	:	131
Other information	:	No supplementary information available.

Transportation of Dangerous Goods

Transport document description	:	UN1131 CARBON DISULFIDE (CARBON DISULFIDE), 3 (6.1), I
UN-No. (TDG)	:	UN1131
Proper Shipping Name	:	CARBON DISULFIDE
TDG Primary Hazard Classes	:	3 - Class 3 - Flammable Liquids
Packing group	:	I - Great Danger
TDG Subsidiary Classes	:	6.1
ERAP Index	:	1 000
Explosive Limit and Limited Quantity Index	:	0
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index	:	Forbidden
Passenger Carrying Ship Index	:	Forbidden

Transport by sea

Transport document description (IMDG)	:	UN UN1131 CARBON DISULFIDE, 3, I
UN-No. (IMDG)	:	UN1131
Proper Shipping Name (IMDG)	:	CARBON DISULFIDE
Class (IMDG)	:	3 - Flammable liquids
Packing group (IMDG)	:	I - substances presenting high danger

Air transport

Transport document description (IATA) : UN Forbidden
UN-No. (IATA) : Forbidden

SECTION 15: Regulatory information

15.1. US Federal regulations

Carbon Disulfide (75-15-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on the United States SARA Section 302 Subject to reporting requirements of United States SARA Section 313	
EPA TSCA Regulatory Flag	TP - TP - indicates a substance that is the subject of a proposed Section 4 test rule under TSCA.
CERCLA RQ	100 lb
Section 302 EPCRA Reportable Quantity (RQ)	100 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	10000 lb
SARA Section 313 - Emission Reporting	1 %

15.2. International regulations

CANADA

Carbon Disulfide (75-15-0)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Carbon Disulfide (75-15-0)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

National regulations

Carbon Disulfide (75-15-0)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Japanese Poisonous and Deleterious Substances Control Law Japanese Pollutant Release and Transfer Register Law (PRTR Law) Listed on the Canadian IDL (Ingredient Disclosure List) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Carbon Disulfide (75-15-0)	
U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	Yes
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	Yes
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	Yes
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Other information : This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product.

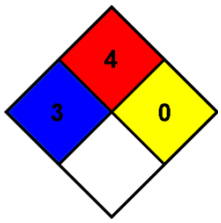
Full text of H-phrases:

H225	Highly flammable liquid and vapour
H304	May be fatal if swallowed and enters airways
H315	Causes skin irritation
H319	Causes serious eye irritation
H332	Harmful if inhaled
H361	Suspected of damaging fertility or the unborn child
H372	Causes damage to organs through prolonged or repeated exposure

NFPA health hazard : 3 - Materials that, under emergency conditions, can cause serious or permanent injury.

NFPA fire hazard : 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA reactivity : 0 - Material that in themselves are normally stable, even under fire conditions.



SDS US (GHS HazCom 2012)

This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide USA LLC and its affiliates' knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

Chromium

Safety Data Sheet

Section 1: Identification

1.1 Product Identifier

Product Name:	Chromium
Product Form:	Solid
Chemical Family:	Metal
CAS Number:	7440-47-3
Molecular Formula:	Cr
Molecular Weight	51.996

1.2 Other Means of Identification

Synonyms:	Chrome; Chromium Element; Chromium Metal; Metallic Chromium; Cr; DLA05001; RTECS GB4200000

1.3 Recommended Uses

Recommended Use:	Variety of mechanical and industrial applications

1.4 Manufacturer, Importer, or Responsible Party

Responsible Party:	Defense Logistics Agency Strategic Materials 8725 John J. Kingman Road Fort Belvoir, Virginia 22060-6223 (571) 767-5525

1.5 Emergency Phone Number

Emergency Phone Number:	(800) 424-9300 (CHEMTREC) (703) 527-3887 (CHEMTREC INTERNATIONAL)

Section 2: Hazard(s) Identification

2.1 Classification of Chemical per OSHA CFR 1910.1200

Acute Toxicity (Oral):	Category 2
Skin Irritation:	Category 2
Eye Irritation:	Category 2B
Skin Sensitization:	Category 1A
Germ Cell Mutagenicity:	Category 2
Reproductive Toxicity:	Effects on or via Lactation
Target Organ Toxicity– Prolonged:	Category 1 (Lungs, Kidney)

2.2 Label Elements

Signal Word: DANGER

Symbol(s):





Hazard Statements:	Fatal if swallowed. Causes skin irritation. Causes eye irritation. May cause an allergic skin reaction. Suspected of causing genetic defects. May cause harm to breast-fed children. Causes damage to lungs and kidneys through prolonged or repeated exposure.
Precautionary Statements:	Prevention: Wear protective gloves, protective clothing, eye protection, and face protection. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Do not breathe dust. Contaminated clothing must not be allowed out of the workplace. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Avoid contact during pregnancy and/or while nursing. Response: If swallowed, immediately call a poison center and/or doctor. Rinse mouth. If on skin, wash with plenty of water. If skin irritation or rash occurs, get medical advice and/or attention. Take off contaminated clothing and wash it before reuse. If in eyes, rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention. If exposed, concerned, or feeling unwell, get medical advice and/or attention. Storage: Store locked up. Disposal: Dispose of contents in accordance with federal, state, and local regulations.

2.3 Other Hazards
Negligible fire and explosion hazard in bulk form. Dust/air mixtures may ignite or explode.

2.4 Unknown Acute Toxicity
Does not apply to this product.

Section 3: Composition / Information on Ingredients

3.1 Chemical Name

Chemical Name:	Chromium
Composition:	99.00%-99.82% Cr

The health and physical hazards information provided in this SDS are for its major component. Chromium metal contains other elements in addition to Cr. For concentrations of other components, see the Certificates of Analysis for each lot.

3.2 Common Names/Synonyms
Synonyms: See **Section 1.2** for common names and synonyms.

3.3 CAS Number/Unique Identifiers

CAS Number:	7440-47-3
EC Number (EINECS):	231-157-5

3.4 Impurities/Stabilizing Additives
No data available.

Section 4: First-Aid Measures

4.1 Description of First-Aid Measures

Inhalation:	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.
Skin Contact:	Wash skin with soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Cover skin burns with dry, sterile dressings after decontamination. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.
Eye Contact:	Flush eyes with plenty of water for at least 15 minutes. Get immediate

medical attention.

Ingestion: Rinse mouth and administer water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Get medical attention.

4.2 Most Important Symptoms/Effects, Acute and Delayed

Inhalation (Acute):	Irritation.
Inhalation (Chronic):	Digestive disorders and lung damage.
Skin Contact (Acute):	Irritation.
Skin Contact (Chronic):	Kidney damage.
Eye Contact (Acute):	Irritation.
Eye Contact (Chronic):	Tearing.
Ingestion (Acute):	Vomiting, stomach pain, and dizziness.
Ingestion (Chronic):	No data available.

4.3 Indication of immediate Medical Attention/Special Treatment

Antidote: Dimercaprol, intramuscular

Section 5: Fire-Fighting Measures

5.1 Suitable Extinguishing Media

Dolomite, dry powder for metal fires, dry sand, graphite, soda ash, and sodium chloride. Do not get water directly on material.

5.2 Specific Hazards

Negligible fire and explosion hazard in bulk form. Dust/air mixtures may ignite or explode.

5.3 Special Protective Equipment and Precautions

Respiratory protection from chromium metal and insoluble chromium salts should include a self-contained breathing apparatus with a full face piece operated in pressure-demand or other positive pressure mode. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep all unauthorized people away, isolate hazard area and deny entry. Let the fire burn. Use extinguishing agents appropriate for surrounding fire. Avoid inhalation of material or combustion by-products.

Section 6: Accidental Release Measures

6.1 Personal Precautions, Protective Equipment, and Emergency Procedures

Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202) 426-2675 (USA). Personal protective equipment is discussed in **Section 8.3**. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Cover solids with a plastic sheet to prevent dissolving in rain or firefighting water. If spilled in water, neutralize with agricultural lime, crushed limestone, or sodium bicarbonate. Adjust pH to neutral.

6.2 Methods and Materials for Containment and Clean Up

If chromium metal or insoluble chromium salts are spilled, the following steps should be taken:

1. Remove all ignition sources where metallic chromium has been spilled.
2. Ventilate area of spill.
3. Dampen the solid spill material with 5% ammonium hydroxide, and transfer the dampened material to a suitable container.
4. Deposit material and contaminated clothing in sealed containers for reclamation or for disposal in a secured sanitary landfill.
5. Wash all contaminated surfaces with 5% ammonium hydroxide followed by washing with a strong soap and water solution.
6. Do not re-enter the contaminated area until the Safety Officer (or other responsible person) has verified

that the area has been properly cleaned.

Liquid containing chromium metal or insoluble chromium salts should be absorbed in vermiculite, dry sand, earth, or a similar material.

Section 7: Handling and Storage

7.1 Precautions for Safe Handling

Handle in accordance with all current regulations and standards. Utilize personal protective equipment to avoid contact with skin. Personal protective equipment is discussed in **Section 8.3**.

7.2 Conditions for Safe Storage

Store in accordance with all current regulations and standards. Store in a tightly closed container. Store in a cool, dry place. Store in a well-ventilated area. Keep separated from incompatible substances. Incompatible materials are identified in **Section 10.5**.

Section 8: Exposure Controls / Personal Protection

8.1 Exposure Limits

OSHA PEL TWA (metal):	1 mg (Cr)/m^3
ACGIH TWA (metal):	0.5 mg (Cr)/m^3
NIOSH REL TWA 10 hour(s) (metal):	0.5 mg (Cr)/m^3
EC OEL TWA (IOELV) (metal):	2 mg/m^3
UK WEL TWA 8 hour(s) (metal):	0.5 mg/m^3

8.2 Appropriate Engineering Controls

Ventilation: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

8.3 Individual Protection Measures

Eye Protection: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate area.

Clothing: Wear appropriate chemical resistant clothing.

Gloves: Wear appropriate chemical resistant gloves.

Respirator:

The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

2.5 mg/m^3: **1.** Any quarter-mask respirator.

5 mg/m^3: **1.** Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100 or P100.
2. Any supplied-air respirator.

12.5 mg/m^3: **1.** Any supplied-air respirator operated in a continuous-flow mode.
2. Any powered, air-purifying respirator with a high-efficiency particulate filter.

25 mg/m^3: **1.** Any air-purifying, full-facepiece respirator equipped with an N100, R100, or P100 filter.
2. Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter.
3. Any self-contained breathing apparatus with a full facepiece. Any supplied-air respirator with a full facepiece.

250 mg/m^3:	**1.** Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.
Unknown Concentrations/IDLH:	**1.** Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. **2.** Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape:	**1.** Any air-purifying, full-facepiece respirator equipped with an N100, R100, or P100 filter. **2.** Any appropriate escape-type, self-contained breathing apparatus.

Section 9: Physical and Chemical Properties

9.1 Appearance

Physical State:	Solid
Physical Description:	Blue-white to steel-gray, lustrous, brittle, hard, odorless solid in pig, ingot or tub form.

9.2 Odor

Odor:	Odorless

9.3 Odor Threshold

Not available.

9.4 pH

Not applicable.

9.5 Melting / Freezing Points

Melting Point:	3,339°F-3,411°F (1,837°C-1877°C)
Freezing Point:	No data available.

9.6 Boiling Point

Boiling Point:	4,842°F (2,672°C)

9.7 Flash Point

No data available.

9.8 Evaporation Rate

Not applicable.

9.9 Flammability

Flammability:	0.230 oz/ft^3

9.10 Upper/Lower Explosive Limits

No data available.

9.11 Vapor Pressure

Vapor Pressure:	1 mmHg @ 1,616°C

9.12 Vapor Density

Not applicable.

9.13 Relative Density

Water = 1:	7.20 @ 28°C

9.14 Solubility(ies)

Insoluble:	Water, Nitric Acid, and Aqua Regia
Soluble:	Dilute Sulfuric Acid and Hydrochloric Acid

9.15 Partition Coefficient

No data available.

9.16 Auto-Ignition Temperature

No data available.

9.17 Decomposition Temperature

No data available.

9.18 Viscosity

No data available.

Section 10: Stability and Reactivity

10.1 Reactivity

Stable at normal temperatures and pressures.

10.2 Chemical Stability

Stable at normal temperatures and pressures. Not oxidized by air, even in presence of much moisture.

10.3 Possibility of Hazardous Reactions

Alkali Carbonates:	Attacked.
Alkalies (Caustic):	Attacked.
Ammonium Nitrate (Fused):	Violent or explosive reaction.
Bromine Pentafluoride:	Violent reaction and possible ignition.
Hydrogen Peroxide:	Violent decomposition reaction.
Lithium (Molten):	Vigorous reaction at elevated temperatures.
Nitrogen Oxide:	Incandescent reaction.
Oxidizers (Strong):	Fire and explosion hazard.
Potassium Chlorate (Fused):	Vigorous incandescent reaction.
Sulphur Dioxide:	Incandescent reaction.

10.4 Conditions to Avoid

None reported.

10.5 Incompatible Materials

Incompatibilities:	Bases, oxidizing materials, halogens, peroxides, and metals.

Reacts with dilute hydrochloric acid and sulfuric acid. Safe storage of the material is discussed in **Section 7.2**.

10.6 Hazardous Decomposition Products

Thermal Decomposition Products:	Oxides of chromium.

Section 11: Toxicological Information

11.1 Likely Routes of Exposure

Routes of entry include inhalation, skin contact, eye contact, and ingestion.

11.2 Symptoms

See **Section 4.2** for symptoms related to the physical, chemical, and toxicological characteristics.

11.3 Short and Long Term Effects

Inhalation (Acute):	High concentrations of dusts or fumes may cause irritation.
Inhalation (Chronic):	Repeated or prolonged exposure to various chromium compounds has been reported to result in ulceration and perforation of the nasal septum, irritation of the throat and lower respiratory tract, less commonly in gastrointestinal disturbances, blood changes, pulmonary sensitization, pulmonary pneurnoconiosis or fibrosis, and rarely liver effects. These effects have not been reported from exposure to the metal per se.
Skin Contact (Acute):	Contact with dusts or powder may cause irritation.
Skin Contact (Chronic):	Repeated or prolonged exposure to various chromium compounds has been reported to cause various types of dermatitis, including eczema, "chrome holes", sensitization, and, in contact with damaged skin, kidney damage. These effects have not been reported from exposure to the metal per se.
Eye Contact (Acute):	Contact with dusts or powders may cause irritation.
Eye Contact (Chronic):	Repeated or prolonged exposure to some chromium compounds may cause conjunctivitis and lacrimation. These effects have not been reported from exposure to the metal per se.
Ingestion (Acute):	Chromium metal is poorly absorbed by the intestinal tract. Absorption of sufficient amounts of some chromium compounds may result in dizziness, intense thirst, abdominal pain, vomiting, shock, oliguria or anuria, and uremia, which may be fatal.
Ingestion (Chronic):	No data available.

