27-45 North Main Street Remedial Investigation Work Plan

27-45 North Main Street and 28 Adee Street Port Chester, NY Section 142.31, Block 1, Lots 7, 11, 12, 13, 14, 15, 16 and 17 BCP Site No. TBD

Submitted to: New York State Department of Environmental Conservation Division of Environmental Remediation 625 Broadway, 12th Floor Albany, NY 12233-7016

Prepared for: Abendroth Green LLC The Hudson Companies Incorporated 826 Broadway, 11th Floor New York, NY 10003

Prepared by: Matthew M. Carroll, P.E. &



121 West 27th Street, Suite 702 New York, NY 10001

January 2023

TABLE OF CONTENTS

CERTI	FICATION	1
1.0	INTRODUCTION	2
1.1	Work Plan Organization	2
1.2	Work Plan Objectives	2
2.0	BACKGROUND	3
2.1	Site Description and Surrounding Uses	3
2.2	Proposed Development	3
2.3	Site Characteristics	4
2.4	Historic Operations	4
2.5	Regulatory Interaction	4
2.6	Summary of Previous Investigations	5
2.7	Summary of Previous Off-Site Investigation	9
3.0	REMEDIAL INVESTIGATION	1
3.1	Scope of Remedial Investigation	1
3.2	Geophysical Survey	2
3.3	Soil Sampling	2
3.3.1	Soil Sampling Methodology	13
3.4	Soil Vapor Sampling	4
3.4.1	Soil Vapor Sampling Methodology	!4
3.4.2	Ambient Air Sampling Methodology	!5
3.5	Groundwater Sampling	6
3.5.1	Groundwater Well Sampling	!6
3.6	Quality Assurance / Quality Control (QA/QC)	17
3.7	Summary Table of Proposed Sampling Locations	17
3.8	Qualitative Exposure Assessment	23
3.9	Health and Safety Plan (HASP)	23
3.10	Air Monitoring	23
3.11	Investigation-Derived Waste (IDW)	23
3.12	Reporting	23
4.0	SCHEDULE	24
5.0	REFERENCES	25

Figures

- Figure 1 Site Location Map
- Figure 2 Site Layout and Previous Sample Locations
- Figure 3 Soil Sample Analytical Results Previous Investigations
- Figure 4 Groundwater Sample Analytical Results Previous Investigations
- Figure 5 Soil Vapor Sample Analytical Results Previous Investigations
- Figure 6 Proposed RI Sampling Locations

Appendices

- Appendix A Previous Environmental Reports (on cd)
- Appendix B Quality Assurance Project Plan (QAPP)
- Appendix C Health and Safety Plan (HASP)
- Appendix D NYSDOH Generic CAMP

CERTIFICATION

I, Matthew Carroll, certify that I am a NYS registered professional engineer as defined in 6NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statues and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

091629 NYS Professional Engineer #

01/19/2023 Date

Matthew M. Carroll, P.E. Signature

It is a violation of Article 130 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 130, New York State Education Law.

1.0 INTRODUCTION

This Remedial Investigation Work Plan (RIWP) was prepared by Matthew M. Carroll, P.E. and Tenen Environmental, LLC (Tenen) on behalf of Abendroth Green LLC (the Requestor). The Requestor submitted a Brownfield Cleanup Program (BCP) application, an Interim Remedial Measures (IRM) Work Plan, and this RIWP to the New York State Department of Environmental Conservation (NYSDEC) to investigate and remediate the property located at 27-45 Main Street and 28 Adee Street (Westchester County TaxID Section 142.31, Block 1, Lots 7, 11, 12, 13, 14, 15, 16 and 17) in the in the Village of Port Chester in Westchester County, New York (the Site). Following NYSDEC review of the BCP application, the Requestor will enter into a Brownfield Cleanup Agreement (BCA) as a Participant with the NYSDEC. The Site location and layout are shown on Figures 1 and 2, respectively.

The RIWP has been designed to further investigate and characterize the nature and extent of contamination previously identified on the Site. The scope of work includes investigation of subsurface soils, soil vapor and groundwater in areas where historical fill material may be present and/or historic operations potentially impacted the Site or surrounding areas. The results of the investigation will be used to prepare a Remedial Investigation Report (RIR) and qualitative human health exposure assessment (QHHEA) and to support the development of a Remedial Action Work Plan (RAWP). This RIWP has been prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10, May 3, 2010).

1.1 Work Plan Organization

This RIWP includes an introduction (Section 1), background information (Section 2), scope of work (Section 3) and project schedule (Section 4). Quality assurance/quality control (QA/QC), health and safety (including community air monitoring), and project team information are addressed in separate appendices. Supporting tables and figures referenced throughout are included at the end of this RIWP.

1.2 Work Plan Objectives

This RIWP has been developed to achieve the following BCP objectives:

- To define the nature and extent of contamination on-site and off-site;
- To identify if additional residual contaminant source areas are present on the Site;
- To determine whether remedial action is needed to protect human health and the environment; and
- To produce data of sufficient quantity and quality to prepare a Remedial Action Work Plan (including alternatives analysis) to support the remediation of the Site if it is determined that remedial action is needed.

2.0 BACKGROUND

This section includes a description of the Site and surrounding uses, a summary of the proposed Site development, Site characteristics, and information regarding historic operations and regulatory interactions. Summaries of previous Site investigations are also provided.

2.1 Site Description and Surrounding Uses

The Site consists of an approximately 48,101-square foot parcel located at 27-45 North Main Street and 28 Adee Street in the Village of Port Chester, New York. The Site is identified by Westchester County as Section 142.31, Tax Block 1, Lots 7, 11, 12, 13, 14, 15, 16 and 17. The Site is an irregularly shaped parcel with approximately 250 feet of frontage along North Main Street, approximately 300 feet of frontage along Abendroth Avenue, and approximately 100 feet of frontage along Adee Street. The Site is location is shown on Figure 1. A map of the current site layout is shown on Figure 2.

The Site lot is currently occupied by one- to three-story commercial or mixed-use residential and commercial buildings. Exterior portions of the Site are largely capped with asphalt. The remainder of the exterior portions of the Site are utilized for landscaping. Currently, the entirety of the Site is vacant, but was most recently utilized by a realtor, restaurant, hardware store, ice cream shop, a jeweler, and non-profit organizations.

The Site is zoned CD-5, denoting an Urban Center Character District that consists of higher-density, mixeduse areas. The surrounding area consists of mixed-use residential, commercial and industrial use. The Site is bound to the northwest by North Main Street and adjacent mixed-use properties; to the northeast by Adee Street and adjacent Walgreens drug store; to the southeast by Abendroth Avenue and an adjacent automotive parking lot, a surface water body leading into Port Chester Bay and a gas station, and; to the southwest by Westchester Avenue and adjacent commercial buildings.

2.2 Proposed Development

The property will be redeveloped with a new six-story mixed-use commercial and residential building. The building will be slab-on-grade and will not contain a cellar. Twenty residential units (approximately 9.85%) will be affordable at 57% area median income (AMI). The proposed building will have a total gross square footage of approximately 226,479 square feet (SF). All existing Site buildings and structures will be demolished to facilitate redevelopment. The development of the project will require excavation to a maximum depth of approximately four feet below sidewalk grade (ft-bg) across the Site to accommodate installation of foundational elements and locally deeper for the elevator pits. The water table was encountered at approximately nine ft-bg and is not expected to be encountered during redevelopment. The proposed development is consistent with the existing zoning and the recent development in this area of Port Chester.

This Remedial Investigation (RI) will be conducted following the completion of an Interim Remedial Measure (IRM) which includes: site mobilization involving Site security setup, equipment mobilization, utility mark outs and marking and staking of excavation areas; demolition of all existing on-site structures; abatement of asbestos containing materials (ACM); removal of the one known UST and any unknown USTs encountered during demolition; and collection of soil samples. The IRM Work Plan was submitted to NYSDEC coincident with this RIWP.

2.3 Site Characteristics

Site Topography

According to the USGS Topographic Map of Glenville, CT & Mamaroneck, NY Quadrangle (2019) topographic map (included in Figure 1), the property lies at an elevation of approximately 12 feet above the National Geodetic Vertical Datum of 1929 (an approximation of mean sea level). The surface topography at the Site slopes gently to the southeast.

Site Geology and Hydrogeology

Groundwater was encountered at approximately nine ft-bg. The groundwater flow direction is to the eastsoutheast towards the Byram River, which is approximately 500 feet east of the Site.

According to previous environmental investigations, subsurface materials beneath the Site consists of overburden composed predominantly of a shallow fill layer containing fine- to medium-grained sand and silt, brick and rock fragments, wood chips, and cobbles, underlain by native till material consisting of fine-to coarse-grained sand, silt and clay. The fill layer ranges in thickness from two to ten feet.

Subsurface Features – USTs

The ground level of the building on Lot 11 contains an active 1,500-gallon UST that contains #2 fuel oil. The UST is reportedly located in a subterranean vault. Lot 11 is identified on the PBS database as PBS #3-801942. The UST on Lot 11 is associated with an open spill (Spill No. 1708684) which was reported on December 15, 2017, due to equipment failure. The spill record indicates the UST was repaired and retested. No further information was provided, and the spill case remains open. A geophysical survey will be performed as part of this RI to if the location of the this UST is not determined during demolition and also to investigate the presence of any other unknown USTs.

2.4 Historic Operations

Prior to 1890, an inlet of the Byram River extended north through the central portion of the Site. By 1890, a small area of the inlet onsite had been filled, and by 1895 the entire Site was filled. By 1895, the Site area along North Main Street was developed with multiple small buildings and stores. While individual store occupants changed over the years, retail use of these buildings is consistent through 2006, the date of the most recent available Sanborn map. The Site was historically utilized for commercial and residential purposes, with non-residential uses of the Site including dry cleaning, a planing/lumber mill, a roller rink, printers, sign painting, lime and cement storage, plumbing, and a metal works. Prior uses that appear to have led to site contamination include the filling of the Site with historic fill material and the use of chlorinated solvents.

2.5 Regulatory Interaction

Brownfield Cleanup Program

A Brownfield Cleanup Program (BCP) application was submitted for the Site in January 2023, along with an IRM Work Plan and this RIWP to the New York State Department of Environmental Conservation NYSDEC. Following NYSDEC review of the BCP application, the Requestor will enter into a Brownfield Cleanup Agreement (BCA) as a Participant with the NYSDEC. The work to be performed under this RIWP, as well as, all future remedial work, will be performed in accordance with the requirements set forth in the BCA.

Regulatory Database Listings

Database information was provided by Environmental Data Resources (EDR) on January 6, 2022, during Teen's 2022 Phase I ESA. Several available federal and state databases were searched using standard radii, as detailed in ASTM 1527-13. Listings associated with the Site address were identified on the NY SPILLS, UST, EDR Hist Cleaner, RCRA-SQG, ICIS, US AIRS, DRYCLEANERS, and MANIFEST databases.

43 North Main Street

A listing for **Feinsod Hardware Co.** identified on the UST database references a 1,500-gallon steel inservice UST containing #2 fuel oil. The SPILLS database references Spill No. 1308618, reported on 11/25/13 and pertaining to an equipment failure from the boiler and release of oil into a subterranean vault. The record noted the UST could not be located and is not in compliance with PBS regulations. There was no indication that oil discharged into the Byram River to the east. A 2013 NYSDEC memo noted that 2,000 gallons of oil and water were vacuumed from the vault and the spill record was closed the next day. A second SPILLS listing, **Business**, references Spill No. 1708684, reported on 12/15/17 due to equipment failure. The record indicates the tank was repaired and retested. No further information was provided, and the spill case remains open.

29 North Main Street

Listings for **Commuter Cleaners** were identified on the EDR Hist Cleaner, RCRA-SQG, ICIS, US AIRS, DRYCLEANERS, and MANIFEST databases. The EDR Hist Cleaner listing indicates the property operated as a dry-cleaning facility from 1992 through 2014 and was a conditionally exempt small quantity generator of spent halogenated solvents in 1989, 2006 and 2007. No violations were found. A listing for **Copacabana Restaurant** on the SPILLS database references Spill No. 1602940, reported on 06/24/16. The record noted that samples were collected after four ASTs were removed from the property. Slightly elevated levels of SVOCs were detected in one of the samples. No additional evidence of leak or contamination was observed. A 2016 NYSDEC memo noted that no further action was required and the spill case was closed on 07/12/16.

2.6 Summary of Previous Investigations

Investigations and sampling efforts conducted at the Site or at portions of the Site are described in the following reports:

- 1. Phase I Environmental Site Assessment, 29-31 and 37-39 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., July 25, 2016.
- 2. Tier II: Soil Vapor Encroachment Screen, 29-31 and 37-39 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., August 30, 2016.
- 3. Indoor Air and Groundwater Survey, 29-31 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., October 5, 2016.
- 4. *Phase I Environmental Site Assessment, 25-27 North Main Street, Port Chester, NY*, EBI Consulting, June 14, 2018.
- 5. *Phase I Environmental Site Assessment, 33-35 North Main Street, Port Chester, NY*, EBI Consulting, May 1, 2019.
- 6. *Phase I Environmental Site Assessment, 41 North Main Street, Port Chester, NY*, EBI Consulting, May 2, 2019.
- 7. Phase I Environmental Site Assessment, 43 North Main Street, Port Chester, NY, EBI Consulting, October 14, 2019.

- 8. *Phase I Environmental Site Assessment, 27-45 North Main Street and 28 Adee Street, Port Chester, NY*, Tenen Environmental, LLC, May 2022.
- 9. Limited Due Diligence Environmental Site Investigation, 27-45 North Main Street and 28 Adee Street, Port Chester, NY, Tenen Environmental, LLC, April 5, 2022.
- 10. Off-Site Environmental Investigation, 27-45 North Main Street and 28 Adee Street, Port Chester, NY, Tenen Environmental, LLC, November 8, 2022.

Summaries of previous investigations are provided below. Previous sample locations are shown on Figure 2. Copies of the aforementioned previous reports for the Site are included as Appendix A.

Site History

- Prior to 1890, an inlet of the Byram River extended north through the central portion of the Site. By 1895, the entirety of the inlet spanning the Site had been filled. By 1895, the Site area along North Main Street was developed with multiple small buildings and stores.
- The Site was historically utilized for commercial and residential purposes. Historic non-residential uses include: dry cleaning, a planing/lumber mill, a roller rink, printers, sign painting, lime and cement storage, plumbing, and a metal works.
- The Site has two closed Spill records and one open Spill record associated with it:
 - Spill No. 1308618 was reported on November 25, 2013 for Lot 11. The spill record indicates the spill was caused by an equipment failure from the boiler which released oil into the subterranean vault containing the known 1,500-gallon UST. The record noted the UST could not be located and is not in compliance with Petroleum Bulk Storage (PBS) regulations. There was no indication that oil discharged into the Byram River to the east. A 2013 NYSDEC memo noted that 2,000 gallons of oil and water were vacuumed from the vault and the spill case was closed the following day.
 - Spill No. 1602940 was reported on June 24, 2016 for Lot 16. The spill record indicates samples were collected after four aboveground storage tanks (ASTs) were removed from the property. Slightly elevated concentrations of semivolatile organic compounds (SVOCs) were detected in one of the soil samples. No additional evidence of a leak or contamination was observed. A 2016 NYSDEC memo noted that no further action was required and the spill case as closed on July 12, 2016.
 - Spill No. 1708684 was reported on December 15, 2017 for Lot 11. The spill record indicates the spill was caused by equipment failure. The record indicates the tank was repaired and retested. No further information was provided and the spill case remains open.
- Previous Phase I Environmental Site Assessment (Phase I ESAs) conducted at the Site or a portion of the Site identified the following Recognized Environmental Conditions (RECs) in connection with the property:
 - The historical use of the Site for dry cleaning, printing, and metalworking;
 - The presence of historical fill material at the Site;
 - Open petroleum spill (Spill No. 1708684) associated with the Site, and the historic and current use of the Site for underground oil storage; and,
 - Historical use of the east adjoining property for coal storage and a west adjoining property for printing.

Geology/Hydrogeology

- The Site is located at an average elevation of approximately twelve feet above mean sea level (ftmsl) and slopes gently to the southeast.
- The overburden at the Site is composed predominantly of a shallow fill layer containing fine- to

medium-grained sand and silt, brick and rock fragments, wood chips, and cobbles underlain by native till material consisting of fine- to coarse-grained sand, silt, and clay. The fill layer ranges in thickness from two to ten feet.

• Groundwater was encountered at approximately nine feet ft-bg and generally flows to the eastsoutheast, towards the Byram River.

Soil

- The results of the soil sampling performed as part of Tenen's 2022 Limited Due Diligence Environmental Site Investigation (LDDESI) noted that petroleum odors and elevated photoionization detector (PID) readings were present in soil around the 1,500 gallon UST.
- Sampling indicated that one volatile organic compound (VOC), acetone, was detected slightly in exceedance of its Unrestricted Use Soil Cleanup Objective (SCO, UUSCO) in two soil samples. Acetone is a common laboratory artifact. No other VOCs were detected in exceedance of UUSCOs or Restricted-Residential Use SCOs (RRSCOs).
- A variety of SVOCs, specifically polyaromatic hydrocarbons (PAHs), were detected in exceedance of Unrestricted Use SCOs in two soil samples, including benzo(a)anthracene [max. 3 parts per million (ppm) with a UUSCO of 1 ppm], benzo(a)pyrene (max. 2 ppm with a UUSCO of 1 ppm), benzo(b)fluoranthene (max. 2.1 ppm with a UUSCO of 1 ppm), benzo(k)fluoranthene (max. 2.2 ppm with a UUSCO of 0.8 ppm), chrysene (max. 2.6 ppm with a UUSCO of 1 ppm), dibenzo(a,h)anthracene (max. 0.56 ppm with a UUSCO of 0.33 ppm), and indeno(1,2,3-cd)pyrene (max. 1.5 ppm with a UUSCO of 0.5 ppm). Of these, the UUSCO is the same as the RRSCO for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, and any exceedances of UUSCOs for these analytes also exceeded RRSCOs. The highest concentrations of SVOCs were detected in SB-1, collected from the northern portion of Lot 11, upgradient of the 1,500-gallon UST. No other SVOCs were detected in exceedance of UUSCOs or RRSCOs.
- One pesticide, dieldrin, was detected slightly in exceedance of its UUSCO, but below its RRSCO, in one soil sample. Dieldrin was detected at a concentration of 0.01 ppm with an UUSCO of 0.005 ppm.
- The metals copper, lead, mercury, and nickel were each detected in one or more soil samples in exceedance of Unrestricted Use SCOs. Copper was detected in one sample at a concentration of 61.1 ppm with a UUSCO of 50 ppm; lead was detected in two samples at a max. concentration of 117 ppm with a UUSCO of 63 ppm; mercury was detected in all three samples at a max. concentration of 2.8 ppm with a UUSCO of 0.18 ppm; and nickel was detected in one soil sample at a concentration of 34.4 ppm with a UUSCO of 30 ppm. Of these, mercury was also detected in exceedance of its RRSCO of 0.81 ppm in one soil sample collected from SB-6 in the southeastern portion of Lot 16.
- Polychlorinated biphenyls (PCBs) were not detected in exceedance of UUSCOs or RRSCOs in any soil samples.

Soil samples results from previous investigations are depicted on Figure 3.

Groundwater

• The results of the groundwater sampling performed on-site as part of the 2016 Indoor Air and Groundwater Survey performed by Advanced Cleanup Technologies, Inc. (ACT) and Tenen's 2022 LDDESI indicated VOCs were not detected in exceedance of the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards (AWQS) and Guidance Values (Class GA Standards) in any groundwater samples.

• The results of the groundwater sampling performed as part of Tenen's 2022 LDDESI indicated a variety of SVOCs, specifically PAHs, were detected in one groundwater monitoring well, GW-1, (located upgradient of the 1,500-gallon UST on Lot 11) slightly in exceedance of Class GA Standards. Benzo(a)anthracene was detected at a concentration of 0.04 parts per billion (ppb), benzo(a)pyrene was detected at a concentration of 0.04 ppb, benzo(b)fluoranthene was detected at a concentration of 0.02 ppb, chrysene was detected at a concentration of 0.01 ppb, and indeno(1,2,3-cd)pyrene was detected at a concentration of 0.02 ppb, with the exception of benzo(a)pyrene, which has a Class GA Standard of 0 ppb. No other SVOCs were detected in exceedance of Class GA Standards in any groundwater samples.

Groundwater samples results from previous investigations are depicted on Figure 4.

Soil Vapor

- The results of the soil vapor sampling performed as part of ACT's 2016 Tier II Vapor Encroachment (VE) Screen indicated elevated concentrations of the chlorinated solvent tetrachloroethene (PCE) in one soil vapor sample collected from the southeastern portion of the exterior of Lot 16. PCE was detected at a concentration of 250 micrograms per cubic meter (µg/m³). No other chlorinated VOCs (cVOCs) included on the New York State Department of Health (NYSDOH) Soil Vapor Intrusion Decision Matrices were detected in any soil vapor samples.
- The results of the soil vapor sampling performed as part of Tenen's 2022 LDDESI indicated concentrations of PCE were detected in all four soil vapor samples at concentrations ranging from 1.8 μ g/m³ to 80.7 μ g/m³. In addition, trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE), breakdown products of PCE, were both detected in one soil vapor sample. TCE was detected at a concentration of 1.98 μ g/m³ and cis-1,2-DCE was detected at a concentration of 0.22 μ g/m³. Carbon tetrachloride was detected in three of four soil vapor samples at a maximum concentration of 0.55 μ g/m³. No other cVOCs included on the NYSDOH Soil Vapor Intrusion Decision Matrices were detected in any soil vapor samples.
- Low levels of petroleum-related VOCs were detected in soil vapor across the Site, including benzene, toluene, ethylbenzene, xylenes, and 1,2,4-trimethylbenzene.

Indoor Air

- The results of the indoor air sampling conducted on Lot 16 as part of ACT's 2016 Air and Groundwater Survey indicated concentrations of cVOCs, including PCE, TCE, carbon tetrachloride, and methylene chloride were detected in all three indoor air samples. In addition, the cVOCs cis-1,2-DCE, vinyl chloride, 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichloroethene (1,1-DCE) were each detected in one soil vapor sample. Of these, TCE was detected in exceedance of its NYSDOH Air Guideline Value (AGV) of 2 μ g/m³ in one indoor air sample collected from the southeastern portion of Lot 16. No other cVOCs were detected in exceedance of their respective NYSDOH AGVs. PCE was detected at a max. concentration of 12 μ g/m³; TCE was detected at a max. concentration of 6.9 μ g/m³; carbon tetrachloride was detected at a max. concentration of 7.5 μ g/m³; methylene chloride was detected at a max. concentration of 4.6 μ g/m³; 1,1,1-TCA was detected at a concentration of 6.7 μ g/m³; and, 1,1-DCE was detected at a concentration of 5.4 μ g/m³.
- Comparison of the concentrations of cVOCs detected in indoor air to the applicable NYSDOH Soil Vapor Intrusion Matrices indicates mitigation would likely be required for PCE at one location (CS-1, collected from the crawl space in the western portion of the building on Lot 16) and would

likely be required for TCE, cis-1,2-DCE, vinyl chloride, carbon tetrachloride, and 1,1-DCE at one location (IA-2, collected from the southeastern portion of the building on Lot 16).

Soil vapor samples results from previous investigations are depicted on Figure 5.

Based on the findings of prior investigations conducted at the Site, the contaminants of concern at the Site are petroleum contamination around the 1,500 gallon UST, chlorinated VOCs (cVOCs), specifically PCE and its degradation compounds, and historic fill-related compounds (PAHs and metals).

2.7 Summary of Previous Off-Site Investigation

In October 2022, Tenen performed a follow-up Off-Site Environmental Investigation to assess potential off-site migration of the contamination identified in the 2022 LDDESI. Soil borings and monitoring wells installed as part of the off-site investigation were situated downgradient of the open petroleum spill, and the soil vapor sample points were biased toward the location of the former dry cleaner (Lot 16). The scope of work performed during the off-site investigation included:

- Advancement of three off-site soil borings with the collection and laboratory analysis of three soil samples for VOCs and SVOCs;
- Installation of three off-site temporary groundwater monitoring wells with the collection and laboratory analysis of three groundwater samples for VOCs and SVOCs; and
- Installation of four off-site soil vapor points with the collection and laboratory analysis of soil vapor samples for VOCs.