11.4 Numerical Measures of Toxicity

Lethal Dose (LD_{50}):	27,500 µg/kg unreported-rat
Tumorigenic Data:	2,160 µg/kg intravenous-rat TDLo/6 week(s) intermittent; 1,200 µg/kg implant-rat TDLo/6 week(s) intermittent; 75 mg/kg implant-rabbit TDLo
Mutagenic Data:	DNA damage - human lung 1 µmol/L

11.5 Carcinogen Status

IARC:	Human Inadequate Evidence, Animal Inadequate Evidence, Group 3 (metal)
ACGIH:	A4 -Not Classifiable as a Human Carcinogen (metal)

Section 12: Ecological Information

12.1 Ecotoxicity

Fish Toxicity:	14,300 µg/L 96 hour(s) LC_{50} (Mortality) Common, mirror, colored, carp (*Cyprinus carpio*)
Invertebrate Toxicity:	2,000 µg/L 0-5 hour(s) LETH (Mortality) Copepod (*Tisbe holothuriae*)
Algal Toxicity:	3,000-5,000 µg/L NR hour(s) (Population Growth) Blue-green algae (*Synechocystis aquatilis*)
Phytotoxicity:	9,900 µg/L 32 week(s) EC_{50} (Biomass) Water-milfoil (*Myriophyllum spicatum*)

12.2 Persistence and Degradability

No data available.

12.3 Bioaccumulative Potential

Bioconcentration:	20-40 µg/L NR week(s) BCF (Residue) Common bay mussel, blue mussel (*Mytilus edulis*) 100 µg/L

12.4 Mobility in Soil

No data available.

12.5 Other Adverse Effects

No data available.

Section 13: Disposal Considerations

Hazardous Waste Number(s): D007. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the regulatory level (5.0 mg/L). Dispose of in accordance with all applicable regulations.

Section 14: Transport Information

14.1 UN Number

UN Number:	3077

14.2 UN Proper Shipping Name

UN Proper Shipping Name:	RQ Environmentally hazardous substances, solid, n.o.s. (chromium)

14.3 Transport Hazard Class(es)

U.S. Department of Transportation:	Hazard Class or Division 9
CA Transportation/Dangerous Goods:	Hazard Class or Division 9
Land Transport ADR:	Hazard Class or Division 9; Classification Code M7
Land Transport RID:	Hazard Class or Division 9; Classification Code M7
Air Transport IATA:	Hazard Class or Division 9
Air Transport ICAO:	Hazard Class or Division 9
Maritime Transport IMDG:	Hazard Class or Division 9

14.4 Packing Group

U.S. Department of Transportation:	III
CA Transportation/Dangerous Goods:	III
Land Transport ADR:	III
Land Transport RID:	III
Air Transport IATA:	III
Air Transport ICAO:	III
Maritime Transport IMDG:	III

14.5 Environmental Hazards

No data available.

14.6 Transport in Bulk

No data available.

14.7 Special Precautions

No data available.

Section 15: Regulatory Information

US Regulations

CERCLA 102A/103 (40 CFR 302.4):	5,000 LBS RQ {solid metal particles <100 µm diameter (0.004 inches)}

SARA Title III

Section 302 (40 CFR 355.30):	Not regulated.
Section 304 (40 CFR 355.40):	Not regulated.
Sections 311/312 (40 CFR 370.21):	Not regulated.
Section 313 (40 CFR 372.65):	Yes (Chromium)

OSHA Process Safety:	Not regulated.

State Regulations
California Proposition 65: Not regulated.

National Inventory Status
US Inventory (TSCA): Listed on inventory.
TSCA 12(b) Export Notification: Not listed.

Section 16: Other Information

The information in this Safety Data Sheet meets the requirements of the United States Department of Labor OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.). This document is intended only as a guide to the appropriate precautionary material handling by a person trained in, or supervised by a person trained in, chemical handling. Exposure to this chemical may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses are so varied, all of the potential hazards of use or interaction with other chemicals or materials cannot be identified on this Safety Data Sheet. The user should recognize that this chemical can cause injury, especially if improperly handled, precautionary measures are not followed, and personal protective equipment not worn. Read and understand all precautionary information prior to use. The Defense Logistics Agency (DLA) shall not be held liable for any damage resulting from handling or from contact with the above chemical.

References:

ChemADVISOR®, Inc. *Material Safety Data Sheet, Chromium*. September 4, 2008. (as provided by the Defense Logistics Agency)

American Conference of Governmental Industrial Hygienists. *2013 TLVs® and BEIs®*, ACGIH® Publication #0113. 2013.

US Department of Transportation. *Emergency Response Guidebook*. 2012

Centers for Disease Control and Prevention. *NIOSH Pocket Guide to Chemical Hazards*, http://www.cdc.gov/niosh/npg/.

National Institute of Health, Toxicology Data Network. http://toxnet.nlm.nih.gov/

NOTE: No data available: no data for this topic found using references listed.

Date of Preparation of Updated SDS: April 24, 2015

SAFETY DATA SHEET

Creation Date 06-Aug-2010 **Revision Date** 30-Oct-2014 **Revision Number** 2

1. Identification

Product Name **Ethylbenzene**

Cat No. : **AC433800000; AC433800010; AC433801000**

Synonyms Ethylbenzol; Phenylethane

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute Inhalation Toxicity - Vapors	Category 4
Carcinogenicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Aspiration Toxicity	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
May be fatal if swallowed and enters airways
Harmful if inhaled
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of causing cancer
May cause damage to organs through prolonged or repeated exposure



Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Do NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects

3. Composition / information on ingredients

Component	CAS-No	Weight %
Ethylbenzene	100-41-4	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention. Aspiration into lungs can produce severe lung damage.

Ingestion Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.

Most important symptoms/effects Breathing difficulties. . Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.

Unsuitable Extinguishing Media Do not use a solid water stream as it may scatter and spread fire

Flash Point 15 °C / 59 °F
Method - No information available

Autoignition Temperature 432 °C / 810 °F
Explosion Limits
Upper 6.8%
Lower 1.2%
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge Yes

Specific Hazards Arising from the Chemical
Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	3	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethylbenzene	TWA: 20 ppm	(Vacated) TWA: 100 ppm (Vacated) TWA: 435 mg/m³ (Vacated) STEL: 125 ppm (Vacated) STEL: 545 mg/m³ TWA: 100 ppm TWA: 435 mg/m³	IDLH: 800 ppm TWA: 100 ppm TWA: 435 mg/m³ STEL: 125 ppm STEL: 545 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Ethylbenzene	TWA: 100 ppm TWA: 434 mg/m³ STEL: 125 ppm STEL: 543 mg/m³	TWA: 100 ppm TWA: 435 mg/m³ STEL: 125 ppm STEL: 545 mg/m³	TWA: 20 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	136 °C / 276.8 °F
Flash Point	15 °C / 59 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.8%
Lower	1.2%
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	0.860
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	432 °C / 810 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C8 H10
Molecular Weight	106.17

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylbenzene	3500 mg/kg (Rat)	15400 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation May cause eye, skin, and respiratory tract irritation

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Ethylbenzene	100-41-4	Group 2B	Not listed	A3	X	Not listed

IARC: (International Agency for Research on Cancer)
Group 2B - Possibly Carcinogenic to Humans
IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans

ACGIH: (American Conference of Governmental Industrial Hygienists)
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system Central nervous system (CNS)
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression

Endocrine Disruptor Information No information available

Other Adverse Effects See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

Do not empty into drains. The product contains following substances which are hazardous for the environment. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Ethylbenzene	2.6 - 11.3 mg/L EC50 72 h 438 mg/L EC50 > 96 h 4.6 mg/L EC50 = 72 h 1.7 - 7.6 mg/L EC50 96 h	9.6 mg/L LC50 96 h 9.1 - 15.6 mg/L LC50 96 h 32 mg/L LC50 96 h 7.55 - 11 mg/L LC50 96 h 4.2 mg/L LC50 96 h 11.0 - 18.0 mg/L LC50 96 h	EC50 = 9.68 mg/L 30 min EC50 = 96 mg/L 24 h	1.8 - 2.4 mg/L EC50 48 h

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Ethylbenzene	3.118

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No UN1175
Proper Shipping Name ETHYLBENZENE
Hazard Class 3
Packing Group II

TDG

UN-No UN1175
Proper Shipping Name ETHYLBENZENE
Hazard Class 3
Packing Group II

IATA

UN-No UN1175
Proper Shipping Name ETHYLBENZENE
Hazard Class 3
Packing Group II

IMDG/IMO

UN-No UN1175
Proper Shipping Name ETHYLBENZENE
Hazard Class 3
Packing Group II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed The product is classified and labeled

according to EC directives or corresponding national laws The product is classified and labeled in accordance with Directive 1999/45/EC

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Ethylbenzene	X	X	-	202-849-4	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Ethylbenzene	100-41-4	>95	0.1

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Ethylbenzene	X	1000 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Ethylbenzene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Ethylbenzene	1000 lb	-

California Proposition 65 This product contains the following Proposition 65 chemicals:

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Ethylbenzene	100-41-4	Carcinogen	54 µg/day 41 µg/day	Carcinogen

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Ethylbenzene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class B2 Flammable liquid
D2A Very toxic materials



16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 06-Aug-2010
Revision Date 30-Oct-2014
Print Date 30-Oct-2014
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided on 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 a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as 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 material or in any process, unless specified in the text.

End of SDS

SAFETY DATA SHEET

Version 5.7
Revision Date 12/28/2015
Print Date 05/13/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Cyanide in Soil

Product Number : SQC011
Brand : Sigma-Aldrich

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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 4), H332

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Warning

Hazard statement(s)
H302 + H332 Harmful if swallowed or if inhaled

Precautionary statement(s)
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271 Use only outdoors or in a well-ventilated area.
P301 + P312 + P330 IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P312 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Hazardous components

Component		Classification	Concentration
Potassium cyanide			
CAS-No. EC-No. Index-No.	151-50-8 205-792-3 006-007-00-5	Met. Corr. 1; Acute Tox. 1; STOT SE 1; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H290, H300 + H310 + H330, H370, H372, H410	>= 0.1 - < 1 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

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. Consult a physician.

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
Nature of decomposition products not known.

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
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. 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

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.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.

Store at Room Temperature.
Storage class (TRGS 510): 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

Component	CAS-No.	Value	Control parameters	Basis
Potassium cyanide	151-50-8	C	4.700000 ppm 5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	10 minute ceiling value		
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		CAS number varies with compound Skin designation		
		C	5.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Headache Nausea Thyroid effects Danger of cutaneous absorption varies		
		C	5.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Headache Nausea Thyroid effects Danger of cutaneous absorption varies		
		C	4.7 ppm 5 mg/m3	USA. NIOSH Recommended Exposure Limits
		10 minute ceiling value		

		TWA	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		CAS number varies with compound Skin designation		
		C	5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Headache Nausea Thyroid effects Danger of cutaneous absorption varies		

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Safety glasses with side-shields conforming to EN166 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.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator.For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	No data available
f)	Initial boiling point and boiling range	No data available
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
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	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

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
No data available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Other decomposition products - No data available
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
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

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
RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence (Potassium cyanide)

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
No data available

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.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG

Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

SARA 302 Components
The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Potassium cyanide	151-50-8	1993-04-24

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

	CAS-No.	Revision Date
Potassium cyanide	151-50-8	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Water	7732-18-5	
Potassium hydroxide	1310-58-3	2007-03-01
Tripotassium hexacyanoferrate	13746-66-2	1989-08-11
Potassium cyanide	151-50-8	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
Water	7732-18-5	

California Prop. 65 Components

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.	CAS-No.	Revision Date
Tripotassium hexacyanoferrate	13746-66-2	2013-07-26
Potassium cyanide	151-50-8	2013-08-15

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H290	May be corrosive to metals.
H300 + H310 + H330	Fatal if swallowed, in contact with skin or if inhaled
H302	Harmful if swallowed.
H332	Harmful if inhaled.
H370	Causes damage to organs (/$/*_ORG_SING_ORAL/$/) if swallowed.
H372	Causes damage to organs (/$/*_ORGAN_REPEAT/$/) through prolonged or repeated exposure.
H410	Very toxic to aquatic life with long lasting effects.
Met. Corr.	Corrosive to metals
STOT RE	Specific target organ toxicity - repeated exposure
STOT SE	Specific target organ toxicity - single exposure

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

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
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: 5.7 Revision Date: 12/28/2015 Print Date: 05/13/2016

Hydrogen Cyanide

Safety Data Sheet 906205

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 07/26/2016 Version: 2.0

SECTION 1: Identification

1.1. Identification

Product form	:	Substance
Substance name	:	Hydrogen Cyanide
CAS-No.	:	74-90-8
Product code	:	SG-1001-06618
Formula	:	CHN
Synonyms	:	Hydrocyanic acid / Prussic acid / Hydrogen cyanide, anhydrous / Cyanhydric acid / Hydrogen cyanide, stabilized / Cyanides / Hydrocyanic acid / Prussic acid / Hydrogen cyanide, anhydrous / Cyanhydric acid / Hydrogen cyanide, stabilized / Cyanides

1.2. Recommended use and restrictions on use

Use of the substance/mixture	:	Laboratory chemicals Manufacture of substances

1.3. Supplier

Air Liquide USA LLC and its affiliates
9811 Katy Freeway, Suite 100
Houston, TX 77024 - USA
T 1-800-819-1704
www.us.airliquide.com

1.4. Emergency telephone number

Emergency number	:	Chemtrec: 1-800-424-9300

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Flammable liquids Category 1	H224	Extremely flammable liquid and vapour
Acute toxicity (oral) Category 1	H300	Fatal if swallowed
Acute toxicity (dermal) Category 1	H310	Fatal in contact with skin
Acute toxicity (inhalation:gas) Category 1	H330	Fatal if inhaled
Skin corrosion/irritation Category 2	H315	Causes skin irritation
Serious eye damage/eye irritation Category 2B	H320	Causes eye irritation
Specific target organ toxicity (single exposure) Category 3	H335	May cause respiratory irritation

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02 GHS06

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H224 - Extremely flammable liquid and vapour
H300+H310+H330 - Fatal if swallowed, in contact with skin or if inhaled
H315 - Causes skin irritation
H320 - Causes eye irritation
H335 - May cause respiratory irritation
CGA-HG04 - May form explosive mixtures with air

CGA-HG11 - Symptoms may be delayed

Precautionary statements (GHS-US) : P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking.
P260 - Do not breathe vapors.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective gloves, protective clothing.
P301+P310 - If swallowed: Immediately call a POISON CENTER
P302+P352 - If on skin: Wash with plenty of 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
P331 - Do NOT induce vomiting.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P403 - Store in a well-ventilated place.
P405 - Store locked up.
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P362 - Take off contaminated clothing and wash before reuse.
P381 - Eliminate all ignition sources if safe to do so.
P307+P311 - If exposed: Call a poison center/doctor
P284 - Wear respiratory protection. Consult respirator supplier´s product information for the selection of the appropriate respiratory protection.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C/125 °F
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG06 - Close valve after each use and when empty
CGA-PG10 - Use only with equipment rated for cylinder pressure
CGA-PG14 - Approach suspected leak area with caution
CGA-PG18 - When returning cylinder, install leak tight valve outlet cap or plug
CGA-PG21 - Open valve slowly

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name	Product identifier	%	GHS-US classification
Hydrogen Cyanide (Main constituent)	(CAS-No.) 74-90-8	> 99%	Flam. Liq. 1, H224 Acute Tox. 1 (Oral), H300 Acute Tox. 1 (Dermal), H310 Acute Tox. 1 (Inhalation:gas), H330 Skin Irrit. 2, H315 Eye Irrit. 2B, H320 STOT SE 3, H335

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Apply artificial respiration with bag and mask if breathing stopped. Get immediate medical advice/attention.

First-aid measures after skin contact : Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If skin irritation occurs: Get medical advice/attention.

First-aid measures after eye contact : Rinse immediately with plenty of water for 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation occurs, seek medical attention.

First-aid measures after ingestion : Do NOT induce vomiting. IF SWALLOWED: Get immediate medical advice/attention.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects after inhalation : Fatal if inhaled. May cause respiratory irritation.

Symptoms/effects after skin contact : Fatal in contact with skin. Causes skin irritation.

Symptoms/effects after eye contact : Causes eye irritation.

Symptoms/effects after ingestion : Fatal if swallowed.

Symptoms/effects upon intravenous administration	:	Not known.
Chronic symptoms	:	Adverse effects not expected from this product.

4.3. Immediate medical attention and special treatment, if necessary

If you feel unwell, seek medical advice. If breathing is difficult, give oxygen.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media	:	Use extinguishing media appropriate for surrounding fire.
Unsuitable extinguishing media	:	Do not use water jet to extinguish.

5.2. Specific hazards arising from the chemical

Fire hazard	:	This product is flammable.
Explosion hazard	:	Product is not explosive. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries.
Reactivity	:	None known.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions	:	In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire.
Protection during firefighting	:	Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures	:	Ensure adequate ventilation.

6.1.1. For non-emergency personnel

Protective equipment	:	Wear protective equipment consistent with the site emergency plan.
Emergency procedures	:	Evacuate personnel to a safe area. Close doors and windows of adjacent premises. Keep containers closed. Mark the danger area. Seal off low-lying areas. Keep upwind.

6.1.2. For emergency responders

Protective equipment	:	Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Equip cleanup crew with proper protection.
Emergency procedures	:	Evacuate and limit access. Ventilate area. Remove ignition sources. Monitor concentration of released product. Consider the risk of potentially explosive atmospheres. Wear self-contained breathing apparatus when entering atmospheres of unknown contaminant concentration until proven to be safe.

6.2. Environmental precautions

Try to stop release if without risk.

6.3. Methods and material for containment and cleaning up

For containment	:	Try to stop release if without risk.
Methods for cleaning up	:	Dispose of contents/container in accordance with local/regional/national/international regulations.

6.4. Reference to other sections

See also Sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed	:	Pressurized container: Do not pierce or burn, even after use. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty. Handle empty containers with care because residual vapors are flammable. In use, may form flammable vapor-air mixture.
Precautions for safe handling	:	Do not handle until all safety precautions have been read and understood. Use only outdoors or in a well-ventilated area. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Use only non-sparking tools.
Hygiene measures	:	Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.

Storage conditions : Do not expose to temperatures exceeding 52 °C/ 125 °F. Keep container closed when not in use. Protect cylinders from physical damage; do not drag, roll, slide or drop. Store in well ventilated area. Store locked up.

Incompatible products : None known.

Incompatible materials : Oxidizing materials. Air. Amines. Acids. Sodium hydroxide. Calcium hydroxide. sodium carbonate.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hydrogen Cyanide (74-90-8)		
ACGIH	ACGIH Ceiling (ppm)	4.7 ppm
OSHA	OSHA PEL (TWA) (mg/m³)	11 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	10 ppm
OSHA	Limit value category (OSHA)	prevent or reduce skin absorption
IDLH	US IDLH (ppm)	50 ppm
NIOSH	NIOSH REL (STEL) (mg/m³)	5 mg/m³
NIOSH	NIOSH REL (STEL) (ppm)	4.7 ppm
NIOSH	US-NIOSH chemical category	Potential for dermal absorption

8.2. Appropriate engineering controls

Appropriate engineering controls : Ensure exposure is below occupational exposure limits (where available). Provide adequate general and local exhaust ventilation. Systems under pressure should be regularly checked for leakages. Consider the use of a work permit system e.g. for maintenance activities. Alarm detectors should be used when toxic gases may be released.

Environmental exposure controls : Refer to local regulations for restriction of emissions to the atmosphere. See section 13 for specific methods for waste gas treatment.

8.3. Individual protection measures/Personal protective equipment

Hand protection:

Wear chemically resistant protective gloves. Wear working gloves when handling gas containers. 29 CFR 1910.138: Hand protection

Eye protection:

Wear safety glasses with side shields. Wear goggles and a face shield when transfilling or breaking transfer connections. 29 CFR 1910.133: Eye and Face Protection

Skin and body protection:

Wear suitable protective clothing, e.g. lab coats, coveralls or flame resistant clothing.

Respiratory protection:

Wear a respirator when performing non-routine tasks not limited to line breaking or sampling. Wear a respirator during routine operations if determined to be necessary during a process-specific review. Consult respirator suppliers' product information or their representatives for the selection of the appropriate respirator. See Sections 5 & 6.

Thermal hazard protection:

None necessary during normal and routine operations.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Colorless or pale-blue liquid or gas (above 26°C).
Color	:	Colorless to pale-blue
Odor	:	Bitter almonds
Odor threshold	:	No data available
pH	:	No data available
Melting point	:	-15 °C
Freezing point	:	No data available
Boiling point	:	26 °C
Critical temperature	:	456.7 °K
Flash point	:	-18 °C (96%)
Relative evaporation rate (butyl acetate=1)	:	No data available
Flammability (solid, gas)	:	See Section 2.1 and 2.2
Vapor pressure	:	630 mm Hg
Relative vapor density at 20 °C	:	No data available
Relative density	:	No data available
Specific gravity / density	:	0.687 g/cm³ (at 20 °C)
Molecular mass	:	27.025 g/mol
Relative gas density	:	Similar to air
Solubility	:	Water: No data available
Log Pow	:	No data available
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	5.6 - 40 vol %
Explosive properties	:	Without adequate ventilation formation of explosive mixtures may be possible.
Oxidizing properties	:	None.

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

None known.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Can form explosive mixture with air.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

Oxidizing materials. Air. Amines. Acids. Sodium hydroxide. Calcium hydroxide. sodium carbonate.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Oral: Fatal if swallowed. Dermal: Fatal in contact with skin. Inhalation:gas: Fatal if inhaled.

Hydrogen Cyanide (74-90-8)	
LD50 oral rat	4.2 mg/kg
LD50 dermal rabbit	6.8 mg/kg
LC50 inhalation rat (ppm)	70 ppm/4h
ATE US (oral)	4.200 mg/kg body weight
ATE US (dermal)	6.800 mg/kg body weight
ATE US (gases)	70.000 ppmV/4h

Skin corrosion/irritation : Causes skin irritation.

Serious eye damage/irritation : Causes eye irritation.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity – single exposure : May cause respiratory irritation.

Specific target organ toxicity – repeated exposure : Not classified

Aspiration hazard : Not classified

Symptoms/effects after inhalation : Fatal if inhaled. May cause respiratory irritation.

Symptoms/effects after skin contact : Fatal in contact with skin. Causes skin irritation.

Symptoms/effects after eye contact : Causes eye irritation.

Symptoms/effects after ingestion : Fatal if swallowed.

Symptoms/effects upon intravenous administration : Not known.

Chronic symptoms : Adverse effects not expected from this product.

SECTION 12: Ecological information

12.1. Toxicity

Hydrogen Cyanide (74-90-8)	
LC50 fish 1	0.082 - 0.137 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
EC50 Daphnia 1	1.8 mg/l (Exposure time: 48 h - Species: Daphnia species)
LC50 fish 2	24 - 35 µg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [flow-through])

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

Hydrogen Cyanide (74-90-8)	
BCF fish 1	(no bioaccumulation expected)

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on ozone layer : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Disposal methods

Regional legislation (waste) : U.S. - RCRA (Resource Conservation & Recovery Act) - Basis for Listing - Appendix VII. U.S. - RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261. U.S. - RCRA (Resource Conservation & Recovery Act) - P Series Wastes - Acutely Toxic Wastes.

Waste treatment methods : Contact supplier if guidance is required. Do not discharge into any place where its accumulation could be dangerous. Ensure that the emission levels from local regulations or operating permits are not exceeded. Waste gas should be flared through a suitable burner with flash back arrestor. Do not discharge into areas where there is a risk of forming an explosive mixture with air. Must not be discharged to atmosphere. Toxic and corrosive gases formed during combustion should be scrubbed before discharge to atmosphere.

Product/Packaging disposal recommendations : Refer to the CGA Pamphlet P-63 "Disposal of Gases" available at www.cganet.com for more guidance on suitable disposal methods.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1051 Hydrogen cyanide, stabilized with less than 3 percent water, 6.1 (3), I

UN-No.(DOT) : UN1051

Proper Shipping Name (DOT) : Hydrogen cyanide, stabilized
with less than 3 percent water

Class (DOT) : 6.1 - Class 6.1 - Poisonous materials 49 CFR 173.132

Packing group (DOT) : I - Great Danger

Subsidiary risk (DOT) : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120

Hazard labels (DOT) : 6.1 - Poison
3 - Flammable liquid



DOT Packaging Non Bulk (49 CFR 173.xxx) : 195

DOT Packaging Bulk (49 CFR 173.xxx) : 244

DOT Special Provisions (49 CFR 172.102) : 1 - This material is poisonous by inhalation (see 171.8 of this subchapter) in Hazard Zone A (see 173.116(a) or 173.133(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.
B35 - Tank cars containing hydrogen cyanide may be alternatively marked Hydrocyanic acid, liquefied if otherwise conforming to marking requirements in subpart D of this part. Tank cars marked HYDROCYANIC ACID prior to October 1, 1991 do not need to be remarked.
B61 - Written procedures covering details of tank car appurtenances, dome fittings, safety devices, and marking, loading, handling, inspection, and testing practices must be approved by the Associate Administrator before any single unit tank car tank is offered for transportation.
B65 - Tank cars must have a test pressure of 34.47 Bar (500 psig) or greater and conform to Class 105A. Each tank car must have a pressure relief device having a start-to-discharge pressure of 15.51 Bar (225 psig). The tank car specification may be marked to indicate a test pressure of 20.68 Bar (300 psig).
B77 - Other packaging are authorized when approved by the Associate Administrator.
B82 - Cargo tanks and portable tanks are not authorized.

DOT Packaging Exceptions (49 CFR 173.xxx) : None

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : Forbidden

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : Forbidden

DOT Vessel Stowage Location : D - The material must be stowed ‘‘on deck only’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers or one passenger per each 3 m of overall vessel length, but the material is prohibited on passenger vessels in which the limiting number of passengers is exceeded.

DOT Vessel Stowage Other : 40 - Stow ‘‘clear of living quarters’’

Emergency Response Guide (ERG) Number : 117 (UN1051);152 (UN1614);154 (UN1613)

Other information : No supplementary information available.

Transportation of Dangerous Goods

Transport document description : UN1051 HYDROGEN CYANIDE, STABILIZED (containing less than 3 percent water), 6.1 (3), I

UN-No. (TDG) : UN1051

Proper Shipping Name : HYDROGEN CYANIDE, STABILIZED

TDG Primary Hazard Classes : 6.1 - Class 6.1 - Toxic Substances

Packing group : I - Great Danger

TDG Subsidiary Classes : 3

TDG Special Provisions	:	23 - (1) A consignor of these dangerous goods must include, except for UN1005, ANHYDROUS AMMONIA, the words “toxic by inhalation” or “toxic — inhalation hazard” or “toxique par inhalation” or “toxicité par inhalation” in the following places, unless the words are already part of the shipping name: (a)on a shipping document, immediately after the description of the dangerous goods; (b)on a small means of containment, next to the shipping name of the dangerous goods; and (c)on a large means of containment, next to the placard for the primary class of the dangerous goods or the placard for the subsidiary class, if any. For example, the notation on a shipping document would be “UN1935, CYANIDE SOLUTION, N.O.S, Class 6.1, PG I, toxic by inhalation”. (2) This special provision does not apply to a person who transports these dangerous goods in accordance with an exemption set out in sections 1.15, 1.17 or 1.17.1 of Part 1 (Coming Into Force, Repeal, Interpretation, General Provisions and Special Cases). (3) A consignor of UN1005, ANHYDROUS AMMONIA, must include the words “inhalation hazard” or “dangereux par inhalation”: (a)on a shipping document, immediately after the shipping name of the dangerous goods; and (b)on a small means of containment, next to the shipping name of the dangerous goods. When UN1005, ANHYDROUS AMMONIA, is contained in a large means of containment on which is affixed the anhydrous ammonia placard, the words “Anhydrous Ammonia, Inhalation Hazard” or “Ammoniac anhydre, dangereux par inhalation” must be displayed next to the placard in accordance with paragraph 4.18.2(b). SOR/2014-306
ERAP Index	:	1 000
Explosive Limit and Limited Quantity Index	:	0
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index	:	Forbidden
Passenger Carrying Ship Index	:	Forbidden

Transport by sea

Transport document description (IMDG)	:	UN UN1051 Hydrogen Cyanide, Stabilized, 6.1, I, MARINE POLLUTANT/ENVIRONMENTALLY HAZARDOUS
UN-No. (IMDG)	:	UN1051
Proper Shipping Name (IMDG)	:	Hydrogen Cyanide, Stabilized
Class (IMDG)	:	6.1 - Toxic substances
Packing group (IMDG)	:	I - substances presenting high danger

Air transport

Transport document description (IATA)	:	UN Forbidden , ENVIRONMENTALLY HAZARDOUS
UN-No. (IATA)	:	Forbidden

SECTION 15: Regulatory information

15.1. US Federal regulations

Hydrogen Cyanide (74-90-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on the United States SARA Section 302 Subject to reporting requirements of United States SARA Section 313	
EPA TSCA Regulatory Flag	T - T - indicates a substance that is the subject of a Section 4 test rule under TSCA.
CERCLA RQ	10 lb
Section 302 EPCRA Reportable Quantity (RQ)	10 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	100 lb
SARA Section 313 - Emission Reporting	1 %

15.2. International regulations

CANADA

Hydrogen Cyanide (74-90-8)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Hydrogen Cyanide (74-90-8)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

National regulations

Hydrogen Cyanide (74-90-8)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Japanese Poisonous and Deleterious Substances Control Law Japanese Pollutant Release and Transfer Register Law (PRTR Law) Listed on the Canadian IDL (Ingredient Disclosure List) Listed on INSQ (Mexican National Inventory of Chemical Substances)

15.3. US State regulations

Hydrogen Cyanide (74-90-8)	
U.S. - California - Proposition 65 - Carcinogens List	Yes
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	Yes
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Other information : This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product.

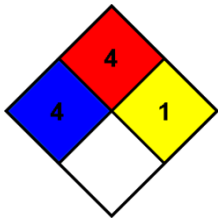
Full text of H-phrases:

H224	Extremely flammable liquid and vapour
H300	Fatal if swallowed
H310	Fatal in contact with skin
H315	Causes skin irritation
H320	Causes eye irritation
H330	Fatal if inhaled
H335	May cause respiratory irritation

NFPA health hazard : 4 - Materials that, under emergency conditions, can be lethal.

NFPA fire hazard : 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA reactivity : 1 - Materials that in themselves are normally stable but can become unstable at elevated temperatures and pressures.