Previous off-site sample locations are shown on Figure 2. The results of the off-site investigation indicated the following:

Off-site Soil

- VOCs were not detected in exceedance of UUSCOs or RRSCOs in any off-site soil samples.
- Four SVOCs, specifically PAHs, were detected in exceedance above UUSCOs in one soil sample (SB-3), including benzo(a)pyrene (1.1 ppm), benzo(b)fluoranthene (1.6 ppm), chrysene (1.3 ppm), and indeno(1,2,3-cd)pyrene (0.81). Of these, the UUSCO is the same as the RRSCO for benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene, and any exceedances of UUSCOs for these analytes also exceeded RRSCOs. No other SVOCs were detected in exceedance of UUSCOs or RRSCOs in the off-site soil samples.

Off-site Groundwater

- VOCs were not detected in exceedance of Class GA Standards in any off-site groundwater samples.
- Six SVOCs, specifically PAHs, were detected in exceedance of Class GA Standards in the off-site groundwater samples, including benzo(a)anthracene (max. 0.07 ppb), benzo(a)pyrene (0.03 ppb), benzo(b)fluoranthene (0.04 ppb), benzo(k)fluoranthene (0.03 ppb), chrysene (max. 0.03 ppb), and indeno(1,2,3-cd)pyrene (0.04 ppb). Two SVOCs, benzo(a)anthracene and chrysene, were detected in all three groundwater samples above Class GA Standards. The other four SVOCs, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene, were only detected in groundwater sample MW-1 above laboratory reporting limits and Class GA Standards. Of these SVOCs, the Class GA Standard is 0.002 ppb, except for benzo(a)pyrene, which has a Class GA Standard of 0 ppb. No other SVOCs were detected in exceedance of Class GA Standards in any groundwater samples.

Off-site Soil Vapor

- The results of the off-site investigation indicated that cVOCs included on the NYSDOH Soil Vapor Intrusion Matrices, which includes PCE, TCE, cis-1,2-DCE, vinyl chloride, 1,1,1-TCA, carbon tetrachloride, 1,1-DCE, and methylene chloride, were not detected except for PCE (max. 72.6 µg /m³) in all four off-site soil vapor samples, and TCE (2.86 µg/m³) in one soil vapor sample, SS-3. No other cVOCs included on the NYSDOH Soil Vapor Intrusion Decision Matrices were detected in any soil vapor samples.
- Low levels of petroleum-related VOCs were detected in all four off-site soil vapor samples, including benzene (max. 20.1 μg/m³), toluene (max. 21.9 μg/m³), ethylbenzene (max. 4.78 μg/m³), and total xylenes (max. 10.77 μg/m³). Other petroleum-related VOCs, including 1,3-butadiene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2,2,4-trimethylpentane, ethanol, isopropanol, n-hexane, and styrene, were detected in the off-site soil vapor samples at varying concentrations up to 626 μg/m³ (2,2,4-trimethylpentane).

3.0 **REMEDIAL INVESTIGATION**

The Remedial Investigation proposed for the Site includes performance of a geophysical survey, sampling of soil, groundwater, soil vapor and ambient air. The objectives of this RI are to define the nature and extent of contamination on-site; to determine if on-site contamination is migrating off-site; and to provide data of sufficient quantity and quality to support development of a Remedial Investigation Report (RIR), Qualitative Human Health Exposure Assessment (QHHEA) and Remedial Action Alternatives Analysis.

This RIWP was developed to meet the following Site-specific objectives:

- Confirm prior investigation results;
- Confirm the location of the known (one 1,500-gallon UST) and investigate the presence of unknown (if present) USTs;
- Define the nature and extent of the residual petroleum and historic fill material present and investigate other petroleum and chlorinated solvent sources on-site;
- Delineate the horizontal and vertical extent of historic fill-related compounds (PAHs and metals) in soil and groundwater beneath the Site;
- Identify the extent of on-site soil vapor impacts, specifically those related to chlorinated solvents (PCE and its degradation compounds) and petroleum-related compounds;
- Evaluate potential sources of contamination, the migration pathways, and actual or potential receptors of contaminants on or through soil, groundwater and soil vapor;
- Evaluate potential off-site impacts to soil, groundwater and soil vapor;
- Assess potential upgradient sources of historic fill-related impacts, and petroleum and chlorinated solvent (if present) in groundwater; and,
- Assess potential impacts to human health resulting from the release of contaminants at the Site.

3.1 Scope of Remedial Investigation

The scoping process, for the purpose of identifying and defining the RI tasks described below, included the following:

- Review of current and historic Site reports and data including several Phase I ESAs;
- Review of sampling results from ACT's 2016 *Tier II: Soil VE Screen*, ACT's 2016 *Indoor Air and Groundwater Survey*, Tenen's 2022 *LDDESI* and Tenen's 2022 *Off-Site Environmental Investigation*; and
- Evaluation of DER-10 requirements and relevant State and Federal guidance documents.

The RI will begin after NYSDEC approval of this RIWP and after the 30-day public comment period is satisfied. The RI will include the following scope of work:

- A geophysical survey;
- Advancement of eleven soil borings [nine on-site borings and two off-site borings] with the collection and laboratory analysis of thirty soil samples along with requisite QA/QC samples;

- Installation of seven permanent groundwater monitoring wells [five on-site monitoring wells and two off-site monitoring wells] with the collection and laboratory analysis of seven groundwater samples along with requisite QA/QC samples;
- Installation of 13 soil vapor points [seven on-site vapor points and six off-site vapor points] with the collection and laboratory analysis of 13 soil vapor samples, and two off-site soil vapor samples (co-located with two off-site indoor air samples), and one ambient sample; and
- A survey of the groundwater monitoring wells.

The Remedial Investigation will be conducted upon completion of the Interim Remedial Measure (IRM), the Work Plan (WP) for which is currently under review with NYSDEC. The IRMWP includes the demolition of all existing on-site structures, as such, indoor air samples are not proposed as part of this RI scope.

The type, location, and rationale for each exploration are detailed in the sections below and in the summary table included in Section 3.6. Proposed RI sample locations are shown on Figure 6.

Installation of soil borings, groundwater monitoring wells and soil vapor points will be completed in accordance with the sections below and the standard procedures included in the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP), included as Appendix B and C, respectively. Following the collection of this data, review and evaluation will be performed to determine if additional investigation is necessary.

3.2 Geophysical Survey

A geophysical survey will be performed across the Site and at the proposed off-site sample locations, to the extent feasible, to clear the proposed sampling locations for subsurface utilities and/or structures, confirm the location of one known 1,500-gallon UST and assess the potential presence of any unknown USTs and/or other subsurface obstructions or structures. The geophysical survey will include electromagnetic (EM), radio-detection (RD), and ground penetrating radar (GPR) methods.

3.3 Soil Sampling

A subsurface investigation will be performed to further characterize soil conditions on-site, to horizontally and vertically delineate documented historical fill-related impacts on-site and to assess soil conditions offsite and previously inaccessible areas on-site (prior to demolition of on-site buildings).

The following scope of work will be implemented:

- Advance nine soil borings (SB-1 through SB-5, and SB-8 through SB-11) on-site to confirm the results and/or fill data gaps from soil samples collected during previous investigations. All soil borings will be advanced five feet below the groundwater interface (approximately 14-15 ft-bg);
- Advance two soil borings (SB-6 and SB-7) off-site to assess soil conditions downgradient of the Site. Off-site soil borings will be advanced five feet below the groundwater interface (approximately 14-15 ft-bg);
- Within each boring, soil samples from each of the following intervals will be collected and analyzed: one shallow sample in the two-foot interval directly below the surface (0-2 ft-bg); one deep sample in the two-foot interval above groundwater interface (7-9 ft-bg); and one intermediate sample within the two-foot interval either directly below the fill interface or at the highest suspected contamination and the succeeding next apparent clean interval. If no visual contamination is

observed, the intermediate sample will not be collected. A minimum of three soil samples will be collected from each boring; and,

• Analyze all soil samples for full-scan Part 375 SCOs (including VOCs, SVOCs, pesticides, herbicides, PCBs, metals, cyanide, trivalent and hexavalent chromium), 1,4-dioxane and perfluoroalkyl acids (PFAS).

3.3.1 Soil Sampling Methodology

A total of 11 soil borings (nine on-site and two off-site) will be advanced as part of this RI; proposed soil sample locations are shown in Figure 6. Based on the geophysical survey results, field measurements and observations, boring locations may be moved or added. Coordination with NYSDEC will take place prior to any major modifications are made.

Soil borings will be installed using a track-mounted Geoprobe[®] direct-push probe drill rig. All borings will be advanced to the proposed excavation depth (approximately 15 ft-bg). Soil samples will be collected from five-foot Macrocores fitted with dedicated acetate liners.

At each location, the liners for each interval will be opened and the soil screened for VOCs using a 10.6 electron-volt (EV) photoionization detector (PID) calibrated with 100 ppm isobutylene gas. The soil retrieved from each sampler will be described by Tenen field staff on boring logs using the Unified Soil Classification System. All observations regarding potential contamination such as odors, staining, etc. will be documented. Soil will be screened from grade to the terminal depth of each boring. If evidence of contamination (e.g., elevated PID readings, odor) or staining is observed, the soil boring will be extended to the extent possible based on the equipment, to delineate the vertical extent of contamination. All descriptions and observations will be documented in a field logbook.

A minimum of three soil samples will be collected from each boring: the first shallow subsurface interval (0-2 ft-bg) and the groundwater interface (13-15 ft-bg) as well as an intermediate sample either directly below the fill layer or at the interval of highest suspected contamination.

Soil samples selected for laboratory analysis will be collected directly from the acetate liner, placed in precleaned, pre-preserved laboratory-provided sample bottles or EnCore samplers (EnNovative Technologies), sealed and labeled, and placed in a cooler and chilled to 4° C for transport under chain-of custody procedures. Soil samples will be submitted to a NYSDOH ELAP-certified laboratory via courier service and analyzed for the respective analyte lists included in 6 NYCRR Part 375 SCOs. Laboratory analytical parameters and methods are outlined below. QA/QC procedures to be followed and requisite QA/QC samples to be collected for laboratory analysis are described in the QAPP included as Appendix B.

All soil samples will be analyzed for the following analytes on the Part 375 list with a Category B deliverable package:

- Target Compound List (TCL) VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270D;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082A;
- Target Analyte List (TAL) Metals by EPA Method 6010C/7471B;
- Total Cyanide by EPA Method 9010C;
- Trivalent and Hexavalent Chromium by EPA Method 3060A;

- PFAS by USEPA Method 1633; and
- 1,4-Dioxane by USEPA Method 8270.

Emerging contaminants (e.g., PFAS and 1,4-Dioxane) will be sampled in accordance with the current NYSDEC guidance, *Sampling, Analysis, and Assessment of PFAS Under NYSDEC's Part 375 Remedial Programs* (November 2022).

A summary table of proposed soil samples and sampling rationale is included in Section 3.6 of this Work Plan.

3.4 Soil Vapor Sampling

The following scope of work is proposed to further investigate the extent of on-site impacts to soil vapor from, specifically those related to chlorinated solvents (PCE and its degradation compounds) and petroleum-related compounds, to further evaluate the potential for impacted soil vapor to migrate off-site. No on-site structures will exist at the time of the RI implementation; therefore, no indoor air samples will be collected as part of this investigation.

The following scope of work will be implemented:

- Install thirteen soil vapor points to a terminal depth of approximately four feet below grade (4 ftbg) on-site, which is approximately development depth and to the estimated depth of the lowest level at the nearest building off-site. Seven soil vapor points will be installed on-site and six soil vapor points will be installed off-site;
- Two indoor air samples will be collected at locations co-located with the two off-site soil vapor samples in the south-adjacent property (SV-12/IA-1 and SV-13/IA-2). The indoor air samples will be collected from breathing height (three to five feet above floor grade);
- One ambient air sample will be collected from an exterior location to assess for background concentrations; and,
- Analyze soil vapor, indoor, and ambient air samples for TO-15 VOCs.

3.4.1 Soil Vapor Sampling Methodology

A total of 13 soil vapor samples (seven on-site and six off-site) and one ambient air sample will be collected as part of this RI. Samples will be collected in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (Soil Vapor Guidance, October 2006 with updates). Seven soil vapor points (SV-1 through SV-7) will be installed on-site around the perimeter of the Site, in the location of the known UST and in the vicinity of previous sample locations to confirm the results. Six soil vapor points (SV-8 through SV-13) will be installed off-site at locations to fill data gaps during the previous offsite investigation to evaluate whether potential soil vapor impacts migrated off-site.

A track-mounted Geoprobe[®] direct-push probe drill rig will be used to install temporary soil vapor sampling probes. A disposable sampling probe consisting of a 1.5-inch-long hardened point and a 6-inch long, 0.5-inch diameter stainless-steel soil vapor screen implant will be installed to the terminal depth, approximately 4 ft-bg on-site and at the estimated depth of the nearest building's lowest slab off-site. At the terminal depth of soil vapor point locations, the sample probes will be attached to ¼-inch diameter Teflon[®] tubing and extended to the surface. The probe was then retracted approximately six inches to create a void. The borehole above the sampling probe to grade will backfilled with sand to fill the annual space and the top of

the borehole was sealed using hydrated bentonite to prevent ambient air mixing with the soil vapor. Prior to sampling, ambient air will be purged from the boring hole by attaching the surface end of the ¹/₄-inch diameter Teflon[®] tube to an air valve and then to a vacuum pump. The vacuum pump will remove three volumes of air (volume of the sample probe and tube) prior to sample collection. The flow rate for both purging and sample collection will not exceed 0.2 liters per minute.

Purged vapors from probes will be first screened for VOCs using a PID calibrated with 100 ppm isobutylene gas. A tracer gas (helium) will be used in accordance with the NYSDOH protocols to verify the integrity of the soil vapor probe seal and check for short-circuiting by ambient air. Helium will be used as the tracer gas and a shroud and/or bucket will serve to keep it in contact with the probe during testing. A portable helium detector will be used to analyze a sample of soil vapor for the tracer prior to sampling. If the tracer sample results show a significant presence of the tracer gas, the probe seals will be adjusted to prevent infiltration.

After purging, the probes will be connected via dedicated tubing and soil vapor samples will be collected in laboratory-supplied, batch-certified clean 2.7-liter SUMMA[®] canisters using eight-hour flow controllers. Sampling will occur for a duration of approximately eight hours. Once sampling is completed, the canisters will be resealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. All soil vapor samples will be analyzed for VOCs by EPA Method TO-15.

A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor extracted, vacuum (in inches of mercury) of canisters before and after the samples are collected, apparent moisture content of the sampling zone and chain of custody

3.4.2 Indoor Air and Ambient Air Sampling Methodology

The indoor air and ambient air samples will be collected in accordance with the NYSDOH Soil Vapor Guidance. The sample location may be adjusted based on field observations or conditions.

The off-site indoor air samples will be collected and co-located with two proposed off-site soil vapor samples, SV-12 and SV-13, inside the south-adjacent property building. The indoor air and ambient air samples will be collected from breathing height (three to five feet above the ground) in a secure, upwind direction. The sampling flow rate will not exceed 0.2 liters per minute (L/min). Sampling will occur for a duration of approximately eight hours. A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor extracted, vacuum of canisters before and after the samples are collected and chain of custody protocols.

Samples will be collected in laboratory-supplied, batch-certified clean 2.7-liter Summa canisters using eight-hour flow controllers and will be resealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. All samples will be analyzed for VOCs by EPA Method TO-15.

A summary table of proposed soil vapor samples and sampling rationale is included in Section 3.6 of this Work Plan. Proposed RI sample locations are shown on Figure 6.

3.5 Groundwater Sampling

The following scope of work is proposed to further characterize groundwater on-and off-site:

- Seven permanent groundwater monitoring wells will be installed concurrent with soil borings to further characterize groundwater conditions both on-site and off-site, and/or fill data gaps. One monitoring well (GW-1) will be installed along the southern Site boundary at a cross-gradient location that was not previously sampled; two monitoring wells (GW-2 and GW-4) will be installed along the eastern Site boundary at downgradient locations; one monitoring well (GW-3) will be installed along the western Site boundary at an upgradient location that was previously inaccessible; one monitoring well (GW-5) will be installed near the location of the 1,500-gallon UST, proximal to previously installed temporary monitoring wells GW-1 and GW-2; and two monitoring wells (GW-6 and GW-7) will be installed off-site at downgradient locations to further assess potential off-site groundwater impacts;
- Gauge and collect groundwater samples from the seven newly installed groundwater wells;
- Analyze all groundwater samples for full-scan Part 375 SCOs (including VOCs, SVOCs, pesticides, herbicides, PCBs, total and dissolved metals, cyanide, trivalent and hexavalent chromium), 1,4-dioxane and PFAS; and,
- Survey newly installed monitoring wells; collect one round of depth-to-groundwater measurements; and evaluate groundwater elevations and present groundwater contours.

Proposed RI well and existing well locations are shown on Figure 6.

3.5.1 Groundwater Well Sampling

Seven newly installed permanent monitoring wells (GW-1 through GW-7) will be sampled. Five monitoring wells (GW-1 through GW-5) will be installed on-site and two monitoring wells (GW-6 and GW-7) will be installed off-site. All sampling equipment will be decontaminated prior to use. Prior to sampling, water levels will be measured using an electronic product-water level indicator. Sample collection will be accomplished by using low-flow procedures. Samples will not be collected until pH, temperature, and conductivity measurements stabilize and the turbidity reading is 50 Nephelometric Turbidity Units (NTU) or less, or stabilizes above 50 NTU.

All monitoring wells will be installed using a track-mounted Geoprobe[®] direct-push probe drill rig. All monitoring wells will consist of a two-inch inner diameter (ID) polyvinyl chloride (PVC) well casing and riser. A ten-foot PVC slotted well screen (0.020-inch slot) will be installed and span the groundwater table (approximately four feet above and six feet below). A filter pack of sand will be placed in the annular space around the screen (minimum 2-inches around the circumference of the screen) and will extend two feet above the screen. The annular space around the well casing above the sand pack will be sealed with bentonite pellets for an interval of two feet. The annular space above the bentonite pellets to one ft-bg will be backfilled with unimpacted drill cuttings or clean sand. Upon completion of the well, a locking well cap will be installed atop the PVC riser and a steel flush-mount roadbox and concrete apron will be installed at grade.

Groundwater well construction logs will be completed for all newly installed wells, including a description of the encompassing lithology, top of casing and screening interval. Boring and well construction logs will be included in the RIR.

The monitoring wells will be developed on the day of installation by pumping using dedicated high-density polyethylene (HDPE) tubing. The wells will be developed until at least three well volumes have been evacuated. Groundwater sampling will occur approximately seven days after installation and development to allow equilibration of the water table. All permanent monitoring wells will be surveyed to a common datum.

Groundwater samples will be collected for laboratory analysis using low-flow techniques in accordance with EPA Region 1 Low-Stress (Low-Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP-GW 001 Revision 3 dated July 30, 1996; revised January 19, 2010). Samples will be collected in pre-cleaned, pre-preserved laboratory-provided sample bottles, sealed and labeled, and placed in a cooler and chilled to 4°C for transport under chain-of custody procedures. Groundwater samples will be submitted to a NYSDOH ELAP-certified laboratory via courier service and analyzed for the respective analyte lists included in 6 NYCRR Part 375 SCOs. Laboratory analytical parameters and methods are outlined below. QA/QC procedures to be followed and requisite QA/QC samples to be collected for laboratory analysis are described in the QAPP included as Appendix B.

All groundwater samples will be analyzed for the following analytes on the Part 375 list and emerging contaminants with a Category B deliverable package:

- TCL VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270D;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- PCBs by EPA Method 8082A;
- Total and Dissolved TAL Metals by EPA Method 6010C/7471B;
- Total and Dissolved Cyanide by EPA Method 9010C; and
- Total and Dissolved Trivalent and Hexavalent Chromium by EPA Method 3060A;
- 1,4-Dioxane by EPA Method 8270D-SIM Modified; and
- PFAS by EPA Method 537.

Emerging contaminants (e.g., PFAS and 1,4-Dioxane) will be sampled in accordance with the current NYSDEC guidance, *Sampling, Analysis, and Assessment of PFAS Under NYSDEC's Part 375 Remedial Programs* (October 2020).

3.6 Quality Assurance / Quality Control (QA/QC)

All samples will be collected in accordance with the Quality Assurance Project Plan (QAPP) included as Appendix B.

Sample analysis will be performed by a NYSDOH ELAP-certified laboratory. The laboratory will report sample results on an approximately 10-day turn-around time. An independent sub-consultant will validate sample results and prepare a Data Usability Summary Report (DUSR).

3.7 Summary Table of Proposed Sampling Locations

As required by Section 3.3(b) 3 of DER-10, below is a table describing all proposed sampling locations and QA/QC samples.

27-45 North Main S	Street – Port Ch	ester, NY
	BCP Site	No. TBD

<u>Soil</u>

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale		
SB-1					Assess on-site soil conditions		
SB-2						Confirm prior investigation results in the former dry cleaner area	
SB-3				EPA 1633 Modified / MDL less than 1	Assess on-site soil conditions		
SB-4		Minimum of three soil samples from each boring: the first shallow subsurface interval (0-2 ft-bg); below the fill layer or the immediate interval of highest suspected contamination (if encountered); and the groundwater interface (7-9 ft-bg).Part 375 Analytes, Part 375 Analytes, 1,4-Dioxane and PFAs from all samplesEPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014 and 3060A/7196 / MDL less than Unrestricted Use SCOs	Minimum of three soil samples from each boring: the first shallow subsurface fill layer or the immediatePart 375 Analytes, Part 375 Analytes,EPA 8270 / MDL less than 0.1 mg/kg for 1,4-Dioxane;Part 375 Analytes, interval (0-2 ft-bg); below the fill layer or the immediate interval of highest suspected contamination (ifPart 375 Analytes, 1,4-Dioxane and samplesEPA 8260C, 8270D, 8081B, 8082A, 8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014	Minimum of three soil	μg/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg	μg/kg for PFAS; EPA 8270 / MDL less than 0.1 mg/kg	Assess on-site soil conditions
SB-5	Soil			Confirm prior investigation results in the known UST area			
SB-6				fill layer or the immediate PFAs from all 8151A, 7196A, interval of highest suspected samples 3050B, 7471B, contamination (if 9010C/9012B/9014	interval of highest suspected samples 3050B, 7471B, contamination (if 9010C/9012B/901	fill layer or the immediate interval of highest suspected contamination (if	interval of highest suspected contamination (if PFAs from all samples 3050B, 7471B, 9010C/9012B/9014
SB-7			encountered); and the groundwater interface (7-9 ft- bg). and 3060A/7196 / MDL less than Unrestricted Use SCOs	and 3060A/7196 / MDL less than Unrestricted Use SCOs	Assess off-site soil conditions		
SB-8					Confirm prior investigation results in the former dry cleaner area		
SB-9					Confirm prior investigation results		
SB-10					Assess on-site soil conditions		
SB-11					Assess on-site soil conditions		

Groundwater

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale					
GW-1										
GW-2			D	EPA 8260C, 8270D, 8270D- SIM Modified, 8081B,						
GW-3		10 ft screen across	10 ft screen across	10 ft screen across	10 ft screen across (including Total	Part 375 Analytes (including Total	Part 375 Analytes (including Total	Part 375 Analytes (including Total	8151A, 7196A, 3050B, 7471B, 9010C/9012B/9014,	Confirm/investigate groundwater
GW-4	Groundwater	groundwater interface (set at 15 ft-bg; 4 ft below	and Dissolved Metals), 1,4-	3060A//196 and 1633 / MDL less than Class GA Standards for Part 375	conditions in shallow aquifer and the potential for					
GW-5		and 6 ft above)	Dioxane, and PFAS from all samples	analytes; MDL less than 0.28 µg/L for 1,4-dioxane;	impacts (if present) to migrate off-site					
GW-6			1	MDL less than 2 nanograms per liter (ng/L) for PFAS						
GW-7										

<u>Soil Vapor</u>

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale						
SV-1											
SV-2											
SV-3											
SV-4											
SV-5						Assess soil vapor					
SV-6		Approximately development depth (4		EPA TO-15 /	conditions on-site and the potential for						
SV-7	Soil Vapor	ft-bg) on-site and at the estimated depth of	TO-15 VOCs	MDL less than 1.00	impacts (if present) to migrate off-site in the						
SV-8		the lowest slab for off- site properties		µg/m ³	direction of surrounding						
SV-9					properties.						
SV-10											
SV-11											
SV-12											
SV-13											

Sample Location	Media	Sampling Intervals	Analytical Parameters	Sampling Method / Minimum Reporting Levels	Rationale
IA-1	Indoor Air			EPA TO-15 /	Assess indoor air
IA-2	IIIdool All	Breathing height (3-5	TO-15	MDL less	conditions off-site
AA-1	Ambient Air	ft above ground)		than 1.00 $\mu g/m^3$	Assess ambient air conditions on-site

Quality Assurance / Quality Control

Sample Location	Media	Sampling Intervals	Analytical Parameters	Rationale
Trip Blanks				
Soil Duplicate				
Soil Field Blank				
Soil MS/MSD	QA/QC		Part 3/5 Analytes and/or 1,4-Dioxane and PFAS, as	Quality Assurance and Quality Control
Groundwater			necessary	
Duplicate				
Groundwater				
Field Blank				
Groundwater				
MS/MSD				

MDL – Method Detection Limit

Reporting limits are laboratory- and sampling event-specific. The overall objective is to ensure that the minimum reporting levels are such that they can be used to evaluate potential sources, assess risk from detected compounds, and compare detected concentrations against applicable regulatory levels.

3.8 Qualitative Exposure Assessment

Following receipt of the sample results, a QHHEA will be completed in accordance with Section 3.3(c)4 and Appendix B (NYSDOH guidance for preparing a qualitative human health exposure assessment) of DER-10. The QHHEA will utilize the results of the RI to evaluate and document potential exposure routes and identify and characterize potential current and future receptors. The results of the RI will be used to identify potential human exposure scenarios associated with contaminants in soil, groundwater and soil vapor. The results of the QHHEA will be included in the RIR.

3.9 Health and Safety Plan (HASP)

All work at the Site will be completed in accordance with the Health and Safety Plan (HASP) included in Appendix C.

3.10 Air Monitoring

The NYSDOH Generic Community Air Monitoring Plan (CAMP), included as Appendix 1A of DER-10 and Appendix D of this Work Plan, will be implemented during all ground-intrusive activities.

Daily CAMP reports will be sent to the NYSDOH and NYSDEC Project Manager via email. Daily reports will include a Site figure depicting Work Zones; activities; wind direction, in addition to CAMP monitor readings and CAMP station locations. Any exceedances of CAMP readings and corrective actions taken will be communicated to the NYSDEC and the NYSDOH Project Managers on the day of occurrence.

3.11 Investigation-Derived Waste (IDW)

Following the completion of sampling, boreholes will be backfilled with clean cuttings or sand. If grossly contaminated soil cuttings are encountered or if excess soil cuttings are generated, they will be placed in 55-gallon drums. Purge water and other investigation-derived waste (IDW) will be containerized in 55-gallon drums. After the investigation is complete, the drum contents will be characterized for off-site disposal.

3.12 Reporting

A RIR will be prepared in accordance with the requirements of DER-10. The report will include details of the sampling, tabulated sample results and an assessment of the data and conclusions. If warranted, recommendations for additional actions will be included.

Soil sample results will be compared to the Unrestricted Use SCOs, Protection of Groundwater SCOs, and Restricted-Residential Use SCOs as included in Part 375-6.8. Groundwater sample results will be compared to the Class GA Standards. Soil vapor samples will be used in conjunction with soil and groundwater data to determine the need for additional investigation.

The report will also include the qualitative exposure assessment, CAMP results, laboratory data packages, DUSR, geologic logs, well construction diagrams and well purging/sampling logs. All data will also be submitted electronically to NYSDEC via the Environmental Information Management System (EIMS) in EqUIS format.

4.0 SCHEDULE

Project activities (Tasks 1-3) will be completed within approximately five weeks after demolition is completed. The following project schedule has been developed:

Work Plan Implementation Schedule

Task	Task	Estimated Task	Total Duration
Number		Duration	(business days)
		(business days)	
0	Work Plan Approval	0	0
1	Mobilization after Demolition	10	10
2	Monitoring Well and Soil Vapor Point Installation / Soil Sampling	5	15
3	Groundwater and Soil Vapor Sampling	2	17
4	Laboratory Analysis	15	32
5	Draft Report and Data Validation	30	62

5.0 **REFERENCES**

New York State Department of Health. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, October 2006 with revisions).

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

New York State Department of Environmental Conservation DEC Policy. Commissioner's Policy 51 – Soil Cleanup Guidance. October 21, 2010. NYSDEC 2010.

Phase I Environmental Site Assessment, 29-31 and 37-39 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., July 25, 2016.

Tier II: Soil Vapor Encroachment Screen, 29-31 and 37-39 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., August 30, 2016.

Indoor Air and Groundwater Survey, 29-31 North Main Street, Port Chester, NY, Advanced Cleanup Technologies, Inc., October 5, 2016.

Phase I Environmental Site Assessment, 25-27 North Main Street, Port Chester, NY, EBI Consulting, June 14, 2018.

Phase I Environmental Site Assessment, 33-35 North Main Street, Port Chester, NY, EBI Consulting, May 1, 2019.

Phase I Environmental Site Assessment, 41 North Main Street, Port Chester, NY, EBI Consulting, May 2, 2019.

Phase I Environmental Site Assessment, 43 North Main Street, Port Chester, NY, EBI Consulting, October 14, 2019.

Phase I Environmental Site Assessment, 27-45 North Main Street and 28 Adee Street, Port Chester, NY, Tenen Environmental, LLC, May 2022.

Limited Due Diligence Environmental Site Investigation, 27-45 North Main Street and 28 Adee Street, Port Chester, NY, Tenen Environmental, LLC, April 5, 2022.

Off-Site Environmental Investigation, 27-45 North Main Street and 28 Adee Street, Port Chester, NY, Tenen Environmental, LLC, November 8, 2022.

Figures







27-45 North Main Street and 28 Adee Street Port Chester, New York Section 142.31, Block 1, Lots 7 & 11-17

Legend

egen	d	Site					
•	LDDESI Soil Sample Location, Tenen 2022			Ļ			
	LDDESI Soil/Groundwater Sample Location, Tenen 2022			< - - Z -	I, LLC		
	LDDESI Soil Vapor Sample Location, Tenen 2022				onmenta	Street	0001 32 79
¢	Air and Groundwater Survey Groundwater Sample Location ACT 2016		ENEN		enen Envirc	21 West 27th 5 Suite 702	vew York, NY 1 D: (646) 606-23 F: (646) 606-23
	Air and Groundwater Survey Indoor Air Sample Location, ACT 2016		F		T	- 0.	
	Tier II Soil Vapor Encroachment Screen Soil Vapor Sample Location, ACT 2016		LM	AP		mber 2022	s Noted
	Off-Site Environmental Investigation Soil/Groundwater Sample Location, Tenen 2022	Drawn Bv		Checked By			Scale As
	Off-Site Environmental Investigation Soil Vapor Sample Location, Tenen 2022			ons			
	Site Boundary		-	ocatic			
*LD Env **A(Tecl	DESI=Limited Due Diligence ironmental Site Investigation CT=Advanced Cleanup hnologies, Inc. Feet 20 40 80	awina Title	Site Plan and	Previous Sample Lo	:		rigure z
		Dra			í	Lra	





Analyte	NY-UNRES	NY-RESRR
VOCs	PI	pm
Acetone	0.05	100
SVOCs	1	
Benzo(a)anthracene	1	1
Benzo(a)pyrene	1	1
Benzo(b)fluoranthene	1	1
Benzo(k)fluoranthene	0.8	3.9
Chrysene	1	3.9
Dibenzo(a,h)anthracene	0.33	0.33
Indeno(1,2,3-cd)pyrene	0.5	0.5
Total Metals	8	•
Copper	50	270
Lead	63	400
Mercury	0.18	0.81
Nickel	30	310
Pesticides		
Dieldrin	0.005	0.2

Notes:
1. Bold and shaded yellow value indicates concentration
exceeds NY-UNRES SCOs
2. Bold and shaded orange value indicates concentration
exceeds NY-RESRR SCOs
3. NY-UNRES = 6 NYCRR Part 375 Unrestricted Use Soil
Cleanup Objectives
4. NY-RESRR = 6 NYCRR Part 375 Restricted-Residential
Use Soil Cleanup Objectives
5. J = Estimated value
6. $ND = Not detected$
7. Only SB-4, SB-5, and SB-6 were analyzed for total metals
and pesticides
8. ppm=parts per million (mg/kg)
Legend
Legena







2. 0 Q 3. 4. 5.



Analyte	NY-AWQS
SVOCs	ppb
Benzo(a)anthracene	0.002
Benzo(a)pyrene	0
Benzo(b)fluoranthene	0.002
Benzo(k)fluoranthene	0.002
Chrysene	0.002
Indeno(1,2,3-cd)pyrene	0.002

Notes:

1. Bold and shaded yellow value indicates concentration exceeds NY-AWQS

2. NY-AWQS = NYSDEC Division of Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards (AWQS)

J = Estimated value

4. ND = Not detected

5. ppb = parts per billion (ug/l)

Legend

LDDESI Groundwater Sample • Location, Tenen 2022* Air and Groundwater Survey Groundwater Sample Location, ACT 2016** \oplus Site Boundary *LDDESI=Limited Due Diligence Environmental Site Investigation **ACT=Advanced Cleanup Technologies, Inc. Feet 40 80 0 20









27-45 North Main Street and

28 Adee Street

Port Chester, New York Section 142.31, Block 1, Lots 7 & 11-17







Appendix A Previous Reports (on cd)
Appendix B Quality Assurance Project Plan

Quality Assurance Project Plan

for

27-45 North Main Street Remedial Investigation Work Plan

27-45 North Main Street and 28 Adee Street Port Chester, NY Block 1, Lots 7, 11, 12, 13, 14, 15, 16, and 17 BCP Site # TBD

Submitted to: New York State Department of Environmental Conservation Division of Environmental Remediation Remedial Bureau B 625 Broadway, 12th Floor Albany, NY 12233-7016

Prepared for: Abendroth Green LLC c/o The Hudson Companies Incorporated 826 Broadway, 11th Floor New York, NY 10003

Prepared by: TENENVIRONMENTAL

121 West 27th Street, Suite 702 New York, NY 10001

December 2022

TABLE OF CONTENTS

1.0	INTRODUCTION
1.1	Project Scope and QAPP Objective
2.0	PROJECT ORGANIZATION
3.0	SAMPLING AND DECONTAMINATION PROCEDURES
3.1	Level of Effort for QC Samples
3.2	Sample Handling
3.3	Custody Procedures
3.4	Sample Storage
3.5	Sample Custody
3.6	Sample Tracking
3.7	Confirmation Soil Sampling MethodologyError! Bookmark not defined.
3.8	Analytical Methods/Quality Assurance Summary Table 11
3.9	Decontamination15
3.10	Data Review and Reporting

Appendices

Appendix A – Resumes Appendix B – EPA 537 Field Sampling Guidelines

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the Remedial Investigation Work Plan (RIWP) prepared for the 27-45 North Main Street property (the Site).

The Site consists of an approximately 48,101-square foot parcel located at 27-45 North Main Street and 28 Adee Street in the Village of Port Chester, New York. The Site is identified by Westchester County as Section 142.31, Tax Block 1, Lots 7, 11, 12, 13, 14, 15, 16 and 17. The Site is an irregularly shaped parcel with approximately 250 feet of frontage along North Main Street, approximately 300 feet of frontage along Abendroth Avenue, and approximately 100 feet of frontage along Adee Street. The Site is location is shown on Figure 1. A map of the current site layout is shown on Figure 2.

The Site is zoned C2, denoting a commercial district of Main Street Business. The Site lot is currently occupied by one- to three-story commercial or mixed-use residential and commercial buildings. Exterior portions of the Site are largely capped with asphalt. The remainder of the exterior portions of the Site are utilized for landscaping. Currently, the entirety of the Site is vacant. The most recent commercial businesses to operate at the Site include a realtor, restaurant, hardware store, ice cream shop, a jeweler, and non-profit organizations.

The ground level of the building on Lot 11 contains an active 1,500-gallon UST that contains #2 fuel oil. The UST is located in a subterranean vault. Lot 11 is identified on the Petroleum Bulk Storage (PBS) database as PBS #3-801942. The UST on Lot 11 is associated with an open spill (Spill No. 1708684) which was reported on December 15, 2017 due to equipment failure. The spill record indicates the UST was repaired and retested. No further information was provided and the spill case remains open.

1.1 **Project Scope and QAPP Objective**

The proposed scope of work includes the following:

- Advancement of borings for soil and soil vapor sampling on the Site;
- Installation of new groundwater monitoring wells; and,
- Collection of soil, groundwater, soil vapor and ambient air samples from soil borings, new permanent monitoring wells and temporary soil vapor points.

The objective of the QAPP is to detail the policies, organization, objectives, functional activities and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of the RIWP. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented for quality control (QC) purposes. Specifically, this QAPP addresses the following:

- The procedures to be used to collect, preserve, package, and transport samples;
- Field data collection and record keeping;
- Data management;

- Chain-of-custody procedures; and,
- Determination of precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort.

2.0 **PROJECT ORGANIZATION**

The personnel detailed are responsible for the implementation of the QAPP. Tenen Environmental, LLC (Tenen) will implement the RIWP on behalf of Abendroth Green LLC (the Requestor) once it has been approved by the New York State Department of Environmental Conservation (NYSDEC).

The Project Manager and Qualified Environmental Professional (QEP) will be Mrs. Alana Carroll, CPG, managing scientist at Tenen. Mrs. Carroll is a certified professional geologist with experience in all aspects of site assessment, development and implementation of remedial strategies. Her experience involves projects from inception through investigation, remediation and closure. Her expertise includes soil, soil vapor and groundwater remediation; remedial selection and design; field/health and safety oversight and preparation of work plans and reports to satisfy the requirements of various regulatory agencies. Mrs. Carroll received her BS in Geology from Hofstra University; her resume is included in Appendix A.

The Quality Assurance Officer will be Mohamed Ahmed, Ph.D., CPG, principal at Tenen. Dr. Ahmed is a certified professional geologist with over 20 years of experience in the New York City metropolitan area. He has designed and implemented subsurface investigations and is proficient in groundwater modeling, design of groundwater treatment systems, and soil remediation. He has managed numerous projects focused on compliance with the requirements of the New York State Brownfield Cleanup Program and spills programs and the New York City E-designation program. Dr. Ahmed also has extensive experience in conducting regulatory negotiations with the New York State Department of Environmental Conservation, the New York City Department of Environmental Protection, the NYC Office of Housing Preservation and Development, and the Mayor's Office of Environmental Remediation. Dr. Ahmed holds advanced degrees in geology and Earth and Environmental Sciences from Brooklyn College and the Graduate Center of the City University of New York; his resume is included in Appendix A.

In addition, Tenen will utilize subcontractors for drilling (AARCO Environmental Services of Lindenhurst, NY), laboratory services (Alpha Analytical of Westborough, MA) and data validation (L.A.B. Validation Corp. of East Northport, NY). The resume for the DUSR preparer, Ms. Lori Beyer, is included in Appendix A.

Contact Information Remedial Party (Abendroth Green LLC), Laszlo Syrop, 917.423.3643 Tenen Environmental, Mohammed Ahmed or Alana Carroll, 646.606.2332 An organization chart for the implementation of the IRM Work Plan and QAPP is below.



3.0 SAMPLING AND DECONTAMINATION PROCEDURES

A detailed description of the procedures to be used during this program for collection of the soil, soil vapor, ambient air and groundwater samples is provided below. Proposed sample locations are shown on Figure 6 of the RIWP. An Analytical Methods/Quality Assurance Summary is provided in Table 1, included in Section 3.12.

3.1 Level of Effort for QC Samples

Field blank, trip blank, field duplicate and matrix spike (MS) / matrix spike duplicate (MSD) samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. Each type of QC sample is discussed below.

- Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field-sampling program. Field (equipment) blank samples are analyzed to check for procedural chemical constituents that may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.
- Duplicate samples are analyzed to check for sampling and analytical reproducibility.
- MS/MSD samples provide information about the effect of the sample matrix on the digestion and measurement methodology.

The general level of QC effort will be one field duplicate and one field blank for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one site-specific MS/MSD for every 20 or fewer investigative samples of a given matrix. One trip blank will be included along with each sample delivery group of volatile organic compound (VOC) samples. One equipment blank will be collected at a frequency of one per day that PFAS samples are collected for a given matrix.

The analytical laboratory, Alpha Analytical, is certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) as Lab IDs 11148 and 11627. NYSDEC Analytical Services Protocol (ASP) Category B deliverables will be prepared by the laboratory.

3.2 Sample Handling

Samples will either be picked up by the laboratory, delivered to the laboratory in person by the sampler, or transported to the laboratory by overnight courier. All samples will be shipped to the laboratory to arrive within 48 hours after collection, and the laboratory will adhere to the analytical holding times for these analyses, as listed in the current version of the New York State ASP.

3.3 Custody Procedures

Sample custody will be controlled and maintained through the chain-of-custody procedures. The chain of custody is the means by which the possession and handling of samples is tracked from the site to the laboratory. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following sections (Sections 3.4 and 3.5) describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory.

3.4 Sample Storage

Samples will be stored in secure limited-access areas. Walk-in coolers or refrigerators will be maintained at $4^{\circ}C$, $+/-2^{\circ}C$, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location, if necessary.

3.5 Sample Custody

Sample custody is defined by this QAPP as the following:

- The sample is in someone's actual possession;
- The sample is in someone's view after being in his or her physical possession;
- The sample was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering; or,
- The sample is placed in a designated and secured area.

Samples will be removed from storage areas by the sample custodian or laboratory personnel and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure.

Laboratory documentation used to establish chain of custody and sample identification may include the following:

- Field chains of custody or other paperwork that arrives with the sample;
- Laboratory chain of custody;
- Sample labels or tags attached to each sample container;
- Sample custody seals;
- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books, filled out in legible handwriting, and signed and dated by the chemist;
- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist;
- Sample storage log (same as the laboratory chain of custody); and,

• Sample disposition log, which documents sample disposal by a contracted waste disposal company.

3.6 Sample Tracking

All samples will be maintained in the appropriate coolers prior to and after analysis. Laboratory analysts will remove and return their samples, as needed. Samples that require internal chain of custody procedures will be relinquished to the analysts by the sample custodians. The analyst and sample custodian will sign the original chain of custody relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original chain of custody to the sample custodian. Sample extracts will be relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department will track internal chain of custody through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the chain of custody (e.g., sample breakage or depletion).

3.7 Soil Sampling

Soil samples will be collected from acetate liners collected by a track-mounted Geoprobe[®] directpush probe drill rig. In general, select soil intervals will be screened between grade and the terminal depth of the boring. New, dedicated disposable acetate liners will be used for all soil samples collected using the Geoprobe. All casings will be decontaminated between borings, as described in Section 3.11.

The liner for each sample interval will be opened and the soil within scanned for volatile organic compounds (VOCs) using a photoionization detector (PID) calibrated with 100 ppm isobutylene gas and geologically described using the Unified Soil Classification System, including documentation of observations regarding potential contamination such as odors, staining, etc. All descriptions and observations will be documented in a field notebook.

At all soil boring locations, the collected soil volumes will be screened with a PID and visual (e.g., source areas – sumps, floor drains, stains, sheens, plebs, presence of NAPL, etc.) and olfactory observations will be recorded. If evidence of VOC impacts is detected and drilling conditions allow, the borehole will be extended until no impacts are detected. The full extent of the boring will be screened and samples will be collected based on the field observations and readings.

For each boring, a minimum of three soil samples will be collected the first shallow subsurface interval (0-2 ft-bg), the immediate interval of highest suspected contamination (if encountered), and the bottom deep interval (13-15 ft-bg). If no contamination is observed, intermediate samples will be collected from the two-foot interval directly above the groundwater interface (7-9 ft-bg). Samples will be collected at the intervals detailed above (e.g., based on screening, visual and olfactory indicators) to delineate the vertical and horizontal extent of site contaminants.

Soil samples to be analyzed will be collected directly from the acetate liners. All collected soil samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles or En Core samplers (En Novative Technologies, Inc.), cooled to 4°C in the field, and transported under chain-of-custody command to the designated laboratory for analysis.

All soil samples will be analyzed for the following analytes on the Part 375 list with a Category B deliverable package:

- Target Compound List (TCL) VOCs by EPA Method 8260C;
- TCL Semivolatile Organic Compounds (SVOCs) by EPA Method 8270C;
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082A;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- Target Analyte List (TAL) Metals by EPA Method 6010C / 7471B;
- Trivalent and Hexavalent Chromium by EPA Method 3060A;
- Total Cyanide by EPA Method 9010C;
- PFAS by USEPA Method 1633; and
- 1,4-Dioxane by USEPA Method 8270.

Emerging contaminants (e.g., PFAS and 1,4-Dioxane) will be sampled in accordance with the current NYSDEC guidance, *Sampling, Analysis, and Assessment of PFAS Under NYSDEC's Part 375 Remedial Programs* (November 2022).

3.8 Monitoring Well Installation and Development

Seven new groundwater well locations are proposed (GW-1 through GW-7). The wells will be installed and screened approximately six feet into the shallow aquifer, as determined based on field readings.

All monitoring wells will be installed using a track-mounted Geoprobe[®] direct-push probe drill rig. A pre-packed, two-inch, ten-foot PVC screen (0.020-inch slot) will be installed in all wells. A pre-packed, filter of sand (US Std. sieve sizes 30 to 8) will be installed in the annular space around the screen (minimum 2-inches around the circumference of the well) and will be extended one foot above the screen. The annular area around the well casing will be sealed with bentonite pellets for an interval of two feet above the filter pack in the shallow and deep wells. The annular space above the bentonite pellets to one foot below grade will be backfilled with drilling cuttings. The remaining one foot will be sealed with a concrete cap and well apron (expanding cement). A locking well cap will be installed upon completion of each well.

Following installation, at least three well volumes of the water column will be removed using a submersible pump. All permanent wells will be surveyed to a common site datum.

3.9 Groundwater Sampling

Prior to sample collection, static water levels will be measured and recorded from newly-installed monitoring wells to be sampled. Monitoring wells will also be gauged for the presence of non-aqueous phase liquid (NAPL). In the event that NAPL is detected, Tenen will record the thickness and will not collect a sample. If NAPL is not detected, Tenen will purge and sample monitoring wells using low-flow/minimal drawdown purge and sample collection procedures (peristaltic pump system). Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, temperature, turbidity, dissolved oxygen, specific conductance, oxidation-reduction potential and water level, as well as visual and olfactory field observations, will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity, dissolved oxygen and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU) or become stable above 50 NTU.

Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Field methods can impact the analysis of perfluoroalkyl acids (PFAS). A sampling guide is included in Appendix B.

Wells will be purged and sampled using dedicated high-density polyethylene (HDPE) pump tubing following low-flow/minimal drawdown purge and sample collection procedures, as described above. The pump will be decontaminated between samples.

Groundwater samples will be collected for analysis through dedicated HDPE tubing. Prior to, and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, dissolved oxygen, turbidity and depth-to-water, as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to the designated laboratory for analysis.

All groundwater samples will be analyzed for the following analytes on the Part 375 list and emerging contaminants with a Category B deliverable package:

- TCL VOCs by EPA Method 8260C;
- TCL SVOCs by EPA Method 8270C;
- Pesticides by EPA Method 8081B;
- Herbicides by EPA Method 8151A;
- PCBs by EPA Method 8082A;
- Total and Dissolved TAL Metals by EPA Method 6010C / 7471B;
- Total and Dissolved Trivalent and Hexavalent Chromium by EPA Method 3060A;
- Total and Dissolved Cyanide by EPA Method 9010C;
- 1,4-dioxane by EPA Method 8270D-SIM Modified; and

• PFAS by EPA Method 1633.

Emerging contaminants (e.g., PFAS and 1,4-Dioxane) will be sampled in accordance with the current NYSDEC guidance, *Sampling, Analysis, and Assessment of PFAS Under NYSDEC's Part 375 Remedial Programs* (October 2020).

3.10 Soil Vapor Installation and Sampling

Soil vapor samples will be collected in accordance with the NYSDOH *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (Soil Vapor Guidance, October 2006 with updates).

A total of nine soil vapor points, including seven on-site soil vapor points (SV-1 through SV-7) and two off-site soil vapor points (SV-8 and SV-9), are proposed. Seven soil vapor points (SV-1 through SV-7) will be installed on-site around the perimeter of the Site, in the location of the known UST and in the vicinity of previous sample locations to confirm the results. Two soil vapor points (SV-8 and SV-9) will be installed off-site at locations to fill data gaps during the previous off-site investigation to evaluate whether potential soil vapor impacts migrated off-site.