SDS US (GHS HazCom 2012)

This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide USA LLC and its affiliates' knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

Hydrogen Sulfide

Safety Data Sheet 900049

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 09/24/2015 Revision date: 04/19/2019 Supersedes: 11/21/2018 Version: 2.3

SECTION 1: Identification

1.1. Identification

Product form : Substance

Substance name : Hydrogen Sulfide

CAS-No. : 7783-06-4

Product code : SG-1001-01824

1.2. Recommended use and restrictions on use

Use of the substance/mixture : Manufacture of substances
Semiconductor Purposes

1.3. Supplier

Air Liquide USA LLC and its affiliates
9811 Katy Freeway, Suite 100
Houston, TX 77024 - USA
T 1-800-819-1704
www.us.airliquide.com

1.4. Emergency telephone number

Emergency number : Chemtrec: 1-800-424-9300

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS US classification

Flammable gases Category 1	H220	Extremely flammable gas
Gases under pressure Liquefied gas	H280	Contains gas under pressure; may explode if heated
Acute toxicity (inhalation:gas) Category 2	H330	Fatal if inhaled
Specific target organ toxicity (single exposure) Category 3	H335	May cause respiratory irritation

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS US labeling

Hazard pictograms (GHS US) :



Signal word (GHS US) : Danger

Hazard statements (GHS US) : H280 - Contains gas under pressure; may explode if heated
H220 - Extremely flammable gas
H330 - Fatal if inhaled
H335 - May cause respiratory irritation
CGA-HG01 - May cause frostbite
CGA-HG04 - May form explosive mixtures with air
CGA-HG11 - Symptoms may be delayed
CGA-HG16 - Extended exposure to gas reduces the ability to smell sulfides.

Precautionary statements (GHS US) : P202 - Do not handle until all safety precautions have been read and understood.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective gloves, protective clothing.
P403 - Store in a well-ventilated place.
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations
P302 - IF ON SKIN: Thaw frosted parts with lukewarm water. Do not rub affected area, Get immediate medical advice/attention.
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking.

P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P260 - Do not breathe gas.
P405 - Store locked up.
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P381 - Eliminate all ignition sources if safe to do so.
P307+P311 - If exposed: Call a poison center/doctor
P284 - Wear respiratory protection. Consult respirator supplier´s product information for the selection of the appropriate respiratory protection.
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C/125 °F
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG06 - Close valve after each use and when empty
CGA-PG10 - Use only with equipment rated for cylinder pressure
CGA-PG14 - Approach suspected leak area with caution
CGA-PG18 - When returning cylinder, install leak tight valve outlet cap or plug
CGA-PG21 - Open valve slowly
CGA-PG29 - Do not depend on odor to detect presence of gas

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Name	Product identifier	%	GHS US classification
Hydrogen Sulfide (Main constituent)	(CAS-No.) 7783-06-4	> 99	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Acute Tox. 2 (Inhalation:gas), H330 STOT SE 3, H335

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Apply artificial respiration with bag and mask if breathing stopped. Get immediate medical advice/attention.

First-aid measures after skin contact : Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice/attention.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects after inhalation : Fatal if inhaled. May cause respiratory irritation.

Symptoms/effects after skin contact : May cause frostbite.

Symptoms/effects after eye contact : Contact with the product may cause cold burns or frostbite.

Symptoms/effects after ingestion : Ingestion is not considered a potential route of exposure.

Symptoms/effects upon intravenous administration : Not known.

Most important symptoms and effects, both acute and delayed : May cause damaging effects to central nervous system, metabolism and gastrointestinal tract. Prolonged exposure to small concentrations may result in pulmonary oedema. Irritation to the respiratory tract. Refer to section 11.

Chronic symptoms : Adverse effects not expected from this product.

4.3. Immediate medical attention and special treatment, if necessary

If you feel unwell, seek medical advice. If breathing is difficult, give oxygen.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

Unsuitable extinguishing media : Do not use water jet to extinguish.

5.2. Specific hazards arising from the chemical

Fire hazard	:	This product is flammable.
Explosion hazard	:	Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries. May form flammable/explosive vapor-air mixture.
Reactivity	:	None known.
Hazardous combustion products	:	If involved in a fire the following toxic and/or corrosive fumes may be produced by thermal decomposition: Sulphur dioxide.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions	:	In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire.
Protection during firefighting	:	Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Ensure adequate ventilation.

6.1.1. For non-emergency personnel

Protective equipment	:	Wear protective equipment consistent with the site emergency plan.
Emergency procedures	:	Evacuate personnel to a safe area. Close doors and windows of adjacent premises. Keep containers closed. Mark the danger area. Seal off low-lying areas. Keep upwind.

6.1.2. For emergency responders

Protective equipment	:	Standard protective clothing and equipment (e.g, Self Contained Breathing Apparatus) for fire fighters. Equip cleanup crew with proper protection.
Emergency procedures	:	Evacuate and limit access. Ventilate area. Remove ignition sources. Monitor concentration of released product. Consider the risk of potentially explosive atmospheres. Wear self-contained breathing apparatus when entering atmospheres of unknown contaminant concentration until proven to be safe.

6.2. Environmental precautions

Try to stop release if without risk.

6.3. Methods and material for containment and cleaning up

For containment	:	Try to stop release if without risk.
Methods for cleaning up	:	Dispose of contents/container in accordance with local/regional/national/international regulations.
Methods and material for containment and cleaning up	:	Hose down area with water. Ventilate area.

6.4. Reference to other sections

See also Sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed	:	Pressurized container: Do not pierce or burn, even after use. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty. Handle empty containers with care because residual vapors are flammable. In use, may form flammable vapor-air mixture.
Precautions for safe handling	:	Do not handle until all safety precautions have been read and understood. Use only outdoors or in a well-ventilated area. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Use only non-sparking tools.
Hygiene measures	:	Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures	:	Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.
Storage conditions	:	Do not expose to temperatures exceeding 52 °C/ 125 °F. Keep container closed when not in use. Protect cylinders from physical damage; do not drag, roll, slide or drop. Store in well ventilated area. Store locked up.
Incompatible products	:	None known.
Incompatible materials	:	Oxidizing materials. Air.

Conditions for safe storage, including any incompatibilities : Observe all regulations and local requirements regarding storage of containers. Containers should not be stored in conditions likely to encourage corrosion. Container valve guards or caps should be in place. Containers should be stored in the vertical position and properly secured to prevent them from falling over. Stored containers should be periodically checked for general condition and leakage. Keep container below 50°C in a well ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Keep away from combustible materials. Segregate from oxidant gases and other oxidants in store. All electrical equipment in the storage areas should be compatible with the risk of a potentially explosive atmosphere.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Hydrogen Sulfide (7783-06-4)		
ACGIH	ACGIH TWA (ppm)	1 ppm
ACGIH	ACGIH STEL (ppm)	5 ppm
OSHA	OSHA PEL (Ceiling) (ppm)	20 ppm
OSHA	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	50 ppm Peak (10 minutes once, only if no other measurable exposure occurs)
IDLH	US IDLH (ppm)	100 ppm
NIOSH	NIOSH REL (ceiling) (mg/m³)	15 mg/m³
NIOSH	NIOSH REL (ceiling) (ppm)	10 ppm

8.2. Appropriate engineering controls

Appropriate engineering controls : Ensure exposure is below occupational exposure limits (where available). Provide adequate general and local exhaust ventilation. Systems under pressure should be regularly checked for leakages. Consider the use of a work permit system e.g. for maintenance activities. Alarm detectors should be used when toxic gases may be released.

Environmental exposure controls : Refer to local regulations for restriction of emissions to the atmosphere. See section 13 for specific methods for waste gas treatment.

8.3. Individual protection measures/Personal protective equipment

Hand protection:

Wear working gloves when handling gas containers. 29 CFR 1910.138: Hand protection

Eye protection:

Wear safety glasses with side shields. 29 CFR 1910.133: Eye and Face Protection

Skin and body protection:

Wear suitable protective clothing, e.g. lab coats, coveralls or flame resistant clothing.

Respiratory protection:

Wear a respirator when performing non-routine tasks not limited to line breaking or sampling. Wear a respirator during routine operations if determined to be necessary during a process-specific review. Consult respirator suppliers' product information or their representatives for the selection of the appropriate respirator. See Sections 5 & 6.

Thermal hazard protection:

None necessary during normal and routine operations.

Other information:

Wear safety shoes while handling containers. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Appearance : Clear, colorless gas.

Color : Colorless

Odor : Rotten eggs Sulfide-like

Odor threshold	:	No data available
pH	:	No data available
Melting point	:	-86 °C
Freezing point	:	-86 °C
Boiling point	:	No data available
Critical temperature	:	101.05 °C
Critical pressure	:	8940 kPa
Flash point	:	No data available
Relative evaporation rate (butyl acetate=1)	:	No data available
Flammability (solid, gas)	:	See Section 2.1 and 2.2
Vapor pressure	:	1722 kPa @ 70°F
Relative vapor density at 20 °C	:	1.175
Relative density	:	0.92
Molecular mass	:	34.08 g/mol
Relative gas density	:	Heavier than air
Solubility	:	Water: 3980 mg/l
Log Pow	:	Not applicable for inorganic products.
Auto-ignition temperature	:	270 °C
Decomposition temperature	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	3.9 - 45.5 vol %
Explosive properties	:	Without adequate ventilation formation of explosive mixtures may be possible.
Oxidizing properties	:	None.

9.2. Other information

Additional information : Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level

SECTION 10: Stability and reactivity

10.1. Reactivity

None known.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Can form explosive mixture with air.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

Oxidizing materials. Air.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral) : Not classified

Acute toxicity (dermal) : Not classified

Acute toxicity (inhalation) : Inhalation:gas: Fatal if inhaled.

Hydrogen Sulfide (7783-06-4)	
LC50 inhalation rat (mg/l)	700 mg/m³ (Exposure time: 4 h)
LC50 inhalation rat (ppm)	356 ppm/4h
ATE US (gases)	356 ppmV/4h
ATE US (vapors)	0.7 mg/l/4h

Hydrogen Sulfide (7783-06-4)	
ATE US (dust, mist)	0.7 mg/l/4h

Skin corrosion/irritation : Not classified

Serious eye damage/irritation : Not classified

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity – single exposure : May cause respiratory irritation.

Specific target organ toxicity – repeated exposure : Not classified

Aspiration hazard : Not classified

Viscosity, kinematic : No data available

Symptoms/effects after inhalation : Fatal if inhaled. May cause respiratory irritation.

Symptoms/effects after skin contact : May cause frostbite.

Symptoms/effects after eye contact : Contact with the product may cause cold burns or frostbite.

Symptoms/effects after ingestion : Ingestion is not considered a potential route of exposure.

Symptoms/effects upon intravenous administration : Not known.

Most important symptoms and effects, both acute and delayed : May cause damaging effects to central nervous system, metabolism and gastrointestinal tract. Prolonged exposure to small concentrations may result in pulmonary oedema. Irritation to the respiratory tract. Refer to section 11.

Chronic symptoms : Adverse effects not expected from this product.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : Very toxic to aquatic life.

Hydrogen Sulfide (7783-06-4)	
LC50 fish 1	0.0448 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [flow-through])
LC50 fish 2	0.016 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
LC50-96 h - fish [mg/l]	0.007 - 0.019 mg/l
EC50 48h - Daphnia magna [mg/l]	0.12 mg/l
EC50 72h Algae [mg/l]	1.87 mg/l

12.2. Persistence and degradability

Hydrogen Sulfide (7783-06-4)	
Persistence and degradability	Not applicable for inorganic products .

12.3. Bioaccumulative potential

Hydrogen Sulfide (7783-06-4)	
BCF fish 1	(no bioaccumulation expected)
Log Pow	Not applicable for inorganic products.
Bioaccumulative potential	No data available.

12.4. Mobility in soil

Hydrogen Sulfide (7783-06-4)	
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

12.5. Other adverse effects

Effect on ozone layer : No known effects from this product.

SECTION 13: Disposal considerations

13.1. Disposal methods

Waste treatment methods : Contact supplier if guidance is required. Do not discharge into any place where its accumulation could be dangerous. Ensure that the emission levels from local regulations or operating permits are not exceeded. Waste gas should be flared through a suitable burner with flash back arrestor. Do not discharge into areas where there is a risk of forming an explosive mixture with air.

Product/Packaging disposal recommendations : Refer to the CGA Pamphlet P-63 "Disposal of Gases" available at www.cganet.com for more guidance on suitable disposal methods.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1053 Hydrogen sulfide, 2.3 (2.1)

UN-No.(DOT) : UN1053

Proper Shipping Name (DOT) : Hydrogen sulfide

Class (DOT) : 2.3 - Class 2.3 - Poisonous gas 49 CFR 173.115

Subsidiary risk (DOT) : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

Hazard labels (DOT) : 2.3 - Poison gas
2.1 - Flammable gas



DOT Packaging Non Bulk (49 CFR 173.xxx) : 304

DOT Packaging Bulk (49 CFR 173.xxx) : 314;315

DOT Special Provisions (49 CFR 172.102) : 2 - This material is poisonous by inhalation (see 171.8 of this subchapter) in Hazard Zone B (see 173.116(a) or 173.133(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.
B9 - Bottom outlets are not authorized.
B14 - Each bulk packaging, except a tank car or a multi-unit-tank car tank, must be insulated with an insulating material so that the overall thermal conductance at 15.5 C (60 F) is no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour per square foot per degree Fahrenheit) temperature differential. Insulating materials must not promote corrosion to steel when wet.
N89 - When steel UN pressure receptacles are used, only those bearing the “H” mark are authorized.

DOT Packaging Exceptions (49 CFR 173.xxx) : None

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : Forbidden

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : Forbidden

DOT Vessel Stowage Location : D - The material must be stowed ‘‘on deck only’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers or one passenger per each 3 m of overall vessel length, but the material is prohibited on passenger vessels in which the limiting number of passengers is exceeded.