Soil vapor samples will be collected using disposable points at the terminal depth of the point. A track-mounted Geoprobe[®] direct-push probe drill rig will be used to install the soil vapor sampling probes to a terminal depth of 4 ft-bg on-site at the estimated lowest level of nearby structures offsite). Once the soil vapor sampling probe has been driven to the desired depth, it will be attached to disposable tubing and extended to the surface for sample collection.

The probe was then retracted approximately six inches to create a void. The borehole above the sampling probe to grade will backfilled with sand to fill the annual space and sealed using an inert sealant (hydrated bentonite) to prevent ambient air mixing with the soil vapor. Prior to sampling, ambient air will be purged from the boring hole by attaching the surface end of the ¹/₄-inch diameter Teflon® tube to an air valve and then to a vacuum pump. The vacuum pump will remove three volumes of air (volume of the sample probe and tube) prior to sample collection. The flow rate for both purging and sample collection will not exceed 0.2 liter per minute (L/min).

Purged vapors from the probes will be first screened for organic vapors using a PID calibrated with 100 ppm isobutylene gas. A tracer gas will be used in accordance with NYSDOH protocols to verify the integrity of the soil vapor probe seal and check for short-circuiting by ambient air. Helium will be used as the tracer gas and a bucket will serve to keep it in contact with the probe during testing. A portable helium detector will be used to analyze a sample of soil vapor for the tracer prior to sampling. If the tracer sample results show a significant presence of the tracer, the probe seals will be adjusted to prevent infiltration.

After purging, the probes will be connected via dedicated tubing and soil vapor samples will be collected in laboratory-supplied, batch-certified clean 2.7-liter SUMMA[®] canisters using eight-hour flow controllers. Sampling will occur for a duration of approximately eight hours. Once sampling is completed, the canisters will be resealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. All soil vapor samples will be

analyzed for VOCs by EPA Method TO-15.

A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, vacuum of canisters before and after the samples are collected, apparent moisture content of the sampling zone and chain of custody.

3.11 Ambient Air Sampling Methodology

All samples will be collected in accordance with the NYSDOH Soil Vapor Guidance. Some sample locations may be adjusted based on field observations or conditions.

The ambient air samples will be collected from breathing height (three to five feet above the floor) from a secure, upwind location. The sampling flow rate will not exceed 0.2 L/min. Sampling will occur for a duration of approximately eight hours. A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of soil vapor extracted, vacuum of canisters before and after the samples are collected, apparent moisture content of the sampling zone, and chain of custody protocols.

One ambient air sample will be collected in laboratory-supplied, batch-certified clean 2.7-liter Summa canisters using eight-hour flow controllers and will be resealed, labeled, and placed in a secure container for delivery to a NYSDOH ELAP-certified analytical laboratory. The ambient air sample will be collected concurrently during soil vapor sample collection and will be analyzed for VOCs by EPA Method TO-15.

3.12 Analytical Methods/Quality Assurance Summary Table

A summary of the analytical methods and quality assurance methods are included in Table 1, below.

27-45 North Main Street – Port Chester, NY BCP Site # TBD

Tenen Environmental, LLC Quality Assurance Project Plan

Matrix	Proposed	QA/QC Samples			Total #	Analytical	Mathad	Duesersting	Holding	Containan	
Matrix	Samples	TB	FB	DUP	MS/MSD	Samples	Parameter	Method	Preservative	Times	Container
	30	2	2	2	2 / 2	40	VOCs	8260C	Cool to 4°C, No Headspace		(3) Encore samplers;(1) 2-oz plastic bottle
Soil	30	0	2	2	2 / 2	38	SVOCs	8270D		14 days	
	30	0	2	2	2 / 2	38	Pesticides / Herbicides	8081B			
	30	0	2	2	2 / 2	38	PCBs	8082A			
	30	0	2	2	2 / 2	38	TAL Metals (plus Cyanide and Chromium)	8151A, 7196A, 3050B, 7471B, 9010C/9012B/ 9014, 3060A/7196	Cool to 4°C	28 days for mercury; 30 days to extraction for hexavalent chromium (plus 7 days for analysis); 6 months for all others	(1) 4-oz amber glass bottle
	30	0	2	2	2 / 2	38	1,4- Dioxane	8270		14 days	
	30	0	2	2	2 / 2	38	PFAS	1633		28 days	(1) 8-oz Polypropyl- ene bottle

 Table 1

 Analytical Methods/Quality Assurance Summary

Tenen Environmental, LLC Quality Assurance Project Plan

Matuin	Proposed	QA/QC Samples				Total #	Analytical	Mathad	Duranting	Holding	Containan	
Matrix	Samples	TB	FB	DUP	MS/MSD	Samples	Parameter	Wiethod	Preservative	Times	Container	
	7	1	1	1	1 / 1	12	VOCs	8260C	8260C Cool to 4°C, HCL		(3) 40 mL amber glass vials	
	7	0	1	1	1 / 1	11	SVOCs	8270D		14 days	(2) 1 L amber glass bottle	
	7	0	1	1	1 / 1	11	11 Pesticides / 8081B Herbicides		Cool to 4°C	7 days to extraction (plus 40 days for analysis)	(2) 1 L amber glass	
	7	0	1	1	1 / 1	11	PCBs	8082A			bottle	
Groundwater	7	0	1	1	1 / 1	11	Total TAL Metals (plus Cyanide and Chromium)	200.7, 200.8, 245.2, 6010C, 6020A, 7470A, 7472, 9010C/9012B/ 9014, 7196A	Cool to 4°C, HNO3		(2) Plastic 500 mL bottles, HNO ₃ preserved	
	7	0	1	1	1 / 1	11	Dissolved TAL Metals (plus Cyanide and Chromium)	200.7, 200.8, 245.2, 6010C, 6020A, 7470A, 7472, 9010C/9012B/ 9014, 7196A	Cool to 4°C	24 hours for hexavalent chromium, 14 days for all others	(1) 500 mL plastic bottle	
	7	0	1	1	1 / 1	11	1,4- Dioxane	8270D-SIM Modified			(2) 500 mL amber glass bottle	
	7	0	1	1	1 / 1	11	PFAS	1633	Cool to 4°C		(2) 250 mL plastic bottle	

Tenen Environmental, LLC Quality Assurance Project Plan

Matrix	Proposed	QA/QC Samples			Total #	Analytical	Mathad	Duccomuctive	Holding	Containar	
	Samples	TB	FB	DUP	MS/MSD	Samples	Parameter	wiethod	rieservative	Times	Container
Soil Vapor	9					9	Noc	TO 15	Nana	20 days	(1) 2.7-L Summa
Ambient Air	1	No QA/QC samples				1	voCs	10-15	Inone	50 days	(1) 2.7-L Summa

TB – Trip Blank

FB – Field Blank

DUP – Duplicate

°C – degrees Celsius

mL – milliliter

L – liter

3.13 Decontamination

Where possible, samples will be collected using new, dedicated sampling equipment so that decontamination is not required. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g., Alconox) and/or a steam cleaner. All non-dedicated sampling equipment will also have a final rinse with deionized water. Decontamination water will be collected and disposed as investigation-derived waste (IDW).

3.14 Data Review and Reporting

The NYSDEC ASP Category B data package will be validated by an independent data validation subconsultant and a DUSR summarizing the results of the data validation process will be prepared. All reported analytical results will be qualified as necessary by the data validation and will be reviewed and compared against background concentrations and/or applicable New York State criteria:

Soil – Unrestricted Use, Protection of Groundwater, and Restricted-Residential Use Soil Cleanup Objectives (SCOs) as listed in 6NYCRR Part 375;

Groundwater – Class GA groundwater standards and guidance values for groundwater as listed in NYSDEC Technical and Operations Guidance Series (TOGS) 1.1.1; and,

Soil Vapor – NYSDOH Matrices and ambient air sample concentrations.

All confirmation soil sample analytical results will be documented in the Final Engineering Report (FER) and will describe Site conditions and document applicable observations made during the sample collection. In addition, the FER will include a description of the sampling procedures, tabulated sample results and an assessment of the data and conclusions. The laboratory data packages, DUSR, and field notes will be included in the FER as appendices. All data will also be submitted electronically to NYSDEC via the Environmental Information Management System (EIMS) in EqUIS format.

Appendix A Resumes

Alana M. Carroll, PG Senior Project Manager

PROFESSIONAL PROFILE

Ms. Alana Carroll is a professional geologist with experience managing a variety of environmental consulting projects in the New York metropolitan area and specializing in remedial investigations, conceptual site modeling, and remedial design and implementation. She provides analytical, technical, and regulatory guidance to clients, including developers and environmental attorneys, on a variety of projects in various stages of investigation, remediation, and redevelopment. Ms. Carroll has managed projects from inception through investigation, remediation, and closure in the New York State Brownfield Cleanup Program, the New York State Department of Environmental Conservation (NYSDEC) Spills and Voluntary Cleanup Programs, the New York State Superfund Program, and the New York City E-Designation Program.

CREDENTIALS AND PROFESSIONAL HONORS

New York State Licensed Professional Geologist #000979 Adjunct Professor, Manhattan College, School of Engineering M.A., Earth and Environmental Sciences, Brooklyn College, New York B.S., Geology, Hofstra University, Uniondale, New York

CONTINUING EDUCATION AND TRAINING

OSHA 10-Hour Construction Training (2015) Hazardous Waste Operations and Emergency Response 40-Hour Certification (2004; refreshers 2005, 2006, 2007, 2009, 2010, 2011, 2012, 2013, 2014, and 2015) First Aid and CPR Certified (2012) Amtrak Contractor Safety Training (2010 and 2011)

PROFESSIONAL AFFILIATIONS

Member of Geologic Society of America Member of New Partners for Community Revitalization

Relevant Experience

New York State Brownfield Cleanup Program, Former West 18th Street MGP Site, Block 690, Lots 20 and 29, West Chelsea, Manhattan, New York—Successfully guided the client into the Brownfield Cleanup Program at the remediation stage. Prepared detailed remedial cost estimates for several redevelopment scenarios. Assisted in negotiating cleanup costs on behalf of the developer with the entity responsible for onsite contamination from former manufactured gas plant (MGP) operations. Designed and managed a pre-design investigation that delineated onsite coal tar impacts and differentiated petroleum impacts. Served on a team that designed an *in situ* stabilization treatability study. Prepared the Remedial Action Work Plan and Alternatives Analysis that included the excavation and removal of coal tar source material within two MGP gas holders and the encapsulation of residual coal tar. Performed an essential role on the construction and design team, coordinating with the structural, foundation, mechanical, and architectural contractors. *New York State Brownfield Cleanup Program, 520 West 28th Street, West Chelsea, Manhattan, New York*—Managed several investigations to address New York State Spills, New York City E-Designation, and New York State Brownfield Cleanup programs. Prepared scopes of work to address requirements of both State and City regulatory agencies. Served as an essential member of the construction and design team, coordinating with the structural, foundation, mechanical, and architectural contractors. Managed access with adjacent property owners for full-scale excavation. Coordinated with State and City agencies for the satisfaction of air, noise, and hazardous waste requirements. Coordinated and managed the characterization and disposal of over 35,000 tons of hazardous material and historic fill. Designed and managed the remedial action necessary to obtain a successful Track 1 Cleanup. Assisted in negotiating a nuanced approach to support excavation that allowed for a Track 1 Cleanup. Prepared the final engineering report that expedited the certificate of completion.

New York State Brownfield Cleanup Program, Teitelbaum Dry Cleaner, Long Island City, New York—Designed and managed multiple onsite and offsite investigations to address NYSDEC and New York State Department of Health (NYSDOH) regulatory requirements with respect to chlorinated solvent impacts to groundwater and soil vapor. Designed and managed chlorinated solvent plume delineation and remediation in both groundwater and soil vapor. Prepared a technical memorandum on the fate and transport of the onsite chlorinated solvent groundwater plume that established limited liability for downgradient impacts and identified a secondary source. Coordinated with multiple adjacent parties for access. Designed a remedial approach for the site building that included source removal, groundwater injection, and a retro-fitted subslab depressurization system (SSDS).

Confidential Project, Steuben County, NY—Performed a forensic review and analysis of environmental records associated with five parcels of land that the State deemed as illegal solid waste dumps. Prepared and presented two technical arguments to NYSDEC and NYSDOH detailing illegal dumping, historic fill material, human health exposure pathways, bioavailability of historic fill constituents and remedial alternatives. Designed a full-scale remedial investigation of soil, groundwater and sediments for five parcels of historically industrial land.

New York City Voluntary Cleanup Program, Gallery Row, West Chelsea, Manhattan, New York—Managed multiple investigations over five tax lots to address New York City E-Designation and Voluntary Cleanup Program requirements. Designed a remedial action that incorporates a phased and targeted excavation below Highline Park. Coordinated with State and City agencies for the satisfaction of air, noise, and hazardous waste requirements. Served as an integral part of the construction and design team.

New York State Brownfield Cleanup Program, Former Nu-Brite Dry Cleaner, 1299 First Avenue, East Side, Manhattan, New York—Designed and managed multiple investigations to address onsite chlorinated solvent impacts to soil, groundwater, and soil vapor. Site challenges included investigation and remedial action within existing, occupied building sites. Designed and managed a bedrock fracture investigation to address potential impacts to bedrock. Designed and managed offsite delineation of chlorinated solvent plume in soil vapor. Directed multiple offsite soil vapor investigations within adjacent properties; assisted in negotiating several nuanced access agreements. Managed an onsite interim remedial measure including the installation of a retro coat vapor barrier and retro-fitted SSDS within the site building.

New York State Brownfield Cleanup Program, 34th Street and 42nd Street, West Side, Manhattan, New York—Designed and managed multiple investigations to address New York State Spills and Brownfield Cleanup programs. Prepared scopes of work to address requirements of both state regulations and those agreed to by the former owner. Coordinated with NYSDEC to modify scopes based on field observations and limitations, which resulted in not having to mobilize for additional investigations. Coordinated with multiple entities for access to perform investigations, including Javits Convention Center, Amtrak, New York City Department of Transportation, Metropolitan Transit Authority, and their contractors. Developed a three-phase analysis plan with the laboratory to determine the minimum required extent of excavation next to an Amtrak line while limiting analytical costs, decreasing in the extent of excavation, and lowering disposal and structural support requirement costs.

New York State Brownfield Cleanup Program, 388 Bridge Street, Downtown Brooklyn, New York—Designed and managed all onsite and offsite investigations of soil, soil gas, groundwater, and indoor air, including coordination of staff and subcontractors. Prepared investigation reports for submittal to client, project team, NYSDEC, and NYSDOH. Participated in project team decision making with clients, lawyers, construction manager, and other consultants. Managed New York City Transit approvals for subsurface investigations near subway lines. Coordinated offsite access in residences, commercial spaces, and a private school. Participated in soil vapor extraction pilot test implementation and reporting. Assisted with implementation of an offsite SSDS in an existing building; activities included system design/layout, installation oversight, testing, and long-term operation and maintenance. Responsible for NYSDEC/NYSDOH coordination and reporting for all investigations. Tracked project activities for inclusion in NYSDEC/NYSDOH programmatic submittals, including monthly reports and remedial schedules.

New York Department of Environmental Remediation, Class 2 State Superfund, Laurel Hill Site, Queens, New York—Managed multiphase, multiparcel project involving design, installation, and ongoing operation, maintenance, and monitoring of six remedial caps. Site challenges included the division of the site into individual parcels that were independent of one another; subsequently, each parcel had a stormwater management design individual to the surrounding parcels. Other challenges included the site's position in a wetlands area fronting Newtown Creek, and working with the New York City Department of Transportation to facilitate its schedule for the adjacent Kosciusko Bridge restoration.

New York State Brownfield Cleanup Program, Willets Point Development, Queens, New York—Managed the Brownfield Cleanup Program application and Phase I environmental site assessment effort for 45 parcels of industrialized land. Coordinated with multiple interested parties, including New York City Department of Housing Preservation and Development and the Economic Development Corporation for access and contracting.

New York State Brownfield Cleanup Program, Uniforms for Industry, Queens, New York— Designed and managed an alternative approach to the offsite soil vapor intrusion investigation. Utilized soil vapor modeling to evaluate potential human health risks and migration probabilities. Provided support for the design of a retrofitted passive venting system.

New York State Spills Program, Gotham Center, Queens, New York—Responsible for proposal and budget development, subcontractor selection and coordination, negotiation, and preparation of subcontractor terms and agreements, budget, and invoice review for a comprehensive subsurface investigation. Prepared and implemented scope of work for delineation of soil contamination and calculation of contaminant mass estimates. Subsequent to interpretation of site data and subgrade characteristics, developed and presented remedial alternatives and associated costs for internal and client project teams. Prepared remedial investigation report in coordination with the New York City Economic Development Corporation and the client for submittal to state regulators.

Matthew Carroll, P.E. Environmental Engineer/Principal

Experience Summary

Matthew Carroll is an environmental engineer experienced in all aspects of site assessment and development and implementation of remedial strategies. He has managed projects from inception through investigation, remediation and closure. His expertise includes soil, soil gas, and groundwater remediation, preparation of cost estimates, remedial alternative selection and design, soil characterization for disposal, field safety oversight, and preparation of work plans and reports to satisfy New York and New Jersey state requirements, and New York City "e" designation and restrictive declarations. Mr. Carroll's project management experience includes past management of a New York City School Construction Authority hazardous materials contract. He is responsible for all engineering work performed by Tenen and is currently the project manager and remedial engineer for several New York State Brownfield Cleanup Program sites.

Selected Project Experience

470 Kent Avenue, Brooklyn

As project manager, supported the client in due diligence and transactional activities, including a Phase I ESA, preliminary site investigation, and remedial cost estimate; preparation of BCP application and remedial investigation work plan. The former manufactured gas plant, sugar refinery and lumberyard will be developed as a mixed-use project with market rate and affordable housing and public waterfront access. As remedial engineer, will be responsible for development of remedial alternatives and oversight and certification of all remedial activities.

500 Exterior Street, Bronx

Designed and implemented the investigation of this former lumberyard and auto repair shop that will be redeveloped as mixed use development with an affordable housing component; prepared BCP application and subsequent work plans and reports. Designed a remedial strategy incorporating both interim remedial measures (IRMs) and remediation during the development phase.

Gateway Elton I and II, Brooklyn

Conducted soil disposal characterization, prepared Remedial Action Work Plans and designed methane mitigation systems for two phases of a nine-building residential development and commercial space; prepared and oversaw implementation of a Stormwater Pollution Prevention Plan during construction and prepared and certified the remedial closure reports for the project.

Affordable Housing Development, Rye, NY

Consultant to the City of Rye on environmental issues pertaining to a county-owned development site slated for an afford senior housing; reviewed environmental documentation for the project and prepared summary memorandum for City Council review; recommended engineering controls to address potential exposure to petroleum constituents, presented report findings at public meetings and currently providing ongoing environmental support during project implementation.

Queens West Development BCP Site, Long Island City, New York

Assistant Project Manager for two developers involved in the site.

- Responsible for oversight of remediation under the New York State Brownfield Cleanup Program
- Technical review of work plans and reports and coordination of the Applicant's investigation and oversight efforts
- Provided input for mass calculations and well placement for an in-situ oxidation remedy implemented on a proposed development parcel and within a City street
- Conducted technical review of work pertaining to a former refinery. Documents reviewed included work plans for characterization and contaminant delineation; pilot test (chemical oxidation); remediation (excavation and groundwater treatment). Managed field personnel conducting full time oversight and prepared progress summaries for distribution to project team
- Following implementation of remedial action, implemented the Site Management Plan and installation/design of engineering controls (SSDS, vapor barrier/concrete slab, NAPL recovery). Also responsible for coordination with NYSDEC

Brownfield Cleanup Program Redevelopment Sites – West Side, New York City

Managed remediation of a development consisting of four parcels being addressed under one or more State and city regulatory programs (NYS Brownfield Cleanup Program, NYS Spills, and NYC "e" designation program). Remediation includes soil removal, screening and disposal; treatment of groundwater during construction dewatering and implementation of a worker health and safety plan and community air monitoring plan (HASP/CAMP)

Managed an additional BCP site, supported the Applicant in coordination with MTA to create station access for the planned No. 7 subway extension; also provided support the client in coordination with Amtrak to obtain access for remedial activities on the portion of the site that is within an Amtrak easement. The site will eventually be used for construction of a mixed-use high-rise building.

BCP Site, Downtown Brooklyn, New York

Performed investigation on off-site properties and designed an SSDS for an adjacent building, retrofitting the system within the constraints of the existing structure; coordinated the installation of the indoor HVAC controls and vapor barrier; provided input to the design of a SVE system to address soil vapor issues on the site.

West Chelsea Brownfield Cleanup Program Site

Designed an in-situ remediation program and sub-slab depressurization system to address contamination remaining under the High Line Viaduct; SSDS design included specification of sub-grade components, fan modeling and selection, identifying exhaust location within building constraints and performance modeling; prepared the Operations Maintenance and Monitoring Plan and Site Management Plan sections pertaining to the SSDS.

Historic Creosote Spill Remediation – Queens, New York – New York State Voluntary Cleanup Program

Modeled contamination volume and extent and prepared mass estimates of historic fill constituents and creosote-related contamination; designed a soil vapor extraction (SVE) and dewatering system to address historic creosote release both above and below static Matthew Carroll, Environmental Engineer/Principal Tenen Environmental

water table; coordinated with the Metropolitan Transit Authority and prepared drawings to secure approval to drill in the area of MTA subway tunnels.

NYSDEC Spill Site- Far West Side, Manhattan

Provided support to client during negotiations with a major oil company regarding allocation of remedial costs. Worked with client's attorney to develop a regulatory strategy to address the client's obligations under the NYSDEC Spills Program and the New York City "e" designation requirements.

Affordable Housing Site, Brooklyn, New York

Modified prior work plans for soil, soil vapor and groundwater investigation to address requirements for site entry into the New York City Brownfield Cleanup Program. Prepared technical basis for use of prior data previously disallowed by OER. Currently conducting site investigation.

New York City School Construction Authority Hazardous Materials Contract

Provided work scopes and cost estimates, managed and implemented concurrent projects, including Phase I site assessments, Phase II soil, groundwater and soil gas investigations, review of contractor bid documents, preparation of SEQR documents, specifications and field oversight for above- and underground storage tank removal, and emergency response and spill control.

Former Manufacturing Facility, Hoboken, New Jersey

Evaluated site investigation data to support a revision of the current property use to unrestricted; modified the John & Ettinger vapor intrusion model to apply the model to a site-specific, mixed use commercial/residential development; implemented a Remedial Action Work Plan that included the characterization, removal and separation of 9,500 cubic yards of historic fill; designed and implemented a groundwater characterization/delineation program using a real-time Triad approach; designed and implemented an innovative chemical oxidation technology for the property.

Former Varnish Manufacturer – Newark, New Jersey

Prepared a Phase I environmental site assessment; implemented soil and groundwater sampling to assess presence of petroleum and chlorinated compounds; prepared alternate cost remediation scenarios for settlement purposes and implemented a groundwater investigation plan, including pump tests and piezometer installation to assess the effect of subsurface utilities and unique drainage pathways upon contaminant transport.

Education and Certifications

Professional Engineer, New York Bachelor of Engineering, Environmental; Stevens Institute of Technology, 2002 Bachelor of Science, Chemistry, New York University, 2002 Technical and Regulatory Training in Underground Storage Tanks, Cook College, Rutgers University, 2006

Mohamed Ahmed, Ph.D., C.P.G. Sr. Geologist/Principal

Experience Summary

Mohamed Ahmed is a certified professional geologist with nearly 23 years of experience in the New York City metropolitan area. He has designed and implemented subsurface investigations and is proficient in groundwater modeling, design of groundwater treatment systems and soil remediation. He has managed numerous projects focused on compliance with the New York State Brownfield Cleanup and Spills programs and the New York City "e" designation program. Dr. Ahmed also has extensive experience in conducting regulatory negotiations with the New York State Department of Environmental Conservation, the NYC Office of Housing Preservation and Development, and the Mayor's Office of Environmental Remediation.

Selected Project Experience

Willoughby Square, Downtown Brooklyn

As Project Manager, directs all regulatory interaction and investigation on this joint publicprivate sector redevelopment that will include a public park and four-level underground parking garage. Prepared the remedial investigation work plan and remedial action work plan, conducted investigation activities and waste characterization, and negotiated with the NYC Department of Environmental Protection and the Mayor's Office of Environmental Remediation to transition the site into the NYC Voluntary Cleanup Program.

School Facility, Borough Park, Brooklyn

Managed all regulatory agency coordination, work plan and report preparation and remedial oversight; worked with OER to determine measures to retroactively address the hazardous materials and air quality E-designations on a previously constructed school building and prepared supporting documentation to justify the use of electrical units rather than natural gas.

LGA Hotel Site, East Elmhurst, Queens

Project manager for all work conducted at this former gasoline service station which is being remediated under the NYS Brownfield Cleanup Program; technical oversight of work plans, reports, and design and implementation of field and soil disposal characterization.

436 10th Avenue, Manhattan

As project manager and technical lead, assisted client in developing remedial cost estimates used for property transaction, developed regulatory strategy to address NYS Spills and NYC E-designation requirements, and currently overseeing remedial activities which include removal and disposal of petroleum-contaminated bedrock and dewatering and disposal of impacted groundwater.

Brownfield Cleanup Program Site, Downtown Brooklyn

Managed investigation and remediation under the BCP program for a proposed mixed-use development; designed the remedial investigation and prepared the remedial action work plan which includes an SVE system monitored natural attenuation. Prepared remedial cost

estimates for several scenarios. The project will include a 53-story mixed-use structure and parking garage.

Queens West Development, Long Island City

Directed project team and subcontractors for soil investigation/remediation studies on multiple properties; provided technical support for negotiations with NYSDEC during investigation and remediation.

Former Creosote Site, Long Island City

Designed and implemented a complex investigation to assess the nature and extent of historic creosote contamination at this former industrial site; conducted studies to optimize recovery of LNAPL and DNAPL and developed strategies using bioremediation and natural attenuation in conjunction with conventional remedial approaches. Performed pilot tests for soil vapor extraction system design and coordinated with NYSDEC and NYSDOH to implement sub-slab soil vapor sampling.

NYSDEC Spill Site – Far West Side, Manhattan

Developed a detailed remedial cost estimate for to support client negotiations with a major oil company. The estimate included costs pertaining to: chipping, removal and disposal of petroleum-impacted bedrock; removal/disposal of recycled concrete; costs for dewatering and disposal of impacted groundwater during construction; and design and installation of a vapor barrier below the redevelopment.

Active Industrial Facility, Newburgh, New York

Designed remedial investigation of soil and groundwater contaminated with trichloroethane; performed soil vapor pilot test and pump test to aid in design of soil and groundwater remediation alternatives; conducted sub-slab vapor sampling in accordance with NYSDOH guidance.

Former Dry Cleaning Facility, New York City

Conducted soil and groundwater investigations, designed and installed a soil vapor extraction system and performed extensive testing of indoor air. Negotiated the scope of the RI and IRM with NYSDEC.

Waterfront Redevelopment, Yonkers, NY

Designed and performed geophysics survey of six parcels to determine locations of subsurface features; supervised test pit excavation to confirm geophysics results and evaluate and classify soil conditions prior to development activities.

Prince's Point, Staten Island, New York

Performed soil, groundwater and sediment sampling to delineate the extent of contamination; used field-screening techniques to control analytical costs and supervised soil excavation and disposal.

Apartment Complex, New York City, New York

Coordinated with Con Edison, the owner of the adjacent property and NYSDEC to determine oil recovery protocol; assessed hydrogeological conditions and conducted pilot tests to design cost-effective recovery system; designed and supervised installation of recovery system.

Publications

"Impact of Toxic Waste Dumping on the Submarine Environment: A Case Study from the New York Bight". Northeastern Geology and Environmental Sciences, V. 21, No. 12, p. 102-120. (With G. Friedman)

Metals Fluxes Across the Water/Sediment Interface and the Influence of pH. Northeastern Geology and Environmental Sciences, in press. (With G. Friedman)

"Water and Organic Waste Near Dumping Ground in the New York Bight". International Journal of Coal Geology, volume 43. (With G. Friedman)

Education and Certifications

Ph.D., Earth and Environmental Sciences, Graduate Center of the City of New York (2001)M.Ph., Earth and Environmental Sciences, City University of New York (1998)M.A. Geology, Brooklyn College (1993)B.S. Geology, Alexandria University, Egypt (1982)

American Institute of Professional Geologists, Certified Professional Geologist, 1997-2015

L.A.B. Validation Corp., 14 West Point Drive, East Northport, New York 11731

Lori A. Beyer

SUMMARY:

General Manager/Laboratory Director with a solid technical background combined with Management experience in environmental testing industry. Outstanding organizational, leadership, communication and technical skills. Customer focused, quality oriented professional with consistently high marks in customer/employee satisfaction.

EXPERIENCE:

L,A,B, Validation Corporation, 14 West Point Drive, East Northport, NY 1998-Present

President

Perform Data Validation activities relating to laboratory generated Organic and Inorganic Environmental Data.

1998-Present American Analytical Laboratories, LLC. 56 Toledo Street, Farmingdale, NY

- Laboratory Director/Technical Director
 - Plan, direct and control the operation, development and implementation of programs for the entire laboratory in order to meet AAL's financial and operational performance standards.
 - Ensures that all operations are in compliance with AAL's QA manual and other appropriate regulatory requirements.
 - Actively maintains a safe and healthy working environmental that is demanded by local laws/regulations.
 - Monitors and manages group's performance with respect to data quality, on time delivery, safety, analyst development/goal achievement and any other key performance indices.
 - Reviews work for accuracy and completeness prior to release of results to customers.

1996-1998 Nytest Environmental, Inc. (NEI) Port Washington, New York

General Manager

- Responsible for controlling the operation of an 18,000 square foot facility to meet NEI's financial and operational performance . standards.
- Management of 65 FTEs including Sales and Operations
- Ensure that all operations are in compliance with NEI's QA procedures
- Ensures that productivity indicators, staffing levels and other cost factors are held within established guidelines
- Maintains a quantified model of laboratory's capacity and uses this model as the basis for controlling the flow of work into and through the lab so as to ensure that customer requirements and lab's revenue and contribution targets are achieved.

1994-1996 Nytest Environmental, Inc. (NEI) Port Washington, New York

- Technical Project Manager
 - Responsible for the coordination and implementation of environmental lesting programs requirements between NEI and their customers
 - Supervise Customer Service Department
 - Assist in the development of major proposals
 - Complete management of all Federal and State Contracts and assigned commercial contracts
 - Provide technical assistance to the customer, including data validation and Interpretation
 - Review and Implement Project specific QAPP's.

Nytest Environmental, Inc. (NEI) Port Washington, New York 1995-1996

Corporate QA/QC Officer

- Responsible for the implementation of QA practices as required in the NJDEP and EPA Contracts .
- Primary contact for NJDEP QA/QC issues including SOP preparation, review and approval
- Responsible for review, verification and adherence to the Contract requirements and NEI QA Plan

1992-1994 Nytest Environmental, Inc. (NEI) Port Washington, New York

- Data Review Manager
 - Responsible for the accurate compilation, review and delivery of analytical data to the company's customers. Directly and effectively supervised a department of 22 personnel.
 - Managed activities of the data processing software including method development, form creation, and production
 - Implement new protocol requirements for report and data management formats
 - Maintained control of data storage/archival areas as EPA/CLP document control officer

1987-1991

Nytest Environmental, Inc. (NEI) Port Washington, New York

Data Review Specialist

- Responsible for the review of GC, GC/MS, Metals and Wei Chemistry data in accordance with regulatory requirements
- Proficient with USEPA, NYSDEC, NJDEP and NEESA requirements
- Review data generated in accordance with SW846, NYSDEC ASP, EPA/CLP and 40 CFR Methodologies

1986-1987 Nytest Environmental, Inc (NEI) Port Washington, New York **GC/MS VOA Analyst**

EDUCATION:

1982-1985 State University of New York at Stony Brook, New York; BS Biology/Biochemistry

- 1981-1982 University of Delaware; Biology/Chemistry
- Rutgers University; Mass Spectral Data Interpretation Course, GC/MS Training 5/91
- 8/92 Westchester Community Colloge; Organic Data Validation Course
- Westchester Community College; Inorganic Data Validation Course 9/93

	Westchester Community College Professional Development Center	Awards this Certificate of Achievement To	LORI BEYER	for Successfully Completing	ORGANIC DATA VALIDATION COURSE (35 HOURS)	Date AUGUST 1992	President President	The Professional SUNY WESTCHESTER COMMUNITY COLLEGE Valuation New York 1055
--	---	---	------------	-----------------------------	---	------------------	------------------------	---

Westchester Community College Professional Development Center	Awards this Certificate of Achievement To	LORI BEYER	for Successfully Completing	INORGANIC DATA VALIDATION	Instructor: Dale Boshart	Date MARCH 1993	Professional Development Center	SUNY Signal SUNY WATCHEETER COMMUNITY COLLEGE	
								The Professional Development Cer	

New York State Department of Environmental Conservation 50 Wolf Road, Albany, New York 12233



Thomas C. Jorling Commissioner

July 8, 1992

Ms. Elaine Sall Program Coordinator Westchester Community College Valhalla, NY 10595-1698

Dear Elaine,

Thank you for your letter of June 29, 1992. I have reviewed the course outline for organic data validation, qualifications for teachers and qualifications for students. The course that you propose to offer would be deemed equivalent to that which is offered by EPA. The individuals who successfully complete the course and pass the final written exam would be acceptable to perform the task of organic data validation for the Department of Environmental Conservation, Division of Hazardous Waste Remediation.

As we have discussed in our conversation of July 7, 1992, you will forward to me prior to the August course deadline, the differences between the EPA SOW/90 and the NYSDEC ASP 12/91. You stated these differences will be compiled by Mr. John Samulian.

I strongly encourage you to offer an inorganic data validation course. I anticipate the same list of candidates would be interested in an inorganic validation course as well, since most of the data to be validated consists of both organic and inorganic data.

Thank you for you efforts and please contact me if I can be of any further assistance.

Sincerely,

Mauren P. Seratin

Maureen P. Serafini Environmental Chemist II Division of Hazardous Waste Remediation

914 285-6619



The Professional Development Center

October 2, 1992

Ms. Lori Beyer 3 sparkill Drive East Northport, NY 11731

Dear Ms. Beyer:

Congratulations upon successful completion of the Organic Data Validation course held August 17 - 21, 1992, through Westchester Community College, Professional Development Center. This course has been deemed by New York State Department of Environmental Conservation as equivalent to EPA's Organic Data Validation Course.

Enclosed is your Certificate. Holders of this Certificate are deemed competent to perform organic data validation for the New York State DEC Division of Hazardous Waste Remediation.

The Professional Development Center at Westchester Community College plans to continue to offer courses and seminars which will be valuable to environmental engineers, chemists and related personnel. Current plans include a TCLP seminar on November 17th and a conference on Environmental Monitoring Regulations on November 18th.

We look forward to seeing you again soon at another environmental program or event. Again, congratulations.

Very truly yours,

Passing Grade is 70% Your Grade is 99%

Elaine Sall Program Coordinator

ES/bf

٦.

914 285-6619



The Professional **Development Center** AT WESTCHESTER COMMUNITY COLLEGE

June 21, 1993

Dear Ms. Beyer:

Enclosed is your graded final examination in the Inorganic Data Validation course you completed this past March. A score of 70% was required in order to receive a certificate of satisfactory completion. Persons holding this certificate are deemed acceptable to perform Inorganic Data Validation for the New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation.

I am also enclosing a course evaluation for you to complete if you have not already done so. The information you provide will greatly aid us in structuring further courses. We wish to make these course offerings as relevant, targeted and comprehensive as possible. Your evaluation is vital to that end.

Congratulations on your achievement. I look forward to seeing you again at another professional conference or course. We will be co-sponsoring an environmental monitoring conference on October 21, 1993 with the New York Water Pollution Control Association, Lower Hudson Chapter, at IBM's Yorktown Heights, NY site. Information regarding this event will be going out in August.

Very truly yours,

Elaine Sall **Program Coordinator**

ES/bf

Enclosures



SUNY WESTCHESTER COMMUNITY COLLEGE Valhalla, New York 10595

Appendix B EPA 537 Field Sampling Guidelines

Method 1633 Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS

References: Method 1633 - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS (2nd Draft - June 2022)

DOD QSM (US Department of Defense Quality Systems Manual for Environmental Laboratories, version 5.4, 20221)

1. Scope and Application

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

Definitions: Refer to Alpha Analytical Quality Manual.

- **1.1** Method 1633 is for use in the Clean Water Act (CWA) for the determination of the per- and polyfluoroalkyl substances (PFAS) in Table 1 in aqueous, solid (soil, biosolids, sediment) and tissue samples by liquid chromatography/mass spectrometry (LC-MS/MS).
- **1.2** The method calibrates and quantifies PFAS analytes using isotopically labeled standards. Where linear and branched isomers are present in the sample and either qualitative or quantitative standards containing branched and linear isomers are commercially available, the PFAS analyte is reported as a single analyte consisting of the sum of the linear and branched isomer concentrations
- **1.3** This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl substances (PFAS) in Non-Drinking Water, tissue soil and biosolid Matrices. Accuracy and precision data have been generated for the compounds listed in Table 1.
- **1.4** The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.
- **1.5** This method is restricted to use by or under the supervision of analysts experienced in the operation of the LC/MS/MS and in the interpretation of LC/MS/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

2. Summary of Method

2.1 Environmental samples are prepared and extracted using method-specific procedures. Sample extracts are subjected to cleanup procedures designed to remove interferences. Analyses of the sample extracts are conducted by LC-MS/MS in the multiple reaction monitoring (MRM) mode. Sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction.
- **2.2** Aqueous samples are spiked with isotopically labeled standards, extracted using solid-phase extraction (SPE) cartridges and undergo cleanup using carbon before analysis.
- 2.3 Solid samples are spiked with isotopically labeled standards, extracted into basic methanol, and cleaned up by carbon and SPE cartridges before analysis
- 2.4 Tissue samples are spiked with isotopically labeled standards, extracted in potassium hydroxide and acetonitrile followed by basic methanol, and cleaned up by carbon and SPE cartridges before analysis.
- **2.5** A sample extract is injected into an LC equipped with a C18 column that is interfaced to an MS/MS). The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

2.6 Method Modifications from Reference

N/A

Reporting Limits 3.

The reporting limit for PFAS's are listed in Table 8.

Interferences 4.

- **4.1** PFAS standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAS analyte and EIS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.
- 4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/2 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.1. Subtracting blank values from sample results is not permitted.
- **4.3** Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of humic content of the sample.

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA **4.4** SPE cartridges can be a source of interferences. The analysis of field and laboratory reagent blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

5. Health and Safety

- **5.1** The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.
- **5.2** All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.
- **5.3** PFOA has been described as "likely to be carcinogenic to humans." Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection for Aqueous Samples

- **6.1.1** Samples must be collected in two (2) 500-mL or 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap. All sample containers must have linerless HDPE or polypropylene caps.
- **6.1.2** The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.
- **6.1.3** Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.
- **6.1.4** Fill sample bottles. Samples do not need to be collected headspace free.
- **6.1.5** After collecting the sample and cap the bottle. Keep the sample sealed from time of collection until extraction.
- **6.1.6** Maintain all aqueous samples protected from light at 0 6 °C from the time of collection until shipped to the laboratory. Samples must be shipped as soon as practical with sufficient ice to maintain the sample temperature below 6 °C during transport and be received by the laboratory within 48 hours of collection. The laboratory must confirm that the sample temperature is 0 6 °C upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 °C until sample preparation.

6.2 Sample Collection for Soil and Sediment samples.

- **6.2.1** Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided. Samples should fill no more than ³/₄ full.
- **6.2.2** Maintain solid samples protected from light (in HDPE containers) at 0 6 °C from the time of collection until receipt at the laboratory. The laboratory must confirm that the sample temperature is 0 6 °C upon receipt. Once received by the laboratory, the samples must be stored at \leq -20 °C until sample preparation.

6.3 Sample Collection for fish and other tissue samples

- 6.3.1 Once received by the laboratory, the samples must be maintained protected from light at ≤ -20 °C until prepared. Store unused samples in HDPE containers or wrapped in aluminum foil at ≤ -20 °C.
- **6.3.2** The nature of the tissues of interest may vary by project. Field sampling plans and protocols should explicitly state the samples to be collected and if any processing will be conducted in the field (e.g., filleting of whole fish or removal of organs). All field procedures must involve materials and equipment that have been shown to be free of PFAS.

6.4 Sample Preservation

Not applicable.

6.5 Sample Shipping

Samples must be chilled during shipment and must not exceed 0 - 6 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 0 - 6 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction but should not be frozen.

NOTE: Samples that are significantly above 0 - 6 ° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

6.6 Sample Handling

- **6.6.1** Aqueous samples (including leachates) should be analyzed as soon as possible; however, samples may be held in the laboratory for up to 90 days from collection, when stored at ≤ -20 °C and protected from the light. When stored at 0 6 °C and protected from the light, aqueous samples may be held for up to 28 days, with the caveat that issues were observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfonamidoacetic acids after 7 days. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.
- **6.6.2** Solid samples (soils and sediments) and tissue samples may be held for up to 90 days, if stored by the laboratory in the dark at either 0 6 °C or ≤ -20 °C, with the caveat that samples may need to be extracted as soon as possible if NFDHA is an important analyte.

6.6.3 Biosolids samples may be held for up to 90 days, if stored by the laboratory in the dark at 0 - 6 °C or at -20 °C. Because microbiological activity in biosolids samples at 0 - 6 °C may lead to production of gases which may cause the sample to be expelled from the container when it is opened, as well as producing noxious odors, EPA recommends that samples be frozen if they need to be stored for more than a few days before extraction. Store sample extracts in the dark at less than 0 - 4 °C until analyzed. If stored in the dark at less than 0 - 4 °C, sample extracts may be stored for up to 90 days, with the caveat that issues were observed for some ether sulfonates after 28 days. These issues may elevate the observed concentrations of the ether sulfonates in the extract over time. Samples may need to be extracted as soon as possible if NFDHA is an important analyte.

7. Equipment and Supplies

- **7.1** SAMPLE CONTAINERS 500-mL or 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.
- **7.2** SAMPLE JARS 8-ounce wide mouth high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.
- **7.3** POLYPROPYLENE BOTTLES 4-mL narrow-mouth polypropylene bottles.
- **7.4** CENTRIFUGE TUBES 50-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts.
- **7.5** AUTOSAMPLER VIALS Polypropylene 0.7-mL autosampler vials with polypropylene caps.
 - **7.5.1** NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.
- **7.6** POLYPROPYLENE GRADUATED CYLINDERS Suggested sizes include 25, 50, 100 and 1000-mL cylinders.
- **7.7** Auto Pipets Suggested sizes include 5, 10, 25, 50, 100, 250, 500, 1000, 5000 and 10,000μls.
- **7.8** PLASTIC PIPETS Polypropylene or polyethylene disposable pipets.
- **7.9** Silanized glass wool (Sigma-Aldrich, Cat # 20411 or equivalent) store in a clean glass jar and rinsed with methanol (2 times) prior to use.
- 7.10 Disposable syringe filter, 25-mm, 0.2-µm Nylon membrane, PALL/Acrodisc or equivalent
- **7.11** Variable volume pipettes with disposable HDPE or polypropylene tips (10 µL to 5 mL) used for preparation of calibration standards and spiked samples.
- **7.12** ANALYTICAL BALANCE Capable of weighing to the nearest 0.0001 g.
- **7.13** ANALYTICAL BALANCE Capable of weighing to the nearest 0.1 g.
- 7.14 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

- **7.14.1** SPE CARTRIDGES (Waters Oasis WAX 150 mg, Cat # 186002493 or equivalent). The SPE sorbent must have a pKa above 8 so that it remains positively charged during the extraction.
 - **7.14.1.1** Note: SPE cartridges with different bed volume (e.g., 500 mg) may be used; however, the laboratory must demonstrate that the bed volume does not negatively affect analyte absorption and elution, by performing the initial demonstration of capability analyses described in Section.
- **7.14.2** VACUUM EXTRACTION MANIFOLD A manual vacuum manifold with large volume sampler for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the MB.
- **7.14.3** SAMPLE DELIVERY SYSTEM Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8" O.D. x 1/16" I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB and LCS QC requirements.
- **7.15** EXTRACT CONCENTRATION SYSTEM Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 55 °C.
- **7.16** LABORATORY OR ASPIRATOR VACUUM SYSTEM Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.
- **7.17** LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM
 - **7.17.1** LC SYSTEM Instrument capable of reproducibly injecting up to 10-μL aliquots and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.4 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase bottle (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.
 - **7.17.2** LC/TANDEM MASS SPECTROMETER The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.4 mL/min. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision.
 - **7.17.3** DATA SYSTEM An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA

abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

- 7.17.4 INSTRUMENT COLUMNS
 - **7.17.4.1** ANALYTICAL: C18 column, 1.7 μm, 50 x 2.1 mm (Waters Acquity UPLC® BEH or equivalent)
 - **7.17.4.2** OPTIONAL GUARD COLUMN: (Phenomenex Kinetex® Evo C18 or equivalent)

8. Reagents and Standards

- **8.1** GASES, REAGENTS, AND SOLVENTS Reagent grade or better chemicals must be used.
 - **8.1.1** REAGENT WATER Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/2 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.
 - **8.1.2** METHANOL (CH₃OH, CAS#: 67-56-1) High purity, demonstrated to be free of analytes and interferences.
 - **8.1.3** AMMONIUM ACETATE (NH₄C₂H₃O₂, CAS#: 631-61-8) High purity, demonstrated to be free of analytes and interferences.
 - **8.1.4** ACETIC ACID (H₃CCOOH, CAS#: 64-19-7) High purity, demonstrated to be free of analytes and interferences.
 - **8.1.5** 1M AMMONIUM ACETATE/REAGENT WATER High purity, demonstrated to be free of analytes and interferences.
 - **8.1.6** 2mM AMMONIUM ACETATE/METHANOL:WATER (5:95) To prepare, mix 2 ml of 1M AMMONIUM ACETATE,1 ml ACETIC ACID and 50 ml METHANOL into I Liter of REAGENT WATER.
 - 8.1.7 ACETONITRILE UPLC grade or equivalent, store at room temperature
 - **8.1.8** TOLUENE HPLC grade or equivalent.
 - **8.1.9** ACETONE pesticide grade or equivalent
 - 8.1.10 AMMONIUM ACETATE (Caledon Ultra LC/MS grade or equivalent
 - **8.1.11** AMMONIUM HYDROXIDE (NH₃, CAS#: 1336-21-6) High purity, demonstrated to be free of analytes and interferences.

- **8.1.12** METHANOLIC AMMONIUM HYDROXIDE (0.3%) add ammonium hydroxide (1 mL, 30%) to methanol (99 mL), store at room temperature, replace after 1 month
- **8.1.13** METHANOLIC AMMONIUM HYDROXIDE (1%) add ammonium hydroxide (3.3 mL, 30%) to methanol (97 mL), store at room temperature, replace after 1 month
- **8.1.14** METHANOLIC AMMONIUM HYDROXIDE (2%) add ammonium hydroxide (6.6 mL, 30%) to methanol (93.4 mL), store at room temperature, replace after 1 month
- **8.1.15** METHANOLIC POTASSIUM HYDROXIDE (0.05 M) add 3.3 g of potassium hydroxide to 1 L of methanol, store at room temperature, replace after 3 months
- **8.1.16** METHANOL WITH 4% WATER, 1% AMMONIUM HYDROXIDE AND 0.625% ACETIC ACID add ammonium hydroxide (3.3 mL, 30%), reagent water (1.7 mL) and acetic acid (0.625 mL) to methanol (92 mL), store at room temperature, replace after 1 month. This solution is used to prepare the instrument blank and calibration standards (Section 8.3.2).
- **8.1.17** FORMIC ACID (greater than 96% purity or equivalent).
- **8.1.18** FORMIC ACID (aqueous, 0.1 M) dissolve formic acid (4.6 g) in reagent water (1 L), store at room temperature, replace after 2 years
- **8.1.19** FORMIC ACID (aqueous, 0.3 M) dissolve formic acid (13.8 g) in reagent water (1 L), store at room temperature, replace after 2 years
- **8.1.20** FORMIC ACID (aqueous, 5% v/v) mix 5 mL formic acid with 95 mL reagent water, store at room temperature, replace after 2 years
- **8.1.21** FORMIC ACID (methanolic 1:1, 0.1 M formic acid/methanol) mix equal volumes of methanol and 0.1 M formic acid, store at room temperature, replace after 2 years
- **8.1.22** FORMIC ACID (aqueous, 50% v/v) mix 50 mL formic acid with 50 mL reagent water, store at room temperature, replace after 2 years
- 8.1.23 POTASSIUM HYDROXIDE certified ACS or equivalent
- 8.1.24 CARBON - EnviCarb® 1-M-USP or equivalent, verified by lot number before use, store at room temperature. Loose carbon allows for better adsorption of interferent organics. Note: The single-laboratory validation laboratory achieved better performance with loose carbon than carbon cartridges. Loose carbon will be used for the multi-laboratory validation to set statistically based method criteria.
- 8.1.25 NITROGEN Used for the following purposes: Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument

manufacturer's specifications. In addition, Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).