DOT Vessel Stowage Other : 40 - Stow ‘‘clear of living quarters’’

Emergency Response Guide (ERG) Number : 117

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transportation of Dangerous Goods

Transport document description : UN1053 HYDROGEN SULFIDE, 2.3 (2.1)

UN-No. (TDG) : UN1053

Proper Shipping Name	:	HYDROGEN SULFIDE
TDG Primary Hazard Classes	:	2.3 - Class 2.3 - Toxic Gas.
TDG Subsidiary Classes	:	2.1
TDG Special Provisions	:	23 - (1) A consignor of these dangerous goods must include, except for UN1005, ANHYDROUS AMMONIA, the words “toxic by inhalation” or “toxic — inhalation hazard” or “toxique par inhalation” or “toxicité par inhalation” in the following places, unless the words are already part of the shipping name: (a)on a shipping document, immediately after the description of the dangerous goods; (b)on a small means of containment, next to the shipping name of the dangerous goods; and (c)on a large means of containment, next to the placard for the primary class of the dangerous goods or the placard for the subsidiary class, if any. For example, the notation on a shipping document would be “UN1935, CYANIDE SOLUTION, N.O.S, Class 6.1, PG I, toxic by inhalation”. (2) This special provision does not apply to a person who transports these dangerous goods in accordance with an exemption set out in sections 1.15, 1.17 or 1.17.1 of Part 1 (Coming Into Force, Repeal, Interpretation, General Provisions and Special Cases). (3) A consignor of UN1005, ANHYDROUS AMMONIA, must include the words “inhalation hazard” or “dangereux par inhalation”: (a)on a shipping document, immediately after the shipping name of the dangerous goods; and (b)on a small means of containment, next to the shipping name of the dangerous goods. When UN1005, ANHYDROUS AMMONIA, is contained in a large means of containment on which is affixed the anhydrous ammonia placard, the words “Anhydrous Ammonia, Inhalation Hazard” or “Ammoniac anhydre, dangereux par inhalation” must be displayed next to the placard in accordance with paragraph 4.18.2(b). SOR/2014-306,16 - (1) The technical name of at least one of the most dangerous substances that predominantly contributes to the hazard or hazards posed by the dangerous goods must be shown, in parentheses, on the shipping document following the shipping name in accordance with clause 3.5(1)(c)(ii)(A) of Part 3 (Documentation). The technical name must also be shown, in parentheses, on a small means of containment or on a tag following the shipping name in accordance with subsections 4.11(2) and (3) of Part 4 (Dangerous Goods Safety Marks). (2) Despite subsection (1), the technical name for the following dangerous goods is not required to be shown on a shipping document or on a small means of containment when Canadian law for domestic transport or an international convention for international transport prohibits the disclosure of the technical name: (a)UN1544, ALKALOID SALTS, SOLID, N.O.S. or ALKALOIDS, SOLID, N.O.S; (b)UN1851, MEDICINE, LIQUID, TOXIC, N.O.S; (c)UN3140, ALKALOID SALTS, LIQUID, N.O.S. or ALKALOIDS, LIQUID, N.O.S; (d)UN3248, MEDICINE, LIQUID, FLAMMABLE, TOXIC, N.O.S; or (e)UN3249, MEDICINE, SOLID, TOXIC, N.O.S. An example in Canada is the “Food and Drugs Act”. (3) Despite subsection (1), the technical name for the following dangerous goods is not required to be shown on a small means of containment: (a)UN2814, INFECTIOUS SUBSTANCE, AFFECTING HUMANS; or (b)UN2900, INFECTIOUS SUBSTANCE, AFFECTING ANIMALS. SOR/2014-306,38 - A person must not handle, offer for transport or transport these dangerous goods in a large means of containment if they are in direct contact with the large means of containment. SOR/2014-306
ERAP Index	:	500
Explosive Limit and Limited Quantity Index	:	0
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index	:	Forbidden
Passenger Carrying Ship Index	:	Forbidden

Transport by sea

Transport document description (IMDG)	:	UN 1053 Hydrogen Sulfide, 2, MARINE POLLUTANT/ENVIRONMENTALLY HAZARDOUS
UN-No. (IMDG)	:	1053
Proper Shipping Name (IMDG)	:	Hydrogen Sulfide
Class (IMDG)	:	2 - Gases
MFAG-No		117

Air transport

Forbidden

SECTION 15: Regulatory information

15.1. US Federal regulations

Hydrogen Sulfide (7783-06-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	100 lb
RQ (Reportable quantity, section 304 of EPA's List of Lists)	100 lb
Section 302 EPCRA Reportable Quantity (RQ)	100 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	500 lb

15.2. International regulations

CANADA

Hydrogen Sulfide (7783-06-4)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Hydrogen Sulfide (7783-06-4)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

National regulations

Hydrogen Sulfide (7783-06-4)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on INSQ (Mexican National Inventory of Chemical Substances) Listed on the TCSI (Taiwan Chemical Substance Inventory)

15.3. US State regulations

Hydrogen Sulfide (7783-06-4)	
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

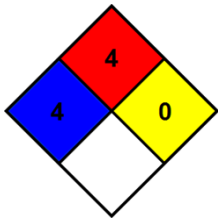
Revision date : 04/19/2019

Other information : This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product.

Full text of H-phrases:

H220	Extremely flammable gas
H280	Contains gas under pressure; may explode if heated
H330	Fatal if inhaled
H335	May cause respiratory irritation

NFPA health hazard	:	4 - Materials that, under emergency conditions, can be lethal.
NFPA fire hazard	:	4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.
NFPA reactivity	:	0 - Material that in themselves are normally stable, even under fire conditions.



SDS US (GHS HazCom 2012)

This Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide USA LLC and its affiliates' knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

SAFETY DATA SHEET

Version 8.2
Revision Date 08/20/2021
Print Date 03/01/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Lead

Product Number : GF59147310
Brand : Aldrich
CAS-No. : 7439-92-1

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 Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Carcinogenicity (Category 2), H351
Reproductive toxicity (Category 1A), H360
Effects on or via lactation, H362
Specific target organ toxicity - repeated exposure, Oral (Category 1), Central nervous system, Blood, Immune system, Kidney, H372

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Hazard statement(s)

H351	Suspected of causing cancer.
H360	May damage fertility or the unborn child.
H362	May cause harm to breast-fed children.
H372	Causes damage to organs (Central nervous system, Blood, Immune system, Kidney) through prolonged or repeated exposure if swallowed.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
P263	Avoid contact during pregnancy/ while nursing.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Molecular weight : 207.20 g/mol
CAS-No. : 7439-92-1

Component	Classification	Concentration
Lead		
	Carc. 2; Repr. 1A; Lact. ; STOT RE 1; H351, H360, H362, H372 Concentration limits: >= 2.5 %: Repr. 2, H361f; >= 0.5 %: STOT RE 2, H373; >= 0.03 %: Repr. 1A, H360;	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

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

SECTION 5: Firefighting measures

5.1 Extinguishing media

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Nature of decomposition products not known.
Not combustible.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Avoid generation and inhalation of dusts in all circumstances. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
No special precautionary measures necessary.

6.3 Methods and materials for containment and cleaning up
Observe possible material restrictions (see sections 7 and 10). Take up carefully. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections
For disposal see section 13.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture.

Hygiene measures
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry. Keep in a well-ventilated place. Keep locked up or in an area accessible only to qualified or authorized persons.

Storage class
Storage class (TRGS 510): 6.1C: Combustible, acute toxic Cat.3 / toxic compounds or compounds which causing chronic effects

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead	7439-92-1	TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Confirmed animal carcinogen with unknown relevance to humans		
		PEL	0.05 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		OSHA specifically regulated carcinogen		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		PEL	0.05 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	200 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

	Remarks	Not critical

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

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). Safety glasses

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
No special precautionary measures necessary.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid
b)	Odor	No data available
c)	Odor Threshold	No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

d)	pH	No data available
e)	Melting point/freezing point	Melting point: 326 °C (619 °F) at ca.1,013 hPa - OECD Test Guideline 102
f)	Initial boiling point and boiling range	1,740 °C 3,164 °F
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Density	11.45 g/cm3 at 23.8 °C (74.8 °F) at 1,013 hPa - OECD Test Guideline 109
	Relative density	11.45 at 23.8 °C (74.8 °F) - OECD Test Guideline 109
n)	Water solubility	0.185 g/l at 20 °C (68 °F) at 1,013 hPa - OECD Test Guideline 105 - partly soluble
o)	Partition coefficient: n-octanol/water	Not applicable for inorganic substances
p)	Autoignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
no information available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - male and female - > 2,000 mg/kg
(OECD Test Guideline 423)
LC50 Inhalation - Rat - male and female - 4 h - > 5.05 mg/l
(OECD Test Guideline 403)
LD50 Dermal - Rat - male and female - > 2,000 mg/kg
(OECD Test Guideline 402)

Skin corrosion/irritation
Skin - Rabbit
Result: No skin irritation - 4 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: No eye irritation - 72 h
(OECD Test Guideline 405)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity

Test Type: Micronucleus test
Species: Rat
Cell type: Red blood cells (erythrocytes)
Application Route: Oral

Result: positive
Remarks: (ECHA)

Test Type: comet assay
Species: Mouse
Cell type: Liver cells
Application Route: Inhalation

Result: negative
Remarks: (ECHA)

Test Type: Micronucleus test
Species: Mouse
Cell type: Bone marrow
Application Route: Oral

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Result: Positive results were obtained in some in vivo tests.
Remarks: (ECHA)

Test Type: Chromosome aberration test in vitro
Species: Monkey
Cell type: lymphocyte
Application Route: Oral

Result: Positive results were obtained in some in vivo tests.
Remarks: (ECHA)

Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lead)

NTP: No ingredient 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 on OSHA's list of regulated carcinogens.

Reproductive toxicity
May damage the unborn child. Positive evidence from human epidemiological studies. May damage fertility. Positive evidence from human epidemiological studies. Studies indicating a hazard to babies during the lactation period

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Oral - Causes damage to organs through prolonged or repeated exposure. - Central nervous system, Blood, Immune system, Kidney

Aspiration hazard
No data available

11.2 Additional Information

anemia
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

On the basis of the morphology of the product, no hazardous properties are to be expected when it is handled and used with appropriate care.

The following applies to lead compounds in general: Due to the poor absorbability via the gastrointestinal tract, only very high doses lead to acute cases of intoxication. After a latency period of several hours, metallic taste, nausea, vomiting, and colics occur, in many instances followed by shock. Chronic uptake causes peripheral muscular weakness ("drop-wrist"), anaemia, and central-nervous disorders. Women of child-bearing age should not be exposed to the substance over longer periods of time (observe critical threshold).

Handle in accordance with good industrial hygiene and safety practice.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 12: Ecological information

12.1 Toxicity
No data available

12.2 Persistence and degradability
Biodegradability — Result: - According to the results of tests of biodegradability this product is not readily biodegradable.
Remarks: The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
Bioaccumulation — Oncorhynchus kisutch - 2 Weeks
- 150 µg/l(Lead)

Bioconcentration factor (BCF): 12

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
Discharge into the environment must be avoided.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

Further information
Not classified as dangerous in the meaning of transport regulations.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	2015-11-23

Reportable Quantity : D008 lbs

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

SECTION 16: Other information

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.

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 8.2 Revision Date: 08/20/2021 Print Date: 03/01/2022

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SAFETY DATA SHEET

Creation Date 20-Aug-2014 **Revision Date** 22-Jun-2015 **Revision Number** 6

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identification

Product Description:	**Mercury**
Cat No. :	**M/3750/50, M/3750/53, M/3750/60, M/3750/48**
Synonyms	Quicksilver
CAS-No	7439-97-6
EC-No.	231-106-7
Molecular Formula	Hg

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use	Laboratory chemicals.
Uses advised against	No Information available

1.3. Details of the supplier of the safety data sheet

Company	Fisher Scientific UK Bishop Meadow Road, Loughborough, Leicestershire LE11 5RG, United Kingdom
E-mail address	begel.sdsdesk@thermofisher.com

1.4. Emergency telephone number

Tel: 01509 231166
Chemtrec US: (800) 424-9300
Chemtrec EU: 001 (202) 483-7616

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

CLP Classification - Regulation (EC) No 1272/2008

Physical hazards

Substances/mixtures corrosive to metal	Category 1

Health hazards

Acute Inhalation Toxicity - Vapors	Category 2
Reproductive Toxicity	Category 1B
Specific target organ toxicity - (repeated exposure)	Category 1

Environmental hazards

Acute aquatic toxicity	Category 1
Chronic aquatic toxicity	Category 1

2.2. Label elements



Signal Word **Danger**

Hazard Statements

H290 - May be corrosive to metals
H410 - Very toxic to aquatic life with long lasting effects
H330 - Fatal if inhaled
H360D - May damage the unborn child
H372 - Causes damage to organs through prolonged or repeated exposure

Precautionary Statements

P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection
P390 - Absorb spillage to prevent material damage
P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing
P310 - Immediately call a POISON CENTER or doctor/ physician

Additional EU labelling

Restricted to professional users

2.3. Other hazards

No information available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substances

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008
Mercury	7439-97-6	EEC No. 231-106-7	100	Acute Tox. 2 (H330) Repr. 1B (H360D) STOT RE 1 (H372) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410) Met. Corr. 1 (H290)

Full text of Hazard Statements: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Skin Contact Immediate medical attention is required. Wash off immediately with plenty of water for at least 15 minutes.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.

Protection of First-aiders Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

4.2. Most important symptoms and effects, both acute and delayed

No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Extinguishing media which must not be used for safety reasons
No information available.

5.2. Special hazards arising from the substance or mixture

Very toxic. Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Keep product and empty container away from heat and sources of ignition. Do not allow run-off from fire fighting to enter drains or water courses.

Hazardous Combustion Products
Mercury oxide, Highly toxic fumes.

5.3. Advice for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Evacuate personnel to safe areas. Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak.

6.2. Environmental precautions

Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained. Should not be released into the environment. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.

6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

6.4. Reference to other sections

Refer to protective measures listed in Sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not breathe vapors or spray mist. Do not ingest.

7.2. Conditions for safe storage, including any incompatibilities

Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store in metal containers.

7.3. Specific end use(s)

Use in laboratories

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits
List source(s): **EU** - Commission Directive 2006/15/EC of 7 February 2006 establishing a second list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Directives 91/322/EEC and 2000/39/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. **UK** - EH40/2005 Containing the workplace exposure limits (WELs) for use with the Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended). Updated by September 2006 official press release and October 2007 Supplement. **IRE -** 2010 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001. Published by the Health and Safety Authority.

Component	European Union	The United Kingdom	France	Belgium	Spain
Mercury	TWA: 0.02 mg/m³ 8 hr	TWA: 0.02 mg/m³ 8 hr	TWA / VME: 0.02 mg/m³ (8 heures). Peau	TWA: 0.02 mg/m³ 8 uren Huid	TWA / VLA-ED: 0.02 mg/m³ (8 horas)

Component	Italy	Germany	Portugal	The Netherlands	Finland
Mercury	TWA: 0.02 mg/m³ 8 ore. Pelle	TWA: 0.02 mg/m³ (8 Stunden). AGW - exposure factor 8 TWA: 0.02 mg/m³ (8 Stunden). MAK Höhepunkt: 0.16 mg/m³ Haut	TWA: 0.02 mg/m³ 8 horas TWA: 0.025 mg/m³ 8 horas Pele	TWA: 0.02 mg/m³ 8 uren	TWA: 0.02 mg/m³ 8 tunteina Iho

Component	Austria	Denmark	Switzerland	Poland	Norway
Mercury	Haut MAK-KZW: 0.08 mg/m³ 15 Minuten MAK-TMW: 0.02 mg/m³ 8 Stunden	TWA: 0.02 mg/m³ 8 timer Hud	Haut/Peau STEL: 0.04 ppm 15 Minuten STEL: 0.4 mg/m³ 15 Minuten STEL: 0.16 mg/m³ 15 Minuten TWA: 0.005 ppm 8 Stunden TWA: 0.05 mg/m³ 8 Stunden TWA: 0.02 mg/m³ 8 Stunden	TWA: 0.02 mg/m³ 8 godzinach	TWA: 0.02 mg/m³ 8 timer STEL: 0.06 mg/m³ 15 minutter.

Component	Bulgaria	Croatia	Ireland	Cyprus	Czech Republic
Mercury	TWA: 0.05 mg/m³ TWA: 0.02 mg/m³	TWA-GVI: 0.02 mg/m³ 8 satima.	TWA: 0.02 mg/m³ 8 hr. STEL: 0.06 mg/m³ 15 min	TWA: 0.02 mg/m³	TWA: 0.02 mg/m³ 8 hodinách. Potential for cutaneous absorption Ceiling: 0.15 mg/m³

Component	Estonia	Gibraltar	Greece	Hungary	Iceland
Mercury	Nahk TWA: 0.03 mg/m³ 8 tundides. fume	TWA: 0.02 mg/m³ 8 hr during exposure monitoring for mercury and its divalent	TWA: 0.02 mg/m³	TWA: 0.02 mg/m³ 8 órában. AK lehetséges borön keresztüli felszívódás	TWA: 0.025 mg/m³ 8 klukkustundum. Skin notation Ceiling: 0.05 mg/m³

		inorganic compounds, account should be taken of relevant biological monitoring techniques that complement the IOELV Hg			

Component	Latvia	Lithuania	Luxembourg	Malta	Romania
Mercury	TWA: 0.02 mg/m³	TWA: 0.02 mg/m³ IPRD	TWA: 0.02 mg/m³ 8 Stunden	TWA: 0.02 mg/m³	Skin notation TWA: 0.02 mg/m³ 8 ore

Component	Russia	Slovak Republic	Slovenia	Sweden	Turkey
Mercury	TWA: 0.005 mg/m³ STEL: 0.01 mg/m³ vapor	TWA: 0.1 mg/m³	TWA: 0.02 mg/m³ 8 urah	LLV: 0.03 mg/m³ 8 timmar. Hud	

Biological limit values

List source(s): **UK** - Biological Monitoring Guidance Values provided by the UK's Health and Safety Executive (HSE) Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended) and EH40/2005.

Component	European Union	United Kingdom	France	Spain	Germany
Mercury		Mercury: 20 µmol/mol creatinine urine random	Total inorganic Mercury: 0.015 mg/L blood end of shift at end of workweek Total inorganic Mercury: 0.050 mg/g creatinine urine prior to shift	Total inorganic mercury: 30 µg/g Creatinine urine pre-shift Total inorganic mercury: 10 µg/L blood end of workweek	Mercury: 25 µg/g urine (no restriction measured as µg/g Creatinine)

Component	Italy	Finland	Denmark	Bulgaria	Romania
Mercury		Mercury: 140 nmol/L urine prior to shift. Mercury: 50 nmol/L blood end of workweek.		Mercury: 100 µg/L urine not fixed vapor of the metal in elemental state	Mercury: 10 µg/L blood end of shift Mercury: 35 µg/g Creatinine urine beginning of next shift

Component	Gibraltar	Latvia	Slovak Republic	Luxembourg	Turkey
Mercury		Mercury: 15 µg/L blood Mercury: 35 µg/g Creatinine urine Mercury: 50 µg/L urine	Mercury: 37.5 µg/L urine not critical Mercury: 15 mg/L blood after all work shifts for long-term exposure		

Monitoring methods

MDHS16/2 Mercury and its inorganic divalent compounds in air Laboratory method using Hydrar diffusive badges or pumped sorbent tubes, acid dissolution and analysis by cold vapour atomic absorption spectrometry or cold vapour atomic flourescence spectrometry

Derived No Effect Level (DNEL) No information available

Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral				
Dermal				
Inhalation				

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Measures

Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles (European standard - EN 166)

Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Natural rubber Nitrile rubber Neoprene PVC	See manufacturers recommendations	-	EN 374	(minimum requirement)

Skin and body protection Long sleeved clothing

Inspect gloves before use.
Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information)
Ensure gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.
Remove gloves with care avoiding skin contamination.

Respiratory Protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
To protect the wearer, respiratory protective equipment must be the correct fit and be used and maintained properly

Large scale/emergency use Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced
Recommended Filter type: Particulates filter conforming to EN 143 or Inorganic gases and vapours filter Type B Grey conforming to EN14387

Small scale/Laboratory use Use a NIOSH/MSHA or European Standard EN 149:2001 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Recommended half mask:- Particle filtering: EN149:2001
When RPE is used a face piece Fit Test should be conducted

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls Prevent product from entering drains. Do not allow material to contaminate ground water system. Local authorities should be advised if significant spillages cannot be contained.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance	Silver	
Physical State	Liquid	
Odor	Odorless	
Odor Threshold	No data available	
pH	Not applicable	
Melting Point/Range	-38.9 °C / -38 °F	
Softening Point	No data available	
Boiling Point/Range	356.5 °C / 673.7 °F	
Flash Point	No information available	**Method -** No information available
Evaporation Rate	No data available	
Flammability (solid,gas)	Not applicable	Liquid
Explosion Limits	No data available	
Vapor Pressure	0.01 hPa @ 20 °C	
Vapor Density	7.0	(Air = 1.0)
Specific Gravity / Density	13.540	
Bulk Density	Not applicable	Liquid
Water Solubility	Insoluble	
Solubility in other solvents	No information available	

Partition Coefficient (n-octanol/water)

Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	1.554 cP at 20 °C
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

Molecular Formula	Hg
Molecular Weight	200.59

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

None known, based on information available

10.2. Chemical stability

Stable under normal conditions

10.3. Possibility of hazardous reactions

Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

10.4. Conditions to avoid

Incompatible products. Excess heat.

10.5. Incompatible materials

Strong oxidizing agents. Ammonia. Metals. Halogens.

10.6. Hazardous decomposition products

Mercury oxide. Highly toxic fumes.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Product Information

(a) acute toxicity;

Oral	No data available
Dermal	No data available
Inhalation	Category 2

(b) skin corrosion/irritation; No data available

(c) serious eye damage/irritation; No data available

(d) respiratory or skin sensitization;

Respiratory	No data available
Skin	No data available

(e) germ cell mutagenicity; No data available

(f) carcinogenicity; No data available

The table below indicates whether each agency has listed any ingredient as a carcinogen

Component	EU	UK	Germany	IARC
Mercury			Cat. 3B	

(g) reproductive toxicity; Category 1B
Developmental Effects May cause harm to the unborn child.

(h) STOT-single exposure; No data available

(i) STOT-repeated exposure; Category 1

Target Organs Central nervous system (CNS), Eyes, Respiratory system, Kidney, Skin.

(j) aspiration hazard; No data available

Other Adverse Effects See actual entry in RTECS for complete information

Symptoms / effects,both acute and delayed No information available

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecotoxicity effects The product contains following substances which are hazardous for the environment. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. May cause long-term adverse effects in the environment. Do not allow material to contaminate ground water system.

Component	Freshwater Fish	Water Flea	Freshwater Algae	Microtox
Mercury	0.9 mg/L LC50 96h 0.18 mg/L LC50 96h 0.16 mg/L LC50 96h 0.5 mg/L LC50 96h	5.0 µg/L EC50 = 96 h		

12.2. Persistence and degradability The product includes heavy metals. Prevent release into the environment. Special pretreatment required

Persistence Insoluble in water, May persist.
Degradability Not relevant for inorganic substances.
Degradation in sewage treatment plant Contains substances known to be hazardous to the environment or not degradable in waste water treatment plants.

12.3. Bioaccumulative potential May have some potential to bioaccumulate; Product has a high potential to bioconcentrate

12.4. Mobility in soil Spillage unlikely to penetrate soil Is not likely mobile in the environment due its low water solubility.

12.5. Results of PBT and vPvB assessment No data available for assessment.

12.6. Other adverse effects

Endocrine Disruptor Information This product does not contain any known or suspected endocrine disruptors
Persistent Organic Pollutant This product does not contain any known or suspected substance
Ozone Depletion Potential This product does not contain any known or suspected substance

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues / Unused Products Should not be released into the environment. Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.

Contaminated Packaging Dispose of this container to hazardous or special waste collection point.

European Waste Catalogue (EWC) According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.

Other Information Do not dispose of waste into sewer. Waste codes should be assigned by the user based on the application for which the product was used. Do not empty into drains. Do not let this chemical enter the environment.

SECTION 14: TRANSPORT INFORMATION

IMDG/IMO

14.1. UN number	UN2809
14.2. UN proper shipping name	MERCURY
14.3. Transport hazard class(es)	8
Subsidiary Hazard Class	6.1
14.4. Packing group	III

ADR

14.1. UN number	UN2809
14.2. UN proper shipping name	MERCURY
14.3. Transport hazard class(es)	8
Subsidiary Hazard Class	6.1
14.4. Packing group	III

IATA

14.1. UN number	UN2809
14.2. UN proper shipping name	MERCURY
14.3. Transport hazard class(es)	8
Subsidiary Hazard Class	6.1
14.4. Packing group	III

14.5. Environmental hazards Dangerous for the environment
Product is a marine pollutant according to the criteria set by IMDG/IMO

14.6. Special precautions for user No special precautions required

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code Not applicable, packaged goods

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories X = listed

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	IECSC	AICS	KECL
Mercury	231-106-7	-		X	X	-	X	-	X	X	X

Component	REACH (1907/2006) - Annex XIV - Substances Subject to Authorization	REACH (1907/2006) - Annex XVII - Restrictions on Certain Dangerous Substances	REACH Regulation (EC 1907/2006) article 59 - Candidate List of Substances of Very High Concern (SVHC)
Mercury		Use restricted. See item 18[a]. (see *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006R1907:EN:NOT* for restriction details)	

National Regulations

Component	Germany - Water Classification (VwVwS)	Germany - TA-Luft Class
Mercury	WGK 3	Class I : 0.05 mg/m³ (Massenkonzentration)

Component	France - INRS (Tables of occupational diseases)
Mercury	Tableaux des maladies professionnelles (TMP) - RG 2

Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment.
Take note of Dir 94/33/EC on the protection of young people at work
Take note of Dir 92/85/EC on the protection of pregnant and breastfeeding women at work
Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) has not been conducted

SECTION 16: OTHER INFORMATION

Full Text of H-/EUH-Statements Referred to Under Section 3
H290 - May be corrosive to metals
H330 - Fatal if inhaled
H360D - May damage the unborn child
H372 - Causes damage to organs through prolonged or repeated exposure
H400 - Very toxic to aquatic life
H410 - Very toxic to aquatic life with long lasting effects

Legend

CAS - Chemical Abstracts Service
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

WEL - Workplace Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
DNEL - Derived No Effect Level
RPE - Respiratory Protective Equipment
LC50 - Lethal Concentration 50%
NOEC - No Observed Effect Concentration
PBT - Persistent, Bioaccumulative, Toxic
TWA - Time Weighted Average
IARC - International Agency for Research on Cancer
PNEC - Predicted No Effect Concentration
LD50 - Lethal Dose 50%
EC50 - Effective Concentration 50%
POW - Partition coefficient Octanol:Water
vPvB - very Persistent, very Bioaccumulative

ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road
IMO/IMDG - International Maritime Organization/International Maritime Dangerous Goods Code
OECD - Organisation for Economic Co-operation and Development
BCF - Bioconcentration factor
ICAO/IATA - International Civil Aviation Organization/International Air Transport Association
MARPOL - International Convention for the Prevention of Pollution from Ships
ATE - Acute Toxicity Estimate
VOC - Volatile Organic Compounds

Key literature references and sources for data
Suppliers safety data sheet, Chemadvisor - LOLI, Merck index, RTECS

Training Advice
Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.
Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.
First aid for chemical exposure, including the use of eye wash and safety showers.
Chemical incident response training.

Creation Date 20-Aug-2014
Revision Date 22-Jun-2015
Revision Summary SDS sections updated, 2, 3, 7, 10.

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer

The information provided on 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 a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as 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 material or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

Creation Date 27-Sep-2010 **Revision Date** 18-Jan-2018 **Revision Number** 5

1. Identification

Product Name **Naphthalene**

Cat No. : **N7-500; N134-500**

CAS-No 91-20-3
Synonyms Tar Camphor; Naphthalin; Naphthene (Crystalline/Certified/Laboratory)

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable solids	Category 2
Acute oral toxicity	Category 4
Carcinogenicity	Category 1B

Label Elements

Signal Word
Danger

Hazard Statements
Flammable solid
Harmful if swallowed
May cause cancer



Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Naphthalene	91-20-3	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention.

Ingestion Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.

Most important symptoms and . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

effects

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.

Unsuitable Extinguishing Media No information available

Flash Point 78 °C / 172.4 °F

Method - No information available

Autoignition Temperature 526 °C / 978.8 °F

Explosion Limits

Upper 5.9 vol %

Lower 0.9 vol %

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Combustible material. Containers may explode when heated. Do not allow run-off from fire fighting to enter drains or water courses.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	2	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid dust formation. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.

Methods for Containment and Clean Up Sweep up or vacuum up spillage and collect in suitable container for disposal. Keep in suitable, closed containers for disposal. Remove all sources of ignition.

7. Handling and storage

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid ingestion and inhalation. Do not get in eyes, on skin, or on clothing. Avoid dust formation. Keep away from open flames, hot surfaces and sources of ignition.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Naphthalene	TWA: 10 ppm Skin	(Vacated) TWA: 10 ppm (Vacated) TWA: 50 mg/m^3 (Vacated) STEL: 15 ppm (Vacated) STEL: 75 mg/m^3 TWA: 10 ppm TWA: 50 mg/m^3	IDLH: 250 ppm TWA: 10 ppm TWA: 50 mg/m^3 STEL: 15 ppm STEL: 75 mg/m^3	TWA: 10 ppm TWA: 50 mg/m^3 STEL: 15 ppm STEL: 75 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	White
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	79 - 82 °C / 174.2 - 179.6 °F
Boiling Point/Range	218 °C / 424.4 °F
Flash Point	78 °C / 172.4 °F
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	5.9 vol %
Lower	0.9 vol %
Vapor Pressure	0.08 mbar @ 20 °C
Vapor Density	Not applicable
Specific Gravity	0.990
Solubility	slightly soluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	526 °C / 978.8 °F
Decomposition Temperature	540 °C
Viscosity	Not applicable
Molecular Formula	C10 H8
Molecular Weight	128.17

10. Stability and reactivity

Reactive Hazard Yes

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Avoid dust formation. Keep away from open flames, hot surfaces and sources of ignition.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Naphthalene	LD50 = 1110 mg/kg (Rat) LD50 = 490 mg/kg (Rat)	LD50 = 1120 mg/kg (Rabbit) LD50 > 20 g/kg (Rabbit)	LC50 > 340 mg/m³ (Rat) 1 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Naphthalene	91-20-3	Group 2B	Reasonably Anticipated	A3	X	Not listed

IARC: (International Agency for Research on Cancer)

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects Not mutagenic in AMES Test

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals.

Teratogenicity Teratogenic effects have occurred in experimental animals.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Naphthalene	EC50: = 0.4 mg/L, 72h (Skeletonema costatum)	LC50 96 h 1-6.5 mg/L (Pimephales promelas)	EC50 = 0.93 mg/L 30 min EC50 > 20 mg/L 18 h	EC50: 1.09 - 3.4 mg/L, 48h Static (Daphnia magna) EC50: = 1.96 mg/L, 48h Flow through (Daphnia magna) LC50: = 2.16 mg/L, 48h (Daphnia magna)

Persistence and Degradability Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Naphthalene	3.6

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Naphthalene - 91-20-3	U165	-

14. Transport information

DOT

- **UN-No** UN1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1
- **Packing Group** III

TDG

- **UN-No** UN1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1
- **Packing Group** III

IATA

- **UN-No** UN1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1
- **Packing Group** III

IMDG/IMO

- **UN-No** UN1334
- **Proper Shipping Name** NAPHTHALENE, CRUDE
- **Hazard Class** 4.1

Packing Group III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Naphthalene	X	X	-	202-049-5	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Naphthalene	91-20-3	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Naphthalene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Naphthalene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Naphthalene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Naphthalene	91-20-3	Carcinogen	5.8 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island

Naphthalene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Moderate risk, Grade 2

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 27-Sep-2010
Revision Date 18-Jan-2018
Print Date 18-Jan-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
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 a 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

End of SDS

SAFETY DATA SHEET

Creation Date 11-Jun-2009 **Revision Date** 10-Jul-2018 **Revision Number** 5

1. Identification

Product Name **Toluene**

Cat No. : **AC421170000; AC421170025; AC421170040; AC421170250; AC421175000**

CAS-No 108-88-3
Synonyms Tol; Methylbenzene

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company

Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, spleen, Blood.	
Aspiration Toxicity	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
May be fatal if swallowed and enters airways
Causes skin irritation

Causes serious eye irritation
May cause drowsiness or dizziness
Suspected of damaging the unborn child
May cause damage to organs through prolonged or repeated exposure



Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Wear eye/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
If skin irritation occurs: Get medical advice/attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Do NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects
WARNING. Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Toluene	108-88-3	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Risk of serious damage to the lungs.