- **8.1.26** ARGON Used as collision gas in some MS/MS instruments. Argon should meet or exceed instrument manufacturer's specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.
- **8.2** REFERENCE MATRICES Matrices in which PFAS and interfering compounds are not detected by this method. These matrices are to be used to prepare the batch QC samples.
 - 8.2.1 Reagent water purified water, Type I
 - 8.2.2 Solid reference matrix Ottawa Sand or equivalent
 - **8.2.3** Tissue Reference matrix Cod loin or other animal tissue demonstrated to be PFAS free
- **8.3** STANDARD SOLUTIONS When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers and are stored at ≤4 °C. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.
 - **8.3.1** Stock standards and diluted stock standards are stored at ≤4 °C. Prepare a spiking solution, containing the method analytes listed in Table 1, in methanol from prime stocks. The solution is used to prepare the calibration standards and to spike the known reference QC samples that are analyzed with every batch. Quantitative standards containing a mixture of branched and linear isomers must be used for method analytes if they are commercially available. Currently, these include PFOS, PFHxS, NEtFOSAA, and NMeFOSAA.
 - **8.3.2** Calibration standard solutions A series of calibration solutions containing the target analytes and the Labeled extracted internal standards (EIS) and non-extracted internal standards (NIS) is used to establish the initial calibration of the analytical instrument. Table 4 represents the concentrations of the native, EIS and NIS analytes of the calibration curve. Calibration standard solutions are made using the solution described in section 8.1.16.
 - **8.3.3** ISOTOPE DILUTION EXTRACTED INTERNAL STANDARD (EIS) Isotopically labelled analogs of the target analytes to be used for the quantification of target analytes. EIS stock standard solutions are purchased in glass ampoules and are stored in accordance with the manufacturer's recommendations. The EIS stock solution to be used for the fortification of samples and QC in accordance with the isotope dilution procedure. Table 2 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.
 - **8.3.4** ISOTOPE DILUTION NON-EXTRACTED INTERNAL STANDARDS (NIS) Isotopically labelled analogs to be added post extraction for the measurement of EIS extraction efficiency and is added to the final volume of all extractions. Table 3 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.

9. Quality Control

9.1 Method Blank

9.1.1 A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents and standards. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination, and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

9.2 Laboratory Control Sample (LCS)

- **9.2.1** Low Level LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LLCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at 2X the LOQ. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:
- **9.2.2** An LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at the midpoint of the calibration curve. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:

Where:

- A = measured concentration in the fortified sample B =fortification concentration.
 - 9.1.1 Where applicable, in the absence of additional sample volume required to perform matrix specific QC, LCSD's are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS The RSD's must fall within ≤30% of the true value for medium and high-level replicates, and ≤50% for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation:

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA $RPD = \frac{|LCS - LCSD|}{(LCS + LCSD) / 2} \times 100$

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

9.3 Non-extracted Internal Standard Area (NIS)

Each time an initial calibration is performed, use the data from all the initial calibration standards used to meet the linearity test in Section 10.3.3.3 to calculate the mean area response for each of the NIS compounds, using the equation below.

Mean Area_{NISi} = $\sum AREA_{NISi} / n$

where:

AreaNISi = Area counts for the ith NIS, where i ranges from 1 to 7, for the seven NIS compounds listed in Table 1

n = The number of ICAL standards (the default value is n = 6). If a different number of standards is used for the ICAL, for example, to increase the calibration range or by dropping a point at either end of the range to meet the linearity criterion, change 6 to match the actual number of standards used)

Record the mean areas for each NIS for use in evaluating results for sample analyses. There is no acceptance criterion associated with the mean NIS area data.

9.4 Extracted Internal Standards (EIS)

9.4.1 The EIS standard is fortified into all samples, CCVs, MBs, LCSs, MSs, MSDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The EIS is a means of assessing method performance from extraction to final chromatographic measurement. Calculate the recovery (%R) for the EIS using the following equation:

%R = (A / B) x 100

Where:

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

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA biases in the recovery of the EIS must be documented in the sample report. If the associated target analytes do not meet the acceptance criteria, the data must be reanalyzed.

9.5 Matrix Spike (MS/MSD)

- **9.5.1** Analysis of an MS is prepared one per preparation batch (if required).
- **9.5.2** Aliquots of field samples that have been fortified with a known concentration of target compounds, prior to sample preparation and extraction, and analyzed to measure the effect of matrix interferences. The use of MS/MSD samples is generally not required in isotope dilution methods because the labeled compounds added to every sample provide more performance data than spiking a single sample in each preparation batch. Aliquots of field samples
- **9.5.3** Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 50-150%. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCS, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.6 Laboratory Duplicate

- **9.6.1** FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or MSD) Within each extraction batch (not to exceed 20 Field Samples), a minimum of one FD or MSD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an MSD should be analyzed rather than an FD.
- **9.6.2** Calculate the relative percent difference (*RPD*) for duplicate measurements (*FD1* and *FD2*) using the equation:

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

- **9.6.3** RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the RL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCV, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.
- **9.6.4** If an MSD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation:

$$RPD = |MS - MSD| \times 100$$

$$(MS + MSD) / 2$$

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA **9.6.5** RPDs for duplicate MSs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when MSs are fortified at analyte concentrations that are within a factor of 2 of the RL. MSs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCSD where applicable, the result is judged to be matrix biased. If no LCSD is present, the associated MS and MSD are to be re-analyzed to determine if any analytical has occurred. If the resulting RPDs are still outside control limits, the result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.7 Bile Salt Interference Check

9.7.1 The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the

9.8 Initial Calibration Verification (ICV)

9.8.1 After each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ± 30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedure to locate and correct the problem.

9.9 Instrument Sensitivity Check (ISC)

9.9.1 At the start of each 12-hour shift, analyze a standard at the LOQ. The signal-tonoise ratio of the ISC standard must be greater than or equal to 3:1. If the requirements cannot be met, the problem must be corrected before analyses can proceed

9.10 Continuing Calibration Verification (CCV)

- **9.10.1** CCV Standards must be analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch.
- **9.10.2** The recovery of native and isotopically labeled compounds for the CVs must be within 70 130%

9.10.3

9.11 Method-specific Quality Control Samples

9.11.1 Instrument Blank – During the analysis of a batch of samples, a solvent blank is analyzed after samples containing high level of target compounds (e.g., calibration, CV) to monitor carryover from the previous injection. The injection blank consists of the solution in

Section 8.1.16 fortified with the EIS and NIS for quantitation purposes.

9.12 Example Method Sequence

- INSTRUMENT BLANK
- INSTRUMENT SENSITIVITY CHECK
- CALIBRATION VERIFICATION STANDARD
- QUALITATIVE IDENTIFICATION STANDARDS
- TDCA STANDARD (only if analyzing tissues)
- INSTRUMENT BLANK
- METHOD BLANK
- LOW-LEVEL LCS/OPR
- OPR/LCS
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK

10. Procedure

10.1 Equipment Set-up

- **10.1.1** This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the MBs should be rotated among the ports to ensure that all the valves and tubing meet the MB requirements.
- **10.1.2** Some of the PFAS's adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected.
- **10.1.3** The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

- **10.1.4** All SPE apparatus, including manifolds, tubing and sample ports must be thoroughly rinsed following each use with 1% methanolic ammonium hydroxide, followed by Methanol and then DI water. Additionally, sample manifold ports and transfer tubing should be inspected regularly for signs of wear and/or discoloration. When such observations are made, the associated components should be replaced.
- **10.1.5** Prior to the start of any extraction, sample site information must be evaluated for any potentially high level PFAS concentrations or sample matrix irregularities that may impact the extraction process. If such samples are identified, aqueous samples may be pre-screened via direct aqueous injection prior to analysis to estimate the potential PFAS concentrations present.
- 10.1.6 To perform a direct aqueous injection (DAI) screen, the sample should be inverted several times to try and evenly disperse any organic matter present. A 1 ml aliquot (or less depending on the matrix) is to be taken from the parent sample, volume adjusted to 1 ml with reagent water if less than 1ml, fortified with EIS and NIS spiking solutions to match the concentrations of an extracted sample (typically 5 µl per 1 ml DAI), and then analyzed under the same analytical conditions as field samples.

10.2 Sample Preparation of Aqueous Samples

- **10.2.1** Samples are preserved, collected, and stored as presented in Section 6.
- **10.2.2** Determine sample volume. Weigh all samples to the nearest 1g. If visible sediment is present, centrifuge and decant into a new HDPE bottle and record the weight of the new container.

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

- **10.2.3** The MB, LCS and FRB may be prepared by measuring reagent water with a polypropylene graduated cylinder or filling an HDPE sample bottle to near the top.
- **10.2.4** Check that the pH is 6.5 ± 0.5 . If necessary, adjust pH with 50% formic acid or ammonium hydroxide and 3% aqueous ammonium hydroxide. The extract is now ready for solid-phase extraction (SPE) and cleanup.
- **10.2.5** Add 20 µL of the EIS to each sample and QC, cap and invert to mix.
- **10.2.6** If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.

10.3 Sample Prep and Extraction Protocol for Soils, Solids and Sediments.

- **10.3.1** Homogenize and weigh 5 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 5 grams of clean sand is used.
 - **10.3.1.1** For Biosolids and other complex matrices, a small aliquot may be required due to co-extracted matrix interferences.

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

- **10.3.1.2** For batch QC samples using 5 g of reference solid, add 2.5 g of reagent water. The addition of reagent water to the sand provides a matrix closer in composition to real-world samples.
- 10.3.2 Add 20 µL of the EIS to each sample and QC.
- **10.3.3** If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.
- **10.3.4** Vortex the samples to evenly disperse the spiking solutions and allow to equilibrate for 30 minutes.
- **10.3.5** To all samples, add 10 ml of 0.3% methanolic ammonium hydroxide, cap, vortex for 25 seconds.
- **10.3.6** Following mixing, shake each sample for 30 minutes on a shaker table.
- **10.3.7** Centrifuge each sample at 2800RPM for 10 minutes.
- **10.3.8** Remove the supernatant and transfer to a clean 50 ml polypropylene centrifuge tube.
- **10.3.9** Repeat steps 10.3.4 to 10.3.7, with 15 ml of 0.3% methanolic ammonium hydroxide, combining the supernatants.
- **10.3.10** Add 5ml of 0.3% methanolic ammonium hydroxide to the sample, vortex for 25 seconds and centrifuge each sample at 2800RPM for 10 minutes.
- **10.3.11** Remove the supernatant and transfer to the same 50 ml polypropylene centrifuge tube containing eluates from the previous cycles.
- **10.3.12** Add 10 mg of carbon to the combined extract, mix by occasional hand shaking for no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50 ml polypropylene centrifuge tube.
- **10.3.13** Dilute to approximately 35 mL with reagent water. Samples containing more than 50% water may yield extracts that are greater than 35 mL in volume; therefore, do not add water to these. Determine the water content in the sample as follows (percent moisture is determined from the % solids):

Water Content in Sample = (Sample Weight * Percent moisture) / 100

10.3.14 Concentrate each extract at approximately 55 °C with a gentle N2 flow to a final volume that is based on the water content of the sample (see table below). Allow extracts to concentrate for 10 minutes, then mix (by vortex if the volume is < 20. Continue concentrating and mixing every 5 minutes until the extract has been reduced to the required volume as specified in the table below. If the extract volume appears to stop dropping, the concentration must be stopped and the volume at which it was stopped recorded.

Water Content in Sample	Concentrated Final Volume
< 5 grams	15 ml
5-8 grams	15-20 ml
8-9 grams	20-22.5 ml
9-10 grams	22.5-25 ml

10.3.15 Add 40 - 50 mL of reagent water to the extract and vortex. Check that the pH is 6.5 ±0.5 and adjust as necessary with 50% formic acid or 30% ammonium

hydroxide, or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.4 Sample Prep and Extraction Protocol for Tissues.

- **10.4.1** Homogenize and weigh 2 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 2 grams of clean tissue is used.
- **10.4.2** Add 20 µL of the EIS PDS to each sample and QC.
- **10.4.3** If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS. Cap and invert each sample to mix.
- **10.4.4** Add 10 mL of 0.05M KOH in methanol to each sample. Vortex to disperse the tissue then place tubes on a mixing table to extract for at 16 hours. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant in a 50-mL polypropylene centrifuge tube.
- **10.4.5** Add 10 mL of acetonitrile to remaining tissue in the 50-mL centrifuge tube, vortex to mix and disperse the tissue. Sonicate for 30 minutes. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the initial extract.
- **10.4.6** Add 5 mL of 0.05M KOH in methanol to the remaining sample in each centrifuge tube. Vortex to disperse the tissue and hand mix briefly. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the first two extracts.
- **10.4.7** Add 10 mg of carbon to the combined extract, mix by occasional hand shaking over a period of no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50-mL centrifuge tube.
- **10.4.8** Add 1 mL of reagent water to each tube and concentrate each extract at approximately 55 °C with a gentle N2 flow to a final volume of 2.5 ml.
- **10.4.9** Add reagent water to each evaporation/concentrator tube to dilute the extracts to 50 mL. Check that the $pH = 6.5 \pm 0.5$ and adjust as needed with 50% formic acid, or ammonium hydroxide or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.5 SPE Extract: All matrices

- **10.5.1** Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.
- **10.5.2** Pre-condition the cartridges by washing them with 3 X 5 mL of 1% methanolic ammonium hydroxide, discarding the wash volumes.
- **10.5.3** Rinse the cartridge with 5 mL of 0.3M formic acid, allowing the cartridge to drain using gravity only, discarding the rinse volume. Do not allow the cartridge to go dry
- **10.5.4** Adjust the vacuum so that the approximate flow rate is ~5 mL/min and load the sample across the cartridge. Do not allow the cartridge to go dry before all the sample has passed through.
- **10.5.5** Once all the sample has passed across the cartridge, rinse the walls of the reservoir with 2 X 5 mL reagent water, loading the rinse across the cartridge.

- 10.5.6 Rinse the walls of the reservoir with 5 mL of 1:1 0.1M formic acid/methanol and pass the rinse through the cartridge using vacuum. Dry the cartridge by pulling air through for 15 seconds.
- **10.5.7** Rinse the inside of the sample bottle with 5 mL of 1% methanolic ammonium hydroxide. Use vacuum to pull the elution solvent through the cartridge and into the collection tubes. When the cartridge bed and glass wool are submerged, stop the cartridge flow by closing the valve, keeping the sorbent bed and wool submerged.
- **10.5.8** Let the wetted sorbent bed and wool soak for 1 minute.
- **10.5.9** Open the cartridge valve and collect the eluate into a 15 ml polypropylene collection tube.
- 10.5.10 Add 25 µL of concentrated acetic acid to each sample eluted in the collection tubes and vortex to mix.
- **10.5.11** Add 10 mg of carbon to each sample and batch QC extract, using a 10-mg scoop. Handshake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon. Immediately vortex (30 seconds) and centrifuge at 2800 rpm for 10 minutes.
- **10.5.12** Add NIS solution to a clean collection tube. Place a syringe filter (25-mm filter, 0.2-µm nylon membrane) on a 5-mL polypropylene syringe. Take the plunger out and carefully decant the sample supernatant into the syringe barrel. Replace the plunger and filter the entire extract into the new collection tube containing the NIS.
- **10.5.13** Vortex to mix and transfer a portion of the extract into a .7-mL polypropylene LC vial for LC-MS/MS analysis. Cap the collection tube containing the remaining extract and store at 4 °C

10.6 Sample Volume Determination

- **10.6.1** If using weight to determine volume, weigh the empty bottle to the nearest 1 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight. Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration.
- **10.7 Initial Calibration -** Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCV is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.
 - 10.7.1 ESI-MS/MS TUNE
 - 10.7.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.
 - 10.7.1.2 Optimize the [M-H]- or [M-CO₂]- for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined.

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

The method analytes may have different optima requiring some compromise between the optima.

The Mass spec conditions found in Table 7 show the Sciex Triple Quad 5500+ operation conditions used in this method.

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

The conditions found on table 5 are representative of expected tune optimizations for each analyte. If conditions other the ones close to the values provided in table 5 are achieved, the process should be reperformed and/or instrument maintenance performed to resolve the problem.

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

Table 6 represents the operation conditions of a Sciex Exion LC system when running this method.

- 10.7.3 Inject 2µl of a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ([M-H]-) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation.
- **10.7.4** Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

- **10.7.5** Prepare a set of CAL standards as outlined in table 5. The lowest concentration CAL standard must be at or below the LOQ.
- **10.7.6** The LC/MS/MS system is calibrated using the isotope dilution technique. Target analytes are quantitated against their isotopically labeled analog (Extracted Internal Standard) where commercially available. If a labeled analog is not

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

commercially available, the extracted internal standard with the closest retention time and /or closest chemical similarity is to be used. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve must always be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.

- 10.7.7 CALIBRATION ACCEPTANCE CRITERIA A linear fit is acceptable if the calculated RSD or RSE for each target analyte is ≤20%. If linear or Quadratic regressions are used, coefficient of determination (r²) values must be greater than 0.99. When quantitated using the initial calibration curve, each calibration point at or above the LOQ for each analyte must calculate to be within 70-130% of its true value. The calculate value of each EIS analyte must be within 50-150% of its true value. If these criteria cannot be met, corrective action is taken to reanalyze the CAL standards, restrict the range of calibration.
- **10.7.8** Bile salts interference check The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the retention window for PFOS by at least one minute), and the initial calibration repeated.
- **10.8 CONTINUING CALIBRATION CHECK (CCV)** Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a "sample" is considered to be a Field Sample. MBs, CCVs, LCSs, MSs, FDs FRBs and MSDs are not counted as samples. The beginning CCV of each analysis batch must be at or below the RL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet these criteria. Subsequent CCVs should alternate between a medium and Low concentration CAL standard.
 - **10.8.1** Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.
 - **10.8.2** Calculate the concentration of each analyte and EIS in the CCV. The calculated amount for each native and EIS analyte for medium level CCVs must be within ± 30% of the true. If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. If the CCV fails because the calculated concentration is greater than 130% for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

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

10.9 EXTRACT ANALYSIS

- **10.9.1** The same operating conditions used for the initial calibration and summarized in Tables 6 and 7 are to be used.
- **10.9.2** Prior to analysis of sample extracts, the Instrument mass calibration verification must be performed using standards whose mass range brackets the masses of interest and performed in the negative ion mode. The mass calibration is verified if the calculated mass is within ± .2 daltons of the specified mass.
- **10.9.3** Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.
- **10.9.4** Calibrate the system by either the analysis of a calibration curve or by confirming the initial calibration is still valid by analyzing a CCV.
- **10.9.5** Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots under the same conditions used to analyze the CAL standards.
- **10.9.6** For concentrations at or above the method LOQ, the total (branched and linear isomer) quantification ion response to the total (branched and linear isomer) confirmation ion response ratio must fall within ± 50% of the ratio observed in the midpoint initial calibration standard.
- **10.9.7** At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard.
- **10.9.8** The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to ensure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.3
- **10.9.9** In instances where re-extraction is not an option, dilute a subsample of the sample extract with 0.1% acetic acid by a factor no greater than 10x adjust the amount of the NIS in the diluted extract, and analyze the diluted extract. If the

responses for each EIS in the diluted extract meet the S/N and retention time, and the EIS recoveries from the analysis of the diluted extract are greater than 5%, then the compounds associated with those EISs may be quantified using isotope dilution. Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit. If the adjusted EIS recoveries are below 5%, the dilution is assumed invalid. If the adjusted EIS recoveries are greater than 5%, adjust the compound concentrations, detection limits, and minimum levels to account for the dilution.

11. Data Evaluation, Calculations and Reporting

- **11.1** Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 9.
- **11.2** Calculate analyte concentrations using the multipoint calibration established in Section 10.9. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.8

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

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

 C_{ex} = The concentration of the analyte in the extract

CF = calibration factor from calibration.

- **11.3** Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.
- **11.4** PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to the linear and branch isomers of these compounds (Sect. 10.10.4.). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.
- **11.5** Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

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

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

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. **12.2** All results for the organic compounds of interest are reportable without qualification if extraction and analytical holding times are met, preservation requirements (including cooler temperatures) are met, all QC criteria are met, and matrix interference is not suspected during extraction or analysis of the samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-extraction and/or re-analysis.

13. Method Performance

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

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

13.2 Demonstration of Capability Studies

- **13.2.1** Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.
- **13.2.2** The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

- **14.1** Refer to Alpha's Chemical Hygiene Plan and Hazardous Waste Management and Disposal SOP for further pollution prevention and waste management information.
- **14.2** This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.
- **14.3** The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

15. Referenced Documents

Chemical Hygiene Plan – ID 2124

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

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

16. Attachments

Table 1: Names, Abbreviations, and CAS Registry Numbers for Target PFAS,Extracted Internal Standards and Non-extracted Internal Standards

Parameter	Acronym	CAS						
PER- and POLYFLUOROALKYLETHER CARBOXYLIC ACIDS (PFECAs)								
Tetrafluoro-2-(heptafluoropropoxy)propanoic 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						
PERFLUOROALKYLCARBOXILIC ACIDS (PFCAs)								

 Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

 Document Type: SOP-Technical
 Pre-Qualtrax Document ID: NA

Alpha Analytical, Inc.ID No.:45852Facility: Mansfield, MARevision 3Department: Emerging ContaminantsPublished Date: 9/29/2022 11:21:03 AMTitle: Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue by LCMSMSPage 25 of 35

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
Perfluoorotetradecanoic acid	PFTeDA	376-06-7

PERFLUOROALKYL SULFONIC ACIDS (PFASs)

Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1

Perfluorodecanesulfonic acid	PFDS	335-77-3					
Perfluorododecanesulfonic acid	PFDoS	79780-39-5					
CHLORO-PERFLU	OROALKYLSULFONAT	ΓE					
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11CI-PF3OUdS	763051-92-9					
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7					
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9CI-PF3ONS	756426-58-1					
FLUOROTELOMER CARBOXYLIC ACIDS							
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5					
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-49-3					
Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4					
PERFLUOROOC	TANESULFONAMIDES						
Perfluorooctanesulfonamide	PFOSA	754-91-6					
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8					
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2					
PERFLUOROCTANE SULFONAMIDE ETHANOLS							
N-Methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7					
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2					
TELOMER SULFONIC ACIDS							

1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2)	4:2FTS	757124-72-4							
1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2)	6:2FTS	27619-97-2							
1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2)	8:2FTS	39108-34-4							
PERFLUOROOCTANESULFONAMIDOACETIC ACIDS									
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9							
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6							
PERFLUOROETHER AND POLYETHER CARBOXYLIC ACIDS									
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1							
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5							
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7							

Table 2: Stock and Nominal Extracted Internal Standard Concentrations

NFDHA

Nonafluoro-3,6-dioxaheptanoic acid

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M4PFBA	2000	40
M5PFPeA	1000	20
M5PFHxA	500	10
M4PFHpA	500	10
M8PFOA	500	10
M9PFNA	250	5
M6PFDA	250	5
M7PFUdA	250	5
MPFDoA	250	5
M2PFTeDA	250	5
M3PFBS	466	9.32
M3PFHxS	474	9.48
M8PFOS	479	9.58
M2-4:2FTS	938	18.8

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online. Document Type: SOP-Technical Pre-Qualtrax Document ID: NA

151772-58-6

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M2-6:2FTS	951	19
M2-8:2FTS	960	19.2
M8FOSA	500	10
d3-N-MeFOSA	500	10
d5-N-EtFOSA	500	10
d3-N-MeFOSAA	1000	20
d5-N-EtFOSAA	1000	20
d7-N-MeFOSE	5000	100
d9-N-EtFOSE	5000	100
M3HFPO-DA	2000	40

Table 3: Stock and Nominal Non-Extracted Internal Standard Concentrations

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M3PFBA	1000	40
M2PFHxA	500	10
M4PFOA	500	10
M5PFNA	250	5
M2PFDA	250	5
18O2PFHxS	474	9.48
M4PFOS	479	9.58

Table 4: Initial Calibration levels and Concentrations

Analyte	Cal A	Cal B (LOQ)	CAL C	Cal D	Cal E (CCV)	Cal F	Cal G	Cal H	Cal I
PFBA	.4	.8	2	5	10	20	50	250	500
PFPeA	.2	.4	1	2.5	5	10	25	125	250
PFHxA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFHpA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFOA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFNA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFUnA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDoA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTrDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFBS	0.089	0.177	0.444	1.11	2.22	4.44	11.1	55.4	111
PFPeS	0.094	0.188	0.471	1.18	2.35	4.71	11.8	58.8	118

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

Alpha Analytical, Inc.ID No.:45852Facility: Mansfield, MARevision 3Department: Emerging ContaminantsPublished Date: 9/29/2022 11:21:03 AMTitle: Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue by LCMSMSPage 29 of 35

PFHxS0.0910.1830.4871.142.294.5711.457.41141PFHpS0.0950.1910.4771.192.384.7711.959.6119PFOS0.0970.1920.4811.202.444.8112.160.3121PFDS0.0970.1930.4831.212.434.8312.160.3121PFDS0.0970.1940.4851.212.434.8512.160.3121PFDS0.0970.1930.4851.212.434.8512.160.3121PFDS0.3750.751.884.699.381.8846.92.344696:2FTS0.380.761.94.759.51.94.752.38475782FOSA1.12.21.51.252.51.256.25125125NMeFOSA1.12.21.51.252.51.256.25125125NMEFOSA1.12.21.51.252.51.256.25125125NMEFOSA1.12.21.51.252.51.256.25125125NMEFOSA1.12.21.51.252.51.251.251.25125125NMEFOSA1.12.21.51.251.51.251.251.251.251.251.25NEFOSA1.12.21.5<										
PFHpS0.0950.1910.4.771.192.384.771.1959.6119PFOS0.0930.1860.4641.162.324.641.1658116PFNS0.0960.1930.4831.202.414.831.216.03121PFDS0.0970.1940.4851.212.434.831.216.03121PFDS0.0970.1940.4851.212.434.841.246.031234.2FTS0.380.761.924.859.651.924.822.044.838:2FTS0.3840.761.924.89.661.924.822.051256.25125NMeFOSA1.12.25.51.255.51.256.25125125125125NMEFOSA1.12.25.51.255.51.256.25125125125125125NMEFOSA1.12.25.51.255.51.251.25125	PFHxS	0.091	0.183	0.457	1.14	2.29	4.57	11.4	57.1	114
PFOS0.0930.1860.4641.162.324.641.165.8116PFNS0.0960.1920.4811.202.414.811.260.1120PFDS0.0970.1940.4851.212.434.8512.160.3121PFDOS0.0970.1940.4851.212.434.8512.160.31214:2FTS0.3750.751.884.699.381.884.692.344856:2FTS0.3840.7681.924.859.651944752.384758.2FTS0.3840.7681.924.89.6619.24.88240480PFOSA.1.2.51.252.5512.562.5125NMeFOSA.1.2.51.252.5512.562.5125NMEFOSA.1.2.51.252.5512.562.5125NMEFOSA.1.2.51.25.512.562.5125NMEFOSA.1.2.51.25.512.562.5125NMEFOSA.1.2.51.25.512.562.5125NMEFOSA.1.2.51.25.512.562.5125NEIFOSE.1.2.51.25.512.5.512.5.512.5NEIFOSE.1.2 <td>PFHpS</td> <td>0.095</td> <td>0.191</td> <td>0.477</td> <td>1.19</td> <td>2.38</td> <td>4.77</td> <td>11.9</td> <td>59.6</td> <td>119</td>	PFHpS	0.095	0.191	0.477	1.19	2.38	4.77	11.9	59.6	119
PFNS0.0960.1920.4811.202.414.811.216.0.11.21PFDS0.0970.1930.4851.212.434.831.216.0.31.21PFDOS0.0970.1940.4851.212.434.8512.16.0.6121.42FTS0.3750.751.884.699.851.924.752.344.758:2FTS0.3840.7661.924.759.551.924.842.04.858:2FTS0.3840.7681.924.89.61.924.856.251.256.251.25NMeFOSA1.12.25.51.252.551.256.251.25NMeFOSA1.12.25.51.252.551.252.51.251.25NMeFOSA1.12.25.51.252.551.251	PFOS	0.093	0.186	0.464	1.16	2.32	4.64	11.6	58	116
PFDS 0.097 0.193 0.483 1.21 2.41 4.83 12.1 60.3 121 PFDOS 0.097 0.194 0.485 1.21 2.43 4.85 12.1 60.6 121. 4:2FTS 0.375 0.75 1.88 4.69 9.38 1.88 46.9 2.34 469 6.2FTS 0.38 0.76 1.9 4.75 9.5 19 47.5 2.38 475 8.2FTS 0.38 0.76 1.92 4.8 9.6 19.2 4.8 2.5 5 12.5 62.5 125 NMeFOSA .1 .2 .5 1.25 2.5 5 12.5 62.5 125 NMeFOSA .1 .2 .5 1.25 2.5 5 12.5 62.5 125 NMeFOSA .1 .2 .5 12.5 62.5 125 125 125 125 125 125 125 125 125<	PFNS	0.096	0.192	0.481	1.20	2.41	4.81	12	60.1	120
PFDOS 0.097 0.194 0.485 1.21 2.43 4.85 1.21 6.06 121. 4:2FTS 0.375 0.75 1.88 4.69 9.38 18.8 46.9 234 469 6:2FTS 0.38 0.76 1.9 4.75 9.5 19 47.5 238 475 8:2FTS 0.384 0.768 1.92 4.8 9.6 19.2 4.8 240 480 PFOSA .1 2 .5 1.25 2.5 5 12.5 62.5 125 NMEFOSA .1 .2 .5 1.25 2.5 5 12.5 62.5 125 NMEFOSA .1 .2 .5 12.5 50 12.5 62.5 125 NMEFOSA .1 .2 .5 12.5 50 12.5 62.5 125 NEFOSE 1 .2 .5 10.5 12.5 62.5 125 62.5	PFDS	0.097	0.193	0.483	1.21	2.41	4.83	12.1	60.3	121
4:2FTS 0.375 0.75 1.88 4.69 9.38 18.8 4.69 2.34 4.69 6:2FTS 0.384 0.768 1.92 4.8 9.6 1.92 4.8 9.6 1.92 4.8 240 480 PFOSA .1 2.5 1.25 2.5 5 12.5 62.5 125 NMeFOSA .1 2.2 .5 1.25 2.5 5 12.5 62.5 125 NMEFOSA .1 2.2 .5 1.25 2.5 5 12.5 62.5 125 NMEFOSA .1 2.2 .5 12.5 2.5 50 12.5 62.5 125 NMEFOSE 1 2.2 .5 12.5 50 12.5 62.5 125 NEFOSE 1 2.2 .5 10.5 12.5 62.5 12.5 62.5 12.5 62.5 12.5 NEFOSE .1 .2 .5 <t< td=""><td>PFDOS</td><td>0.097</td><td>0.194</td><td>0.485</td><td>1.21</td><td>2.43</td><td>4.85</td><td>12.1</td><td>60.6</td><td>121.</td></t<>	PFDOS	0.097	0.194	0.485	1.21	2.43	4.85	12.1	60.6	121.
6:2FTS0.380.761.94.759.51947.52.384758:2FTS0.3840.7681.924.89.619.24.8240480PFOSA12.51.252.5512.562.5125NMeFOSA.12.251.252.5512.562.5125NEIFOSA.12.2.51.252.5512.562.5125NMeFOSA.1.2.51.252.5512.562.5125NMeFOSA.1.2.51.252.55012.562.5125NMeFOSA.1.2.51.252.55012.562.5125NMeFOSA.1.2.512.52.55012.562.5125NMeFOSA.1.2.512.52.55012.562.5125NMeFOSA.1.2.512.52.55012.562.512.5NMeFOSA.1.2.512.52.55012.562.512.5NMeFOSA.1.2.512.52.55012.562.512.5NHFOA.4.8.2.510.512.562.512.562.512.5ADONA.0.3780.7561.894.739.4518.947.323.623.5PFMPA.2 <td>4:2FTS</td> <td>0.375</td> <td>0.75</td> <td>1.88</td> <td>4.69</td> <td>9.38</td> <td>18.8</td> <td>46.9</td> <td>234</td> <td>469</td>	4:2FTS	0.375	0.75	1.88	4.69	9.38	18.8	46.9	234	469
8:2FTS0.3840.7681.924.89.61.9.24.82.404.80PFOSA.1.2.51.252.55.1.2.56.2.51.25NMeFOSA.1.2.51.252.55.1.2.56.2.51.2.5NMeFOSAA.1.2.51.2.52.55.1.2.56.2.51.2.5NMeFOSAA.1.2.51.2.52.55.1.2.56.2.51.2.5NMeFOSE.1.2.51.2.52.55.01.2.56.2.51.2.5NMeFOSE.1.2.51.2.52.55.01.2.56.2.51.2.5NMeFOSE.1.2.51.2.52.55.01.2.56.2.51.2.5NEFOSE.1.2.51.2.52.55.01.2.56.2.51.2.5NEFOSE.1.2.51.2.5.51.2.56.2.51.2.56.2.51.2.5NEFOSE.1.2.51.0.2.5.5.6.4.739.3.51.8.94.7.32.3.64.7.3SQL-PFONS.0.3780.7561.8.94.7.39.4.51.8.94.7.32.3.64.7.3PFMPA.2.412.5.51.02.51.2.51.2.51.2.5PFMBA.2.412.5.51.02.51.2.51.2.51.2.5PFMBA.2 <td>6:2FTS</td> <td>0.38</td> <td>0.76</td> <td>1.9</td> <td>4.75</td> <td>9.5</td> <td>19</td> <td>47.5</td> <td>238</td> <td>475</td>	6:2FTS	0.38	0.76	1.9	4.75	9.5	19	47.5	238	475
PFOSA1.11.21.51.251.255.512.562.512.5NMeFOSA1.11.21.51.252.55.512.562.5125NEtFOSA1.11.21.51.252.55.512.562.5125NMeFOSAA1.11.21.51.252.55.012.562.5125NMeFOSE1.11.25.512.52.55.012.562.5125NMeFOSE1.12.25.012.52.55.012.562.51250NEtFOSE1.12.25.012.52.55.012.562.51250NETFOSE1.12.25.012.56.012.562.512.5ADONA0.3780.7561.894.739.4518.947.323.647.39CI-PFONS0.3740.7481.874.689.3518.746.823.446811CI-PFOUdS0.3780.7561.894.739.4518.947.323.647.39FMPA2.24.412.5510.025.12.525.0PFMBA2.24.412.5510.212.512.525.PFEESA0.1780.3560.892.234.458.922.311.1223NFDHA2.5555555555 <t< td=""><td>8:2FTS</td><td>0.384</td><td>0.768</td><td>1.92</td><td>4.8</td><td>9.6</td><td>19.2</td><td>48</td><td>240</td><td>480</td></t<>	8:2FTS	0.384	0.768	1.92	4.8	9.6	19.2	48	240	480
NMeFOSA .1 .2 .5 1.25 2.5 5 1.25 2.5 5 12.5 5.5 12.5 2.5 5 12.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	PFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEIFOSA .1 .2 .5 1.25 2.5 5 12.5 62.5 12.5 NMeFOSAA .1 .2 .5 1.25 2.5 5 12.5 62.5 125 NEIFOSAA .1 .2 .5 12.5 25 50 12.5 62.5 125 NMeFOSE 1 .2 .5 12.5 25 50 12.5 62.5 1250 NEFOSE 1 .2 .5 12.5 25 .50 12.5 62.5 .1250 MEFOSE 1 .2 .5 .10 .20 .50 .250 .500 MEFOSE .1 .2 .5 .10 .20 .50 .500 .250 .500 .250 .500 .250 .500 .250 .260 .473 .245 .473 .245 .473 .245 .473 .245 .473 .245 .10 .5 .125 .250 .251<	NMeFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSAA .1 .2 .5 1.25 2.5 5 12.5 62.5 125 NEIFOSAA .1 .2 .5 12.5 2.5 5 12.5 62.5 125 NMeFOSE 1 2 5 12.5 25 50 12.5 62.5 1250 NEIFOSE 1 2 5 12.5 25 50 12.5 62.5 1250 MEFOSEA 1 2 5 10.0 20 50.0 250 500 MEFO-DA .4 .8 2 5 10.0 20 50.0 250 500 ADONA 0.378 0.756 1.89 4.73 9.45 18.9 47.3 236 473 9CI-PFONS 0.378 0.756 1.89 4.73 9.45 18.9 47.3 236 473 PFMPA .2 .4 1 2.5 10 25 125 250	NEtFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEIFOSAA.1.2.5.1.25.2.5.5.12.5.62.5.12.5NMEFOSE125.12.5.2.5.50.12.5.62.5.12.5NEIFOSE125.12.5.50.12.5.62.5.12.5HFPO-DA.4.8.2.5.10.20.5025.0.50.ADONA.0.378.0.756.1.89.4.73.9.45.18.9.47.3.23.6.4739CL-PFONS.0.374.0.748.1.87.4.68.9.35.18.7.46.8.23.4.46.811CL-PFOUdS.0.378.0.756.1.89.4.73.9.45.18.9.47.3.23.6.473PFMPA.2.4.1.2.5.5.10.2.5.12.5.250PFMBA.2.4.1.2.5.5.10.2.5.12.5.250PFESA.0.178.0.36.0.89.2.3.4.45.8.9.2.3.11.1.2.3NFDHA.2.4.1.2.5.5.10.2.5.12.5.2.5.5.5.5.1.5.1.5.1.5.1.5.1.5.2.5.2.5.2.5.5.5.5.5.5.5.1.5.3.12.2.5.3.12.3.12.3.12.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5 <td>NMeFOSAA</td> <td>.1</td> <td>.2</td> <td>.5</td> <td>1.25</td> <td>2.5</td> <td>5</td> <td>12.5</td> <td>62.5</td> <td>125</td>	NMeFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSE12512.525501256251250NEtFOSE12512.525501256251250HFPO-DA.4.8251020500250500ADONA0.3780.7561.894.739.4518.947.32364739CI-PFONS0.3740.7481.874.689.3518.746.823446811CI-PFOUdS0.3780.7561.894.739.4518.947.3236473PFMPA.2.412.551025125250PFMBA.2.412.551025125250PFESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.5510251252503:3FTCA.512.56.2512.53126243123127:3FTCA2.5512.531.362.512.531.215603125MAPFBA10101010101010101010MSPFPeA555555555555555555555555555555 </td <td>NEtFOSAA</td> <td>.1</td> <td>.2</td> <td>.5</td> <td>1.25</td> <td>2.5</td> <td>5</td> <td>12.5</td> <td>62.5</td> <td>125</td>	NEtFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEtFOSE 1 2 5 12.5 25 50 125 625 1250 HFPO-DA .4 .8 2 5 10 20 50 250 500 ADONA 0.378 0.756 1.89 4.73 9.45 18.9 47.3 236 473 9CI-PFONS 0.374 0.748 1.87 4.68 9.35 18.7 46.8 234 468 11CI-PFOUdS 0.378 0.756 1.89 4.73 9.45 18.9 47.3 236 473 PFMPA .2 .4 1 2.5 5 10 25 125 250 PFMBA .2 .4 1 2.5 5 10 25 125 250 PFESA 0.178 0.356 0.89 2.23 4.45 8.9 22.3 111 223 NFDHA .2 .4 1 2.5 5 125 312	NMeFOSE	1	2	5	12.5	25	50	125	625	1250
HFPO-DA.4.825102050250500ADONA0.3780.7561.894.739.4518.947.32364739CI-PFONS0.3740.7481.874.689.3518.746.823446811CI-PFOUdS0.3780.7561.894.739.4518.947.3236473PFMPA.2.412.551025125250PFMBA.2.412.551025125250PFESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.5510251252503:SFTCA.512.56.2512.5125250312156031207:3FTCA.512.56.2512.5312156031207:3FTCA2.5512.531.362.512.531215603125M4PFBA10101010101010101010MSPFPeA5.555555555555M4PFBA2.5	NEtFOSE	1	2	5	12.5	25	50	125	625	1250
ADONA0.3780.7561.894.739.4518.947.32364739CI-PFONS0.3740.7481.874.689.3518.746.823446811CI-PFOUdS0.3780.7561.894.739.4518.947.3236473PFMPA.2.412.551025125250PFMBA.2.412.551025125250PFEESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.55102512525097FEESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.551025125250313FTCA.512.56.2512.51252503126245:3FTCA2.5512.531.362.5125312156031207:3FTCA2.5512.531.362.512531215603125M4PFBA101010101010101010M5PFPeA5555555555M5PFHxA2.52.52.52.52.52.52.52.52.52.52.52.52.52.5	HFPO-DA	.4	.8	2	5	10	20	50	250	500
9CI-PFONS0.3740.7481.874.689.3518.746.823446811CI-PFOUdS0.3780.7561.894.739.4518.947.3236473PFMPA.2.412.551025125250PFMBA.2.412.551025125250PFMBA.2.412.551025125250PFEESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.5510251252503'SFTCA.512.56.2512.52562.53126245'3FTCA.512.56.251252562.53126245'3FTCA2.5512.531.362.5125312156031207'3FTCA2.5512.531.362.512531215603125M4PFBA10101010101010101010M5PFPeA55555555555M5PFHxA2.5	ADONA	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
11Cl-PFOUdS 0.378 0.756 1.89 4.73 9.45 18.9 47.3 236 473 PFMPA .2 .4 1 2.5 5 10 25 125 250 PFMBA .2 .4 1 2.5 5 10 25 125 250 PFEESA 0.178 0.356 0.89 2.23 4.45 8.9 22.3 111 223 NFDHA .2 .4 1 2.5 5 10 25 125 250 3:3FTCA .5 1 2.5 6.25 12.5 312 624 312 562 312 625 3:3FTCA .5 1 2.5 6.25 12.5 312 1560 3120 7:3FTCA 2.5 5 12.5 31.3 62.5 125 312 1560 3125 M4PFBA 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	9CI-PFONS	0.374	0.748	1.87	4.68	9.35	18.7	46.8	234	468
PFMPA.2.412.551025125250PFMBA.2.412.551025125250PFEESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.5510251252503:3FTCA.512.56.2512.52562.53126245:3FTCA2.5512.531.362.5125312156031207:3FTCA2.5512.531.362.512531215603125M4PFBA10101010101010101010M5PFPeA55555555555M5PFHxA2.52.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.52.51.251.251.251.251.251.251.251.251.25M6PFDA1.25<	11CI-PFOUdS	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
PFMBA.2.412.551025125250PFEESA0.1780.3560.892.234.458.922.3111223NFDHA.2.412.5510251252503:3FTCA.512.56.2512.52562.53126245:3FTCA2.5512.531.362.5125312156031207:3FTCA2.5512.531.362.512531215603125M4PFBA101010101010101010M5PFPeA55555555M5PFHxA2.52.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.52.5M4PFHpA2.5 <t< td=""><td>PFMPA</td><td>.2</td><td>.4</td><td>1</td><td>2.5</td><td>5</td><td>10</td><td>25</td><td>125</td><td>250</td></t<>	PFMPA	.2	.4	1	2.5	5	10	25	125	250
PFEESA 0.178 0.356 0.89 2.23 4.45 8.9 22.3 111 223 NFDHA .2 .4 1 2.5 5 10 25 125 250 3:3FTCA .5 1 2.5 6.25 12.5 25 62.5 312 624 5:3FTCA 2.5 5 12.5 31.3 62.5 125 312 1560 3120 7:3FTCA 2.5 5 12.5 31.3 62.5 125 312 1560 3125 M4PFBA 10	PFMBA	.2	.4	1	2.5	5	10	25	125	250
NFDHA.2.412.5510251252503:3FTCA.512.56.2512.52562.53126245:3FTCA2.5512.531.362.5125312156031207:3FTCA2.5512.531.362.512531215603120M4PFBA101010101010101010M5PFPeA55555555M4PFHA2.52.52.52.52.52.52.52.5M4PFHA2.52.52.52.52.52.52.52.52.5M4PFHA2.52.52.52.52.52.52.52.52.52.5M4PFHA2.52.52.52.52.52.52.52.52.52.52.5M4PFHA2.51.251.251.251.251.251.25 <td>PFEESA</td> <td>0.178</td> <td>0.356</td> <td>0.89</td> <td>2.23</td> <td>4.45</td> <td>8.9</td> <td>22.3</td> <td>111</td> <td>223</td>	PFEESA	0.178	0.356	0.89	2.23	4.45	8.9	22.3	111	223
3:3FTCA .5 1 2.5 6.25 12.5 25 62.5 312 624 5:3FTCA 2.5 5 12.5 31.3 62.5 125 312 1560 3120 7:3FTCA 2.5 5 12.5 31.3 62.5 125 312 1560 3125 M4PFBA 10	NFDHA	.2	.4	1	2.5	5	10	25	125	250
5:3FTCA2.5512.531.362.5125312156031207:3FTCA2.5512.531.362.512531215603125M4PFBA10101010101010101010M5PFPeA5555555555M5PFHxA2.52.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.51.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25	3:3FTCA	.5	1	2.5	6.25	12.5	25	62.5	312	624
7:3FTCA2.5512.531.362.512531215603125M4PFBA10101010101010101010M5PFPeA55555555555M5PFHxA2.52.52.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.52.52.52.52.52.52.52.52.52.52.5M9PFNA1.251.251.251.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.251.251.25	5:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3120
M4PFBA101010101010101010M5PFPeA5555555555M5PFHxA2.52.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.52.52.52.52.52.52.52.52.52.5M9PFNA1.251.251.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25	7:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3125
M5PFPeA5555555M5PFHxA2.52.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.52.52.52.52.52.52.52.52.5M9PFNA1.251.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.25	M4PFBA	10	10	10	10	10	10	10	10	10
M5PFHxA2.52.52.52.52.52.52.52.5M4PFHpA2.52.52.52.52.52.52.52.52.52.5M8PFOA2.52.52.52.52.52.52.52.52.52.52.5M9PFNA1.251.251.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.251.25	M5PFPeA	5	5	5	5	5	5	5	5	5
M4PFHpA2.52.52.52.52.52.52.52.5M8PFOA2.52.52.52.52.52.52.52.52.5M9PFNA1.251.251.251.251.251.251.251.251.25M6PFDA1.251.251.251.251.251.251.251.251.25M7PFUdA1.251.251.251.251.251.251.251.251.25MPFDoA1.251.251.251.251.251.251.251.251.25	M5PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M8PFOA 2.5 1.25	M4PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M9PFNA 1.25 <	M8PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M6PFDA 1.25 <	M9PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M7PFUdA 1.25	M6PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
MPFDoA 1.25 1.25 1.25 1.25 1.25 1.25 1.25 1.25 1.25 1.25	M7PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	MPFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

Alpha Analytical, Inc.	ID No.: 4585	2
Facility: Mansfield, MA	Revision	3
Department: Emerging Contaminants	Published Date: 9/29/2022 11:21:03 AM	V
Title: Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue	by LCMSMS Page 30 of 3	5

M2PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M3PFBS	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
M3PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M8PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
M2-4:2FTS	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69
M2-6:2FTS	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76
M2-8:2FTS	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
M8FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-N-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSAA	5	5	5	5	5	5	5	5	5
d5-N-EtFOSAA	5	5	5	5	5	5	5	5	5
d7-N-MeFOSE	25	25	25	25	25	25	25	25	25
d9-N-EtFOSE	25	25	25	25	25	25	25	25	25
M3HFPO-DA	10	10	10	10	10	10	10	10	10
M3PFBA	5	5	5	5	5	5	5	5	5
M2PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M4PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M5PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M2PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M4PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4

 Table 5: Expected Mass Transitions and instrument conditions.