Ingestion Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.

Most important symptoms and effects . Causes central nervous system depression: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.

Unsuitable Extinguishing Media No information available

Flash Point 4 °C / 39.2 °F

Method - No information available

Autoignition Temperature 535 °C / 995 °F

Explosion Limits

Upper 7.1 vol %

Lower 1.1 vol %

Oxidizing Properties Not oxidising

Sensitivity to Mechanical Impact No information available

Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	3	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Flammables area. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Toluene	TWA: 20 ppm	(Vacated) TWA: 100 ppm (Vacated) TWA: 375 mg/m³ Ceiling: 300 ppm (Vacated) STEL: 150 ppm (Vacated) STEL: 560 mg/m³ TWA: 200 ppm	IDLH: 500 ppm TWA: 100 ppm TWA: 375 mg/m³ STEL: 150 ppm STEL: 560 mg/m³	TWA: 50 ppm TWA: 188 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	1.74 ppm
pH	No information available
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	111 °C / 231.8 °F @ 760 mmHg

Flash Point	4 °C / 39.2 °F
Evaporation Rate	2.4 (Butyl acetate = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	7.1 vol %
Lower	1.1 vol %
Vapor Pressure	29 mbar @ 20 °C
Vapor Density	3.1
Specific Gravity	0.866
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	535 °C / 995 °F
Decomposition Temperature	No information available
Viscosity	0.6 mPa.s @ 20 °C
Molecular Formula	C7 H8
Molecular Weight	92.14

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.

Incompatible Materials Strong oxidizing agents, Strong acids, Strong bases, Halogenated compounds

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Toluene	> 5000 mg/kg (Rat)	12000 mg/kg (Rabbit)	26700 ppm (Rat) 1 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes, respiratory system and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Toluene	108-88-3	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects Not mutagenic in AMES Test

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals.

Teratogenicity Possible risk of harm to the unborn child.

STOT - single exposure Respiratory system Central nervous system (CNS)
STOT - repeated exposure Kidney Liver spleen Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Causes central nervous system depression: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

The product contains following substances which are hazardous for the environment. Contains a substance which is:. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Toluene	EC50: = 12.5 mg/L, 72h static (Pseudokirchneriella subcapitata) EC50: > 433 mg/L, 96h (Pseudokirchneriella subcapitata)	50-70 mg/L LC50 96 h 5-7 mg/L LC50 96 h 15-19 mg/L LC50 96 h 28 mg/L LC50 96 h 12 mg/L LC50 96 h	EC50 = 19.7 mg/L 30 min	EC50: = 11.5 mg/L, 48h (Daphnia magna) EC50: 5.46 - 9.83 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Persistence is unlikely

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Toluene	2.7

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Toluene - 108-88-3	U220	-

14. Transport information

DOT

UN-No UN1294
Proper Shipping Name TOLUENE
Hazard Class 3
Packing Group II

TDG

UN-No UN1294
Proper Shipping Name TOLUENE
Hazard Class 3
Packing Group II

IATA

UN-No UN1294
Proper Shipping Name TOLUENE
Hazard Class 3

Packing Group II

IMDG/IMO

UN-No UN1294
Proper Shipping Name TOLUENE
Hazard Class 3
Packing Group II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Toluene	X	X	-	203-625-9	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Toluene	108-88-3	>95	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Toluene	X	1000 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Toluene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Toluene	1000 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Toluene	108-88-3	Developmental	-	Developmental

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Toluene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 11-Jun-2009
Revision Date 10-Jul-2018
Print Date 10-Jul-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
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 a 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

End of SDS

SAFETY DATA SHEET

Version 6.4
Revision Date 07/23/2022
Print Date 07/30/2022

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Xylenes

Product Number : 214736
Brand : Aldrich
Index-No. : 601-022-00-9
CAS-No. : 1330-20-7

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 Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 3), H226
Acute toxicity, Inhalation (Category 4), H332
Acute toxicity, Dermal (Category 4), H312
Skin irritation (Category 2), H315
Eye irritation (Category 2A), H319
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, Liver, Kidney, H373
Aspiration hazard (Category 1), H304
Short-term (acute) aquatic hazard (Category 2), H401
Long-term (chronic) aquatic hazard (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal Word Danger

Hazard statement(s)

H226	Flammable liquid and vapor.
H304	May be fatal if swallowed and enters airways.
H312 + H332	Harmful in contact with skin or if inhaled.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H373	May cause damage to organs (Central nervous system, Liver, Kidney) through prolonged or repeated exposure if inhaled.
H401	Toxic to aquatic life.
H412	Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P210	Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe mist or vapors.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/ doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P314	Get medical advice/ attention if you feel unwell.
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Xylene mixture of isomers

Formula : C_8H_{10}
Molecular weight : 106.17 g/mol
CAS-No. : 1330-20-7
EC-No. : 215-535-7
Index-No. : 601-022-00-9

Component	Classification	Concentration
Xylene		
	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; Aquatic Chronic 3; H226, H332, H312, H315, H319, H335, H373, H304, H401, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Immediately call in physician. If breathing stops: immediately apply artificial respiration, if necessary also oxygen.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: caution if victim vomits. Risk of aspiration! Keep airways free. Pulmonary failure possible after aspiration of vomit. Call a physician immediately.

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

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Carbon dioxide (CO2) Foam Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture

Carbon oxides
Combustible.
Vapors are heavier than air and may spread along floors.
Forms explosive mixtures with air at elevated temperatures.
Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters

Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information

Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Keep away from heat and sources of ignition.
Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture. Avoid generation of vapours/aerosols.

Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition.Take precautionary measures against static discharge.

Hygiene measures

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition.

Storage class
Storage class (TRGS 510): 3: Flammable liquids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Xylene	1330-20-7	PEL	100 ppm 435 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	300 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	150 ppm 655 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Not classifiable as a human carcinogen		
		STEL	150 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Not classifiable as a human carcinogen		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Xylene	1330-20-7	Methylhippuric acids	1.5g/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

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). Safety glasses

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Viton®
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Viton®
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Body Protection
Flame retardant antistatic protective clothing.

Respiratory protection
required when vapours/aerosols are generated. Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure
Do not let product enter drains. Risk of explosion.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: clear, liquid Color: colorless
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

e)	Melting point/freezing point	Melting point/range: -94 - 13.2 °C (-137 - 55.8 °F) at 1,013 hPa
f)	Initial boiling point and boiling range	137 - 140 °C 279 - 284 °F - lit.
g)	Flash point	25 °C (77 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 7.0 %(V) Lower explosion limit: 1.1 %(V)
k)	Vapor pressure	23.99 hPa at 37.70 °C (99.86 °F)
l)	Vapor density	3.67 - (Air = 1.0)
m)	Density	0.86 g/mL at 25 °C (77 °F) - lit.
	Relative density	No data available
n)	Water solubility	0.1705 g/l at 25 °C (77 °F) - partly soluble
o)	Partition coefficient: n-octanol/water	log Pow: 3.12 at 20 °C (68 °F) - Bioaccumulation is not expected.
p)	Autoignition temperature	463 °C (865 °F) at 1,013 hPa
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information

Relative vapor density	3.67 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity

Vapor/air-mixtures are explosive at intense warming.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Exothermic reaction with:
Strong oxidizing agents
Acids
sulfur
conc. sulfuric acid
Risk of explosion/exothermic reaction with:
Nitric acid

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

uranium hexafluoride

10.4 Conditions to avoid
Heating.

10.5 Incompatible materials
No data available

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - male - 3,523 mg/kg
(EC Directive 92/69/EEC B.1 Acute Toxicity (Oral))
Remarks: (ECHA)
LC50 Inhalation - Rat - male - 4 h - 29.09 mg/l - vapor

(Regulation (EC) No. 440/2008, Annex, B.2)
Remarks: (Regulation (EC) No 1272/2008, Annex VI)
LD50 Dermal - Rabbit - > 1,700 mg/kg
Remarks: (RTECS)
No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Moderate skin irritation - 24 h
Remarks: (IUCLID)
Drying-out effect resulting in rough and chapped skin. After long-term exposure to the chemical: Dermatitis

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Causes serious eye irritation. - 24 h
Remarks: (RTECS)

Respiratory or skin sensitization
Local lymph node assay (LLNA) - Mouse
Result: negative
(OECD Test Guideline 429)

Germ cell mutagenicity
Test Type: Mutagenicity (mammal cell test): chromosome aberration.
Test system: Chinese hamster ovary cells
Metabolic activation: with and without metabolic activation
Method: Regulation (EC) No. 440/2008, Annex, B.10
Result: negative
Remarks: (National Toxicology Program)
Test Type: Ames test
Test system: Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Test Type: sister chromatid exchange assay
Test system: Chinese hamster ovary cells
Metabolic activation: with and without metabolic activation
Method: Regulation (EC) No. 440/2008, Annex, B.19
Result: negative

Test Type: dominant lethal test
Species: Mouse

Method: OECD Test Guideline 478
Result: negative

Carcinogenicity

IARC: No ingredient 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 ingredient 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 on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
May cause respiratory irritation. - Respiratory system

Specific target organ toxicity - repeated exposure
Inhalation - May cause damage to organs through prolonged or repeated exposure. - Central nervous system, Liver, Kidney

Aspiration hazard
May be fatal if swallowed and enters airways.

11.2 Additional Information

Repeated dose toxicity - Rat - male and female - Oral - 90 d - NOAEL (No observed adverse effect level) - 150 mg/kg - LOAEL (Lowest observed adverse effect level) - 150 mg/kg

Blurred vision, Incoordination., Headache, Nausea, Vomiting, Dizziness, Weakness, anemia, Prolonged or repeated exposure to skin causes defatting and dermatitis.
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

After absorption:

Systemic effects:

Headache
somnolence
Dizziness
agitation, spasms
narcosis
inebriation

Effect potentiated by: ethanol

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Other dangerous properties can not be excluded.

Handle in accordance with good industrial hygiene and safety practice.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Oncorhynchus mykiss (rainbow trout) - 2.60 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to algae	static test EC50 - Pseudokirchneriella subcapitata - 4.36 mg/l - 73 h (OECD Test Guideline 201)
Toxicity to bacteria	Remarks: (ECHA) (Xylene)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 28 d Result: 94 % - Readily biodegradable. (OECD Test Guideline 301F)

12.3 Bioaccumulative potential

Bioaccumulation	Oncorhynchus mykiss (rainbow trout) - 56 d at 10 °C - 1.3 mg/l(Xylene) Bioconcentration factor (BCF): 7.4 - 18.5

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 14: Transport information

DOT (US)

UN number: 1307 Class: 3 Packing group: III
Proper shipping name: Xylenes
Reportable Quantity (RQ): 100 lbs
Reportable Quantity (RQ): 100 lbs
Poison Inhalation Hazard: No

IMDG

UN number: 1307 Class: 3 Packing group: III EMS-No: F-E, S-D
Proper shipping name: XYLENES

IATA

UN number: 1307 Class: 3 Packing group: III
Proper shipping name: Xylenes

SECTION 15: Regulatory information

SARA 302 Components

This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Xylene	1330-20-7	1993-04-24

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Reportable Quantity : F003 lbs

Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 16: Other information

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.

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.4 Revision Date: 07/23/2022 Print Date: 07/30/2022

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Appendix D

Forms

GEI Consultants

Incident Report Form

Please complete this form and send it to your supervisor or project manager as soon as the scene is safe, and any medical attention has been addressed.

SECTION A INCIDENT DETAILS

EMPLOYEE INFORMATION:

Name: _____

Home Address: _____
Street Address City State Zip

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor:

OTHER INJURED (IF APPLICABLE):

Name: _____

Home Address: _____
Street Address City State Zip

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor:

Date and Time Incident	Date and Time Reported
____ / ____ / ____ Month Day Year	____ / ____ / ____ Month Day Year
____ A.M. ____ P.M.	____ A.M. ____ P.M.

LOCATION OF INCIDENT

Project Name: _____

Client and Location: _____

or _____

Office Location:

INCIDENT TYPE: (Check All That Applies)

- ☐ **Personal Injury/Illness**
- ☐ **Vehicle Incident**
- ☐ **Property Damage**
- ☐ **Environmental Spill**
- ☐ **Other**

WITNESS INFORMATION

Name: _____

Contact Number: _____

Company: _____

WHAT HAPPENED TO THE INJURED PARTY: ☐First Aid Administered ☐Refused Treatment/Transport ☐Transported to Hospital ☐Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: _____ Phone: _____
Name Street Address City State Zip Code

SECTION B PERSONAL INJURY

Cause of Injury: _____

Part of Body Injured: _____ Multiple Injuries: ☐Y ☐N

Was PPE worn when injured? : ☐Y ☐N What PPE was worn? _____

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

GEI Consultants

Incident Report Form

Please complete this form and send it to your supervisor or project manager as soon as the scene is safe, and any medical attention has been addressed.

SECTION C — AUTO INCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: _____

Department: _____

Driver's License Number: _____

DOB: ____/____/____ State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year: _____ Color: _____

Owner: _____

Name of Other Driver: _____

Driver's License Number: _____

State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year: _____ Color: _____

Insurance Carrier: _____

Policy Number: _____ Ph. Number: _____

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): _____

Cause of Damage(s): _____

Type of Chemical Released (if known): _____

Quantity of Chemical Released: _____

Spill Measures Employed: _____

SECTION E — NATURE OF INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

_____

_____

_____

_____

_____

_____

_____

_____

_____

I hereby certify that the above information is true and correct to my understanding of this incident.

_____ _____

Employee/Preparer's Name **Date and Time**

GEI Consultants

Near Miss Report Form

Please complete this form and send it to your supervisor or project manager as soon as the scene is safe, and any medical attention has been addressed.

NEAR MISS DETAILS

Employee Name: _____

Phone Number: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported	LOCATION OF NEAR MISS
____/____/____ Month Day Year ____A.M. ____P.M.	____/____/____ Month Day Year ____A.M. ____P.M.	**Project Name:** _____ **Client and Location:** _____ **or** _____ **Office Location:** _____

WHAT HAPPENED?

(Please give a detailed description of what happened. Attach photos or a sketch, if applicable.)

_____

_____

_____

_____

_____

☐ **Photos were Taken**

WHAT WAS DONE?

(Please give a detailed description of what was done to prevent and incident from occurring.)

_____

_____

_____

_____

_____

_____

☐ **I have verbally contacted a member of the Safety Team and my Supervisor.**

_____ _____

Employee/Preparer's Name **Date and Time**

GEI Consultants

Project Safety Briefing Form

Project Number:	**Project Name:**
Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents that a project specific-briefing was conducted in accordance with the site-specific HASP and GEI's H&S policy. GEI personnel who perform work on site are required to attend this project briefing. Applicable health and safety SOPs and any additional hazards are also required to be reviewed during this briefing. Prior to the start of the project or upon the start of a new on-site project team member, this form must be completed. Please keep a copy of this form with the project files.

TOPICS COVERED (check all those covered):			
SOP HS-001 Biological Hazards		SOP HS-025 Manual Lifting	
SOP HS-002 Bloodborne Pathogens		SOP HS -26 Hazard Identification	
SOP HS-003 Container Management		SOP HS-27 Confined Space Entry for Sanitary Sewers	
SOP HS-004 Driver Safety		SOP HS-28 Safe Trailer Use	
SOP HS-005a Electrical Safety		Accident Reporting Procedures	
SOP HS-005b Lockout/Tagout		Changes to the HASP	
SOP HS-006 Excavation/Trenching		Cold Stress	
SOP HS-008a Hand Tools (Non-Powered)		Confined Space	
SOP HS-008b Powered Hand Tools		Decon Procedures	
SOP HS-009 Hazardous Substances Management		Exposure Guidelines	
SOP HS-010 Inclement Weather		General PPE Usage	
SOP HS-011 Ladders		Heat Stress	
SOP HS-012 Noise Exposure		Hearing Conservation	
SOP HS-013 Nuclear Density Gauge		Personal Hygiene	
SOP HS-014 Utility Markout		Respiratory Protection	
SOP HS-015 Respirator Fit Test		Review of Hazard Evaluation	
SOP HS-016 Traffic Hazards		Site Control	
SOP HS-017 Water Safety		Site Emergency Procedures	
SOP HS-018 Working Around Heavy Equipment		Slips, Trips, Falls	
SOP HS-019 Rail Safety		Other (Specify):	
SOP HS-020 Aerial Lift		Other (Specify):	
SOP HS-021 Mobile Equipment		Other (Specify):	
SOP HS-022 Aquatic Ecological Survey/Electrofishing		Other (Specify):	
SOP HS-023 Scaffolding		Other (Specify):	
SOP HS-024 Wilderness Safety		Other (Specify):	

Personnel Sign-in List	
Printed Name	**Signature**

Daily Safety Briefing and Site Visitor Sign-In

Project Number:	**Project Name:**
[1]Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the site specific HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

☐ Accident Reporting Procedures	☐ General PPE Usage	☐ Site Control	☐ Other:
☐ Cellular Phone Charged w/Service	☐ Heat Stress	☐ Site Emergency Procedures	☐ Other:
☐ Changes to the HASP	☐ Hearing Conservation	☐ Slips, Trips, Falls	☐ Other:
☐ Cold Stress	☐ Lockout/Tagout	☐ Traffic Safety	☐ Other:
☐ Confined Space	☐ Personal Hygiene	☐ Other:	☐ Other:
☐ Decon Procedures	☐ Respiratory Protection	☐ Other:	☐ Other:
☐ Exposure Guidelines	☐ Review of Hazards	☐ Other:	☐ Other:

Daily Safety Topic Description:

Personnel Sign-in List

Printed Name	Signature	Company Name	Time-In	Time-Out

[1] This form is applicable for *only* 1 day of site activity.

Appendix E

GEI's Health and Safety SOPs and Programs

Applicable GEI H&S SOPs *(check all that apply)*		
☒ Biological Hazards – 001	☒ Inclement Weather – 010	☐ Aerial Lift – 020
✔ Bloodborne Pathogens – 002	☐ Ladders -011	☐ Mobile Equipment – 021
☒ Container Management – 003	☒ Noise Exposure -012	☐ Aquatic Ecological Survey & Electrofishing -022
☒ Driver Safety - 004	☐ Nuclear Density Gauge Operation -013	☐ Scaffolding - 023
☐ Electrical Safety - 005a	☒ Utility Markout-014	☐ Wilderness Safety - 024
☐ Lockout Tagout - 005b	☐ Respirator Fit Test Procedure-015	☒ Manual Lifting – 025
☐ Excavation Trenching - 006	☒ Traffic Hazards -016	✔ Hazard Identification - 026
☒ Non-Powered Hand Tools - 008a	☐ Water Safety – 017	☐ Confined Space Entry for Sanitary Sewers – 027
☐ Powered Hand Tools – 008b	☒ Working Around Heavy Equipment – 018	☐ Safe Trailer Use – 028
☒ Hazardous Substances Management -009	☐ Rail Safety -019	

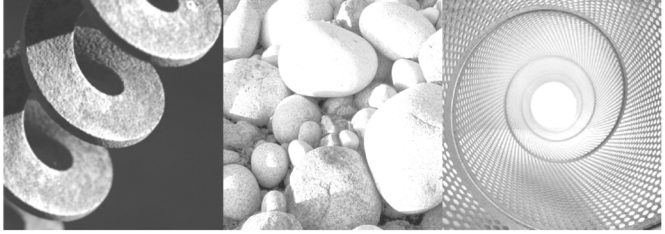
Scan this QR code with your smartphone to access all GEI H&S SOPs

Applicable GEI H&S Programs *(check all that apply)*		
☐ Asbestos Program	☐ DOT Driver Safety	☒ Hydrogen Sulfide
☐ Arsenic Safety	✔ Ergonomic	☐ Injury and Illness Prevention (California Only)
☒ Benzene Awareness	☐ Fall Protection	☐ Respiratory Protection Program
☐ Cadmium Safety	✔ Hazard Communication	☐ Lead Awareness
☒ Cold Stress	☒ Hearing Conservation	✔ Fire Prevention
☐ Confined Space Entry	☒ Heat Illness Prevention	
☒ Crystalline Silica	☐ Hexavalent Chromium	

Scan this QR code with your smartphone to access all GEI Programs

Appendix F

Community Air Monitoring Plan (CAMP)



GEI Consultants

Community Air Monitoring Plan

Hunts Point 600 Food Center Drive
NYSDEC BCP Site No. C203104

For the Property located at:
600 Food Center Drive, Bronx, New York

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7020

On Behalf of:
New York City Economic Development Corporation
1 Liberty Plaza
New York, New York 10006

Submitted by:
GEI Consultants, Inc.
530 7th Avenue, Suite 2007
New York, NY 10018
212.687.8282

February 2026
Project No. 2303564



Stacey Ng, P.G.
Project Manager

Kevin P. McCarty
Senior Project Manager/Environmental Lead

Table of Contents

Acronyms and Abbreviations **ii**

1. Introduction **1**
1.1. Site Background 1

2. Air Monitoring Procedures, Response Levels and Actions **2**
2.1. General 2
2.1.1. Special Requirements for Work Within 20 ft of Potentially Exposed Individuals or Structures 2
2.2. Multi-Gas (TVOCs, H_2S and HCN) Monitoring 2
2.2.1. TVOCs 2
2.2.2. H_2S 3
2.2.3. HCN 3
2.3. Particulate Air Monitoring 4

3. Project Notifications and Deliverables **6**

SN/KM
B:\Working\NYCEDC\2303564 600 FCD RIWP\RIWP\Appendix D - HASP & CAMP\Appendix F - CAMP\600 FCD RIWP CAMP_DRAFT_REV_20260203.docx

Acronyms and Abbreviations

BCP	Brownfield Cleanup Program
CAMP	Community Air Monitoring Plan
Con Edison	Consolidated Edison Company of New York, Inc.
DER-10	Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation
FCD	Food Center Drive
H_2S	Hydrogen Sulfide
HCN	Hydrogen Sulfide
HPFDC	Hunts Point Food Distribution Center
MGP	Manufactured Gas Plan
NYCEDC	New York City Economic Development Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PM_{10}	Particulate Matter (10 microns or less)
ppm	parts per million
RIWP	Remedial Investigation Work Plan
TVOCs	Total Volatile Organic Compounds
$\mu g/m^3$	microgram per cubic meter

1. Introduction

This Community Air Monitoring Plan (CAMP) has been developed for the property located at 600 Food Center Drive (FCD) in the borough of the Bronx, New York (Site), on behalf of the New York City Economic Development Corporation (NYCEDC). The Site is currently enrolled in the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) as Site No. C203104. This CAMP supports implementation of the Remedial Investigation Work Plan (RIWP) and fulfills the requirements set forth by the New York State Department of Health (NYSDOH) *Generic Community Air Monitoring Plan*, dated June 2000, and the Division of Environmental Remediation for Site Investigation and Remediation (DER-10) *Fugitive Dust and Particulate Monitoring*.

The purpose of the CAMP is to provide a measure of protection for the community (i.e., off-Site receptors including residences and businesses and on-Site workers not directly involved with the subject work activities) from potential airborne contaminant releases during investigative and remedial work activities. During all ground intrusive activities at the Site, continuous real-time air monitoring for particulate matter that is 10 microns in diameter, or less (PM_{10}), total volatile organic compounds (TVOCs), hydrogen sulfide (H_2S), and hydrogen cyanide (HCN) will be conducted. Ground intrusive activities include, but are not limited to, the installation of soil borings, monitoring wells, or soil vapor probes, and soil/waste handling.

1.1. Site Background

The Site was historically part of a Manufactured Gas Plant (MGP) operated by Consolidated Edison Company of New York, Inc. (Con Edison) during the first half of the 20th century until its demolition in the 1960's. Gas operations included a coke/oven gas plant, a carbureted water gas plant, a light oil plant, and a liquid petroleum production area. In total, approximately 46 buildings or structures existed on the former Con Edison MGP facility that were actively involved in gas production.

As indicated in historic NYSDEC files, the Site contains a significant layer of fill material overlaying native soils consisting of a mixture of sand, construction and demolition material (brick, concrete, stone, wood, etc.), coal and coal ash, slag and cinders. Contamination and waste material that has previously been found on other sites within the Hunts Point Food Distribution Center (HPFDC) include coal tar and purifier bed material (purifier waste). Community air monitoring on sites containing coal tar is generally performed for TVOCs. However, due to the potential for the presence of purifier waste material, monitoring for H_2s and HCN will also be performed.

The electrochemical sensors that are used in the multi-gas meters are often shown to have cross-sensitivity to gases other than its target gas, and HCN is known to have a positive cross-sensitivity with H_2S. Due to characteristically high sulfur concentrations present in purifier waste, it is believed that elevated readings on the multi-gas meter for HCN may be due to a false-positive detection of H_2S on the HCN sensor. If a significant amount of purifier waste material is identified, HCN-specific sampling using colorimetric tubes will be conducted to obtain more accurate concentrations and ensure that the compound is not present in vapor form.

2. Air Monitoring Procedures, Response Levels and Actions

2.1. General

Real-time air monitoring for TVOCs, H_2S, HCN and particulate matter will be implemented at the Site during all ground-intrusive activities completed as part of the RIWP. Monitoring for the aforementioned parameters will be performed at two locations (upwind and downwind) at the Site perimeter of the designated work area each day. Upwind concentrations will be measured continuously at one location to establish background conditions, and the downwind location will provide information regarding any emissions from the Site. Monitoring locations will be adjusted if wind direction changes.

2.1.1. Special Requirements for Work Within 20 ft of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for TVOCs, H_2S, HCN, and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls will be considered to prevent exposures related to the work activities and to control dust and odors if they are identified. Requirements specific to each type of monitoring when working within 20 feet of exposed individuals or occupied structures are further detailed in their respective sections below.

2.2. Multi-Gas (TVOCs, H_2S and HCN) Monitoring

Monitoring will be conducted using a multi-gas meter configured to monitor for TVOCs, H_2S and HCN at each upwind and downwind monitoring station. The equipment will be calibrated daily and equipped with an alarm to indicate exceedance of the action level. The multi-gas meter will be set to record 15-minute running average concentrations, which will be compared to the levels specified below.

2.2.1. TVOCs

- *Alert Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone exceeds 3.7 parts per million (ppm) for TVOCs, work activities must be temporarily halted and monitoring continued. If the level readily decreases (per instantaneous readings) below 3.7 ppm for TVOCs, work activities can resume with continued monitoring.

- *Action Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone exceeds and persists at levels in excess of 5.0 ppm for TVOCs, but less than 25 ppm,

work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the TVOC concentrations 200 feet downwind of the exclusion zone, or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less), is below 5.0 ppm for TVOCs for the 15-minute average.

- *Stop Work Limit*

  If the TVOC level is above 25.0 ppm at the perimeter of the Site, activities will be shutdown.

If TVOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1.0 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces will be taken prior to commencement of the planned work. Any unusual background readings will be discussed with NYSDOH prior to commencement of the work.

2.2.2. H_2S

- *Alert Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone exceeds 3.7 ppm for H_2S for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the level readily decreases (per instantaneous readings) below 3.7 ppm for H_2S, work activities can resume with continued monitoring.

- *Action Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone persists at levels in excess of 3.7 ppm, but less than 5.0 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the H_2S concentrations 200 feet downwind of the exclusion zone, or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less), is below 5.0 ppm for H_2S for the 15-minute average.

- *Stop Work Limit*

  If the H_2S level is above 5.0 ppm at the perimeter of the Site, activities will be shutdown.

If H_2S concentrations opposite the walls of occupied structures or next to intake vents exceed 1.0 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces will be taken prior to commencement of the planned work. Any unusual background readings will be discussed with NYSDOH prior to commencement of the work.

2.2.3. HCN

- *Alert Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone exceeds 1.0 ppm for HCN, for the 15-minute average, a colorimetric tube will be run to

confirm concentrations. If the concentration is less than 1.0 ppm as confirmed by colorimetric tube, work activities and monitoring via real-time meter will continue.

- *Action Limit*

  If the measured concentration at the downwind perimeter of the work area or exclusion zone persists at levels in excess of 1.0 ppm, but less than 2.0 ppm as confirmed by colorimetric tube, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the HCN concentrations 200 feet downwind of the exclusion zone, or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less), is below 2.0 ppm for the 15-minute average.

- *Stop Work Limit*

  If the HCN level is above 2.0 ppm at the perimeter of the Site, as confirmed by colorimetric tube, activities will be shutdown.

If HCN concentrations opposite the walls of occupied structures or next to intake vents exceed 1.0 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces will be taken prior to commencement of the planned work. Any unusual background readings will be discussed with NYSDOH prior to commencement of the work.

2.3. Particulate Air Monitoring

Particulate concentrations will be monitored continuously at one upwind location and one downwind location at the Site perimeter of the designated work area via temporary particulate monitoring stations. The particulate monitoring will be performed using a real-time monitoring device capable of measuring particulate matter that is 10 microns in diameter, or less (PM_{10}) and capable of integrating over a period of 15 minutes for comparison to criteria. The equipment will be calibrated daily and equipped with an alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

- *Alert Limit*

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

- *Action Limit*

  If, after implementation of dust suppression techniques, downwind PM_{10} concentrations are greater than 150 $\mu g/m^3$ above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other

controls are successful in reducing the downwind PM_{10} particulate concentration to within 150 µg/m^3 of the upwind level and mitigating visible dust migration.

If PM_{10} concentrations opposite the walls of occupied structures or next to intake vents exceed 150 µg/m^3, work activities will be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 µg/m^3 or less at the monitoring point.

In the event of heavy rain, particulate monitoring will not be performed for the protection of the equipment. Heavy rain would limit the effectiveness of the sensors in the device and act as a natural dust suppressant. In the event of extreme wind conditions that would make dust control ineffective, work activities may need to be suspended and re-evaluated.

3. Project Notifications and Deliverables

All Action Limit exceedances will be reported to NYSDEC within 24-hours. All 15-minute readings will be recorded and be available for NYSDEC and NYSDOH personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded and documented in the Site's field book and daily field reports.