Q1	Q2	Analyte	DP Volts	CE Volts
213.032	169.022	PFBA	-50	-14
263.039	219.03	PFPeA	-55	-12
263.039	68.9	PFPeA_2	-55	-55
313.047	269.037	PFHxA	-45	-12
313.047	119	PFHxA_2	-45	-28
363.055	319.045	PFHpA	-60	-12
363.055	169.022	PFHpA_2	-60	-24
413.063	369.053	PFOA	-65	-14
413.063	169.022	PFOA_2	-65	-23
463.071	419.061	PFNA	-70	-14
463.071	219.03	PFNA_2	-70	-24

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

Document Type: SOP-Technical

 Department:
 Emerging Contaminants
 Published D

 Title:
 Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue by LCMSMS

IS	Page 31 of 35
ed Date:	9/29/2022 11:21:03 AM
	Revision 3

513.078	469.069	PFDA	-80	-16
513.078	219.03	PFDA_2	-80	-30
563.086	519.076	PFUnA	-85	-18
563.086	269.037	PFUnA_2	-85	-25
613.094	569.084	PFDoA	-85	-18
613.094	319.045	PFDoA_2	-85	-28
663.102	619.092	PFTrDA	-85	-20
663.102	169.022	PFTrDA_2	-85	-36
713.11	669.1	PFTA	-70	-22
713.11	169.022	PFTA_2	-70	-38
299.092	80.062	PFBS	-100	-65
299.092	99.061	PFBS_2	-100	-40
349.1	80.062	PFPeS	-100	-75
349.1	99.061	PFPeS_2	-100	-60
399.107	80.062	PFHxS	-120	-75
399.107	99.061	PFHxS_2	-120	-80
449.115	80.062	PFHpS	-140	-95
449.115	99.061	PFHpS_2	-140	-80
499.113	80.062	PFOS	-145	-108
499.113	99.061	PFOS_2	-145	-85
549.131	80.062	PFNS	-180	-100
549.131	99.061	PFNS_2	-180	-100
599.139	80.062	PFDS	-170	-110
599.138	99.061	PFDS_2	-170	-100
699.154	80.062	PFDoS	-160	-150
699.154	99.061	PFDoS_2	-160	-130
327.146	307.139	4:2FTS	-100	-28
327.146	81.07	4:2FTS_2	-100	-50
427.161	407.155	6:2FTS	-120	-33
427.161	81.07	6:2FTS_2	-120	-65
527.177	507.17	8:2FTS	-140	-39
527.177	81.07	8:2FTS_2	-140	-85
498.146	78.07	FOSA	-150	-90
498.146	478	FOSA_2	-150	-35
512.163	219.03	NMeFOSA	-130	-35
512.163	169.022	NMeFOSA_2	-130	-40
526.192	219.03	NEtFOSA	-140	-35
526.192	169.022	NEtFOSA_2	-140	-35
570.202	419.061	NMeFOSAA	-100	-28

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

Alpha Analytical, Inc. Facility: Mansfield, MA

Department: Emerging Contaminants

Revision 3

Published Date: 9/29/2022 11:21:03 AM Title: Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue by LCMSMS Page 32 of 35

570.202	483	NMeFOSAA_2	-100	-22
584.229	419.061	NEtFOSAA	-100	-28
584.229	526.192	NEtFOSAA_2	-100	-38
616.1	58.9	NMeFOSE	-90	-70
630	58.9	NEtFOSE	-80	-75
285.035	169.022	HFPO-DA	-60	-12
285.035	184.9	HFPO-DA_2	-60	-18
377.06	251.028	ADONA	-65	-18
377.06	84.8	ADONA_2	-65	-48
530.8	351.05	9CI-PFONS	-130	-38
532.8	353	9CI-PFONS_2	-130	-38
630.9	451.031	11Cl-PFOUdS	-145	-41
632.9	452.9	11Cl-PFOUdS_2	-145	-41
241.085	177.069	3:3FTCA	-60	-12
241.085	117	3:3FTCA_2	-60	-50
341.101	237.072	5:3FTCA	-70	-20
341.101	217	5:3FTCA_2	-70	-35
441.117	316.9	7:3FTCA	-85	-30
441.117	337.088	7:3FTCA_2	-85	-20
315.093	135.013	PFEESA	-100	-35
315.093	82.9	PFEESA_2	-100	-25
229.032	85.006	PFMPA	-40	-25
279.042	85.006	PFMBA	-45	-25
295.032	201	NFDHA	-30	-15
295.032	84.9	NFDHA_2	-30	-40
217.001	171.999	MPFBA	-50	-14
268.001	222.999	M5PFPeA	-55	-12
318.009	273.007	M5PFHxA	-45	-12
367.024	322.022	M4PFHpA	-60	-12
421.002	376	M8PFOA	-65	-14
472.002	427	M9PFNA	-70	-14
519.033	474.03	M6PFDA	-80	-16
570.033	525.031	M7-PFUdA	-85	-18
615.079	570.033	MPFDoA	-85	-18
715.094	670.092	M2PFTeDA	-70	-22
302.069	80.062	M3PFBS	-100	-65
402.084	80.062	M3PFHxS	-120	-74
507.062	80.062	M8PFOS	-145	-85
329.13	81.07	M2-4:2FTS	-100	-50

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.

Alpha Analytical, Inc.	ID No.:4	5852
Facility: Mansfield, MA	Revis	sion 3
Department: Emerging Contaminants	Published Date: 9/29/2022 11:21:0	3 AM
Title: Method 1633 PFAS in Aqueous, Solid, Biosolids and Tissue	by LCMSMS Page 33	of 35

429.162	81.07	M2-6:2FTS	-120	-65
529.162	81.07	M2-8:2FTS	-140	-85
506.077	78.07	M8FOSA	-150	-90
515.183	219.03	d3-NMeFOSA	-130	-35
531.222	219.03	d5-NEtFOSA	-140	-35
573.22	419.061	d3-NMeFOSAA	-75	-28
589.259	419.061	d5-NEtFOSAA	-90	-28
623.2	58.9	d7-NMeFOSE	-100	-28
639.2	58.9	d9-NEtFOSE	-100	-28
287.02	169.022	M3HFPO-DA	-60	-12
216.009	171.999	M3PFBA	-50	-14
315.032	270.03	M2PFHxA	-45	-12
417.032	372.03	M4PFOA	-65	-14
468.032	423.03	M5PFNA	-70	-14
515.063	470.061	M2PFDA	-80	-16
403.107	84.062	18O2-PFHxS	-120	-74
503.093	80.062	M4PFOS	-145	-85

Table 6: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 CH/H ₂ O)	100% Acetonitrile	Gradient Curve
Initial	100.0	0.0	0
.2	100.0	0.0	2
4	70	30	7
7	45	55	8
9	25	80	8
10	5	95	6
10.4	98	2	10
11.8	100	0	7
12	100	0	1
Waters Aquity UP			
	Flow rate of 0.4 mL/min		
	2 µL injection		

ESI Conditions			
Polarity	Negative ion		
Curtain Gas	30		
Collision gas	9		
Ion Spray Voltage	-4500		
Desolvation gas temp.	500 °C		
Ion Source Gas 1	30		
Ion Source Gas 2	50		
Entrance Poitential	-10		
Exic Cell Potential	-11		

Table 7: ESI-MS Method Conditions

	Aqueous	Solid	Tissue		
Compound	(ng/L)	(ng/g)	(ng/g)		
PFBA	6.4	0.8	2		
PFPeA	3.2	0.4	1		
PFHxA	1.6	0.2	0.5		
PFHpA	1.6	0.2	0.5		
PFOA	1.6	0.2	0.5		
PFNA	1.6	0.2	0.5		
PFDA	1.6	0.2	0.5		
PFUnA	1.6	0.2	0.5		
PFDoA	1.6	0.2	0.5		
PFTrDA	1.6	0.2	0.5		
PFTA	1.6	0.2	0.5		
PFBS	1.6	0.2	0.5		
PFPeS	1.6	0.2	0.5		
PFHxS	1.6	0.2	0.5		
PFHpS	1.6	0.2	0.5		
PFOS	1.6	0.2	0.5		
PFNS	1.6	0.2	0.5		
PFDS	1.6	0.2	0.5		
PFDoS	1.6	0.2	0.5		
4:2FTS	6.4	0.8	2		
6:2FTS	6.4	0.8	2		
8:2FTS	6.4	0.8	2		
FOSA	1.6	0.2	2		
NMeFOSA	1.6	0.2	0.5		

Table 8. Reporting limits by Matrix

Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work,
the published version of the document should be viewed online.Document Type: SOP-TechnicalPre-Qualtrax Document ID: NA

NEtFOSA	1.6	0.2	0.5
NMeFOSAA	1.6	0.2	0.5
NEtFOSAA	1.6	0.2	0.5
NMeFOSE	16	2	5
NEtFOSE	16	2	5
HFPO-DA	6.4	0.8	2
ADONA	6.4	0.8	2
9CI-PFONS	6.4	0.8	2
11Cl-PFOUdS	6.4	0.8	2
3:3FTCA	8	1	2.5
5:3FTCA	40	5	12.5
7:3FTCA	40	5	12.5
PFEESA	3.2	0.4	1
PFMPA	3.2	0.4	1
PFMBA	3.2	0.4	1
NFDHA	3.2	0.4	1

Appendix C Health and Safety Plan

Health and Safety Plan

for

27-45 North Main Street Remedial Investigation Work Plan

27-45 North Main Street and 28 Adee Street Port Chester, NY Block 1, Lots 7, 11, 12, 13, 14, 15, 16, and 17 BCP Site # TBD

Submitted to: New York State Department of Environmental Conservation Division of Environmental Remediation Remedial Bureau B 625 Broadway, 12th Floor Albany, NY 12233-7016

Prepared for: Abendroth Green LLC The Hudson Companies Incorporated 826 Broadway, 11th Floor New York, NY 10003



121 West 27th Street, Suite 702 New York, NY 10001

December 2022
TABLE OF CONTENTS

1.0	INTRODUCTION	. 1
1.1	Scope of HASP	. 1
2.0	PROJECT SAFETY AUTHORITY	. 2
2.1	Designated Personnel	. 2
3.0	HAZARD ASSESSMENT AND CONTROL MEASURES	. 3
3.1	Human Exposure Pathways	. 6
3.2	Chemical Hazards	. 6
3.3	Physical Hazards	. 7
4.0	Covid-19 Health and Safety	10
5.0	AIR MONITORING	12
6.0	PERSONAL PROTECTIVE EQUIPMENT	14
7.0	EXPOSURE MONITORING	15
8.0	SITE ACCESS	16
9.0	WORK AREAS	17
10.0	DECONTAMINATION PROCEDURES	18
11.0	GENERAL SAFE WORK PRACTICES	19
12.0	EMERGENCY PROCEDURES	20
12.1	Route to Hospital	21
12.2	Emergency Contacts	21
13.0	TRAINING	22
14.0	MEDICAL SURVEILLANCE	23

Figures

Figure 1 – Route to Hospital (page 21)

Tables

Table 1 – Emergency Contact Information (page 21)

Appendices

Appendix A – Acknowledgement of HASP

Appendix B – Injury Reporting Form (OSHA Form 300)

Appendix C – Material Safety Data Sheets

1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared in conformance with the Occupational Safety and Health Administration (OSHA) standards and guidance that govern site investigation activities, other applicable regulations, and Tenen Environmental LLC (Tenen) health and safety policies and procedures. The purpose of this HASP is the protection of Tenen field personnel and others during the implementation of a Remedial Investigation (RI).

The Site consists of an approximately 48,101-square foot parcel located at 27-45 North Main Street and 28 Adee Street in the Village of Port Chester, New York. The Site is identified by Westchester County as Section 142.31, Tax Block 1, Lots 7, 11, 12, 13, 14, 15, 16 and 17. The Site is an irregularly shaped parcel with approximately 250 feet of frontage along North Main Street, approximately 300 feet of frontage along Abendroth Avenue, and approximately 100 feet of frontage along Adee Street. The Site is location is shown on Figure 1. A map of the current site layout is shown on Figure 2.

The Site is zoned C2, denoting a commercial district of Main Street Business. The Site lot is currently occupied by one- to three-story commercial or mixed-use residential and commercial buildings. Exterior portions of the Site are largely capped with asphalt. The remainder of the exterior portions of the Site are utilized for landscaping. Currently, the entirety of the Site is vacant. The most recent commercial businesses to operate at the Site include a realtor, restaurant, hardware store, ice cream shop, a jeweler, and non-profit organizations.

The ground level of the building on Lot 11 contains an active 1,500-gallon UST that contains #2 fuel oil. The UST is located in a subterranean vault. Lot 11 is identified on the Petroleum Bulk Storage (PBS) database as PBS #3-801942. The UST on Lot 11 is associated with an open spill (Spill No. 1708684) which was reported on December 15, 2017 due to equipment failure. The spill record indicates the UST was repaired and retested. No further information was provided and the spill case remains open.

1.1 Scope of HASP

This HASP includes safety procedures to be used by Tenen staff during the following activities:

- Collection of soil samples from soil borings;
- Collection of groundwater samples from groundwater monitoring wells; and,
- Collection of soil vapor samples from temporary soil vapor points.

Subcontractors will ensure that performance of the work is in compliance with this HASP and applicable laws and regulations.

2.0 PROJECT SAFETY AUTHORITY

The following personnel are responsible for project health and safety under this HASP.

- Project Manager, Alana Carroll
- Health and Safety Officer (HSO), Matthew Carroll

In addition, each individual working at the Site will be responsible for compliance with this HASP and general safe working practices. All Site workers will have the authority to stop work if a potentially hazardous situation or event is observed.

2.1 Designated Personnel

The Project Manager is responsible for the overall operation of the project, including compliance with the HASP and general safe work practices. The Project Manager may also act as the Health and Safety Officer (HSO) for this project.

Tenen will appoint one of its on-site personnel as the on-site HSO. This individual will be responsible for the implementation of the HASP. The HSO will have a 4-year college degree in occupational safety or a related science/engineering field, and at least two (2) years of experience in implementation of air monitoring and hazardous materials sampling programs. The HSO will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards.

The HSO will be present on-site during all field operations involving drilling or other subsurface disturbance, and will be responsible for all health and safety activities and the delegation of duties to the field crew. The HSO has stop-work authorization, which he/she will execute on his/her determination of an imminent safety hazard, emergency situation, or other potentially dangerous situation. If the HSO must be absent from the field, a replacement who is familiar with the Construction Health and Safety Plan, air monitoring and personnel protective equipment (PPE) will be designated.

3.0 HAZARD ASSESSMENT AND CONTROL MEASURES

Prior to 1890, an inlet of the Byram River extended north through the central portion of the Site. By 1890, a small area of the inlet onsite had been filled, and by 1895 the entire Site was filled. By 1895, the Site area along North Main Street was developed with multiple small buildings and stores. While individual store occupants changed over the years, retail use of these buildings is consistent through 2006, the date of the most recent available Sanborn map. The Site was historically utilized for commercial and residential purposes, with non-residential uses of the Site including dry cleaning, a planing/lumber mill, a roller rink, printers, sign painting, lime and cement storage, plumbing, and a metal works. Prior uses that appear to have led to site contamination include the filling of the Site with historic fill material and the use of chlorinated solvents.

A summary of previous environmental investigations conducted at the Site or a portion of the Site between 2016 and 2022 is provided below.

Site History

- Prior to 1890, an inlet of the Byram River extended north through the central portion of the Site. By 1895, the entirety of the inlet spanning the Site had been filled. By 1895, the Site area along North Main Street was developed with multiple small buildings and stores.
- The Site was historically utilized for commercial and residential purposes. Historic nonresidential uses include: dry cleaning, a planing/lumber mill, a roller rink, printers, sign painting, lime and cement storage, plumbing, and a metal works.
- The Site has two closed Spill records and one open Spill record associated with it:
 - Spill No. 1308618 was reported on November 25, 2013 for Lot 11. The spill record indicates the spill was caused by an equipment failure from the boiler which released oil into the subterranean vault containing the known 1,500-gallon UST. The record noted the UST could not be located and is not in compliance with PBS regulations. There was no indication that oil discharged into the Byram River to the east. A 2013 NYSDEC memo noted that 2,000 gallons of oil and water were vacuumed from the vault and cleanup was completed. The spill case was closed on November 26, 2013.
 - Spill No. 1602940 was reported on June 24, 2016 for Lot 16. The spill record indicates samples were collected after four aboveground storage tanks (ASTs) were removed from the property. Slightly elevated concentrations of semivolatile organic compounds (SVOCs) were detected in one of the soil samples. No additional evidence of a leak or contamination was observed. A 2016 NYSDEC memo noted that no further action was required and the spill casew as closed on July 12, 2016.
 - Spill No. 1708684 was reported on December 15, 2017 for Lot 11. The spill record indicates the spill was caused by equipment failure. The record indicates the tank was repaired and retested. No further information was provided and the spill case remains open.
- Previous Phase I Environmental Site Assessment (Phase I ESAs) conducted at the Site or a portion of the Site identified the following Recognized Environmental Conditions (RECs) in connection with the property:
 - The historical use of the Site for dry cleaning, printing, and metalworking;

- The presence of historical fill material at the Site;
- Open petroleum spill (Spill No. 1708684) associated with the Site, and the historic and current use of the Site for underground oil storage; and,
- Historical use of the east adjoining property for coal storage and a west adjoining property for printing.

Geology/Hydrogeology

- The Site is located at an average elevation of approximately twelve feet above mean sea level (ft-msl) and slopes gently to the southeast.
- The overburden at the Site is composed predominantly of a shallow fill layer containing fine- to medium-grained sand and silt, brick and rock fragments, wood chips, and cobbles underlain by native till material consisting of fine- to coarse-grained sand, silt, and clay. The fill layer ranges in thickness from two to ten feet.
- Groundwater was encountered at approximately nine feet below grade (ft-bg) and generally flows to the east-southeast, towards the Byram River.

Soil

- The results of the soil sampling performed as part of Tenen's 2022 LDDESI indicated one volatile organic compound (VOC), acetone, was detected slightly in exceedance of its Unrestricted Use Soil Cleanup Objective (SCO, UUSCO) in two soil samples. Acetone is a common laboratory artifact. No other VOCs were detected in exceedance of UUSCOs or Restricted-Residential Use SCOs (RRSCOs).
- A variety of SVOCs, specifically polyaromatic hydrocarbons (PAHs), were detected in exceedance of Unrestricted Use SCOs in two soil samples, including benzo(a)anthracene [max. 3 parts per million (ppm) with a UUSCO of 1 ppm], benzo(a)pyrene (max. 2 ppm with a UUSCO of 1 ppm), benzo(b)fluoranthene (max. 2.1 ppm with a UUSCO of 1 ppm), benzo(k)fluoranthene (max. 2.2 ppm with a UUSCO of 0.8 ppm), chrysene (max. 2.6 ppm with a UUSCO of 1 ppm), dibenzo(a,h)anthracene (max. 0.56 ppm with a UUSCO of 0.33 ppm), and indeno(1,2,3-cd)pyrene (max. 1.5 ppm with a UUSCO of 0.5 ppm). Of these, the UUSCO is the same as the RRSCO for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, and any exceedances of UUSCOs for these analytes also exceeded RRSCOs. The highest concentrations of SVOCs were detected in SB-1, collected from the northern portion of Lot 11, upgradient of the 1,500-gallon UST. No other SVOCs were detected in exceedance of UUSCOs.
- One pesticide, dieldrin, was detected slightly in exceedance of its UUSCO, but below its RRSCO, in one soil sample. Dieldrin was detected at a concentration of 0.01 ppm with an UUSCO of 0.005 ppm.
- The metals copper, lead, mercury, and nickel were each detected in one or more soil samples in exceedance of Unrestricted Use SCOs. Copper was detected in one sample at a concentration of 61.1 ppm with a UUSCO of 50 ppm; lead was detected in two samples at a max. concentration of 117 ppm with a UUSCO of 63 ppm; mercury was detected in all three samples at a max. concentration of 2.8 ppm with a UUSCO of 0.18 ppm; and, nickel was detected in one soil sample at a concentration of 34.4 ppm with a UUSCO of 30 ppm. Of these, mercury was also detected in exceedance of its RRSCO of 0.81 ppm in one soil sample collected from SB-6 in the southeastern portion of Lot 16.

• Polychlorinated biphenyls (PCBs) were not detected in exceedance of UUSCOs or RRSCOs in any soil samples.

Groundwater

- The results of the groundwater sampling performed onsite as part of the 2016 Indoor Air and Groundwater Survey performed by Advanced Cleanup Technologies, Inc. (ACT) and Tenen's 2022 LDDESI indicated VOCs were not detected in exceedance of the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards (AWQS) and Guidance Values (Class GA Standards) in any groundwater samples.
- The results of the groundwater sampling performed as part of Tenen's 2022 LDDESI indicated a variety of SVOCs, specifically PAHs, were detected in one groundwater monitoring well, GW-1, (located upgradient of the 1,500 gallon UST on Lot 11) slightly in exceedance of Class GA Standards. Benzo(a)anthracene was detected at a concentration of 0.04 parts per billion (ppb), benzo(a)pyrene was detected at a concentration of 0.04 ppb, benzo(b)fluoranthene was detected at a concentration of 0.04 ppb, benzo(b)fluoranthene was detected at a concentration of 0.06 ppb, benzo(k)fluoranthene was detected at a concentration of 0.01 ppb, and, indeno(1,2,3-cd)pyrene was detected at a concentration of 0.03 ppb. The aforementioned analytes all have a Class GA Standard of 0.002 ppb, with the exception of benzo(a)pyrene, which has a Class GA Standard of 0 ppb. No other SVOCs were detected in exceedance of Class GA Standards in any groundwater samples.

Soil Vapor

- The results of the soil vapor sampling performed as part of ACT's 2016 Tier II Vapor Encroachment (VE) Screen indicated elevated concentrations of the chlorinated solvent tetrachloroethene (PCE) in one soil vapor sample collected from the southeastern portion of the exterior of Lot 16. PCE was detected at a concentration of 250 micrograms per cubic meter (ug/m3). No other cVOCs included on the NYSDOH Soil Vapor Intrusion Decision Matrices were detected in any soil vapor samples.
- The results of the soil vapor sampling performed as part of Tenen's 2022 LDDESI indicated concentrations of PCE were detected in all four soil vapor samples at concentrations ranging from 1.8 ug/m3 to 80.7 ug/m3. In addition, trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE), breakdown products of PCE, were both detected in one soil vapor sample. TCE was detected at a concentration of 1.98 ug/m3 and cis-1,2-DCE was detected at a concentration of 0.22 ug/m3. Carbon tetrachloride was detected in three of four soil vapor samples at a maximum concentration of 0.55 ug/m3. No other cVOCs included on the NYSDOH Soil Vapor Intrusion Decision Matrices were detected in any soil vapor samples.
- Low levels of petroleum-related VOCs were detected in soil vapor across the Site, including benzene, toluene, ethylbenzene, xylenes, and 1,2,4-trimethylbenzene.

Indoor Air

• The results of the indoor air sampling conducted on Lot 16 as part of ACT's 2016 Air and Groundwater Survey indicated concentrations of cVOCs, including PCE, TCE, carbon tetrachloride, and methylene chloride were detected in all three indoor air samples. In addition, the cVOCs cis-1,2-DCE, vinyl chloride, 1,1,1-trichloroethane

(1,1,1-TCA), and 1,1-dichloroethene (1,1-DCE) were each detected in one soil vapor sample. Of these, TCE was detected in exceedance of its NYSDOH Air Guideline Value (AGV) of 2 ug/m3 in one indoor air sample collected from the southeastern portion of Lot 16. No other cVOCs were detected in exceedance of their respective NYSDOH AGVs. PCE was detected at a max. concentration of 12 ug/m3; TCE was detected at a max. concentration of 12 ug/m3; TCE was detected at a max. concentration of 7.5 ug/m3; methylene chloride was detected at a max. concentration of 4.9 ug/m3; cis-1,2-DCE was detected at a concentration of 5.9 ug/m3; vinyl chloride was detected at a concentration of 4.6 ug/m3; 1,1,1-TCA was detected at a concentration of 6.7 ug/m3; and, 1,1-DCE was detected at a concentration of 5.4 ug/m3.

• Comparison of the concentrations of cVOCs detected in indoor air to the applicable NYSDOH Soil Vapor Intrusion Matrices indicates mitigation would likely be required for PCE at one location (CS-1, collected from the crawl space in the western portion of the building on Lot 16) and would likely be required for TCE, cis-1,2-DCE, vinyl chloride, carbon tetrachloride, and 1,1-DCE at one location (IA-2, collected from the southeastern portion of the building on Lot 16).

Offsite Investigation

- In October 2022, Tenen performed a follow-up offsite investigation to assess potential offsite migration of the contamination identified in the 2022 LDDESI. Soil borings and monitoring wells installed as part of the offsite investigation were situated downgradient of the open petroleum spill, and the soil vapor sample points were biased toward the location of the former dry cleaner (Lot 16).
- The results of the offsite investigation indicated VOCs were not detected in any offsite soil or groundwater samples. Several SVOCs, consistent with the presence of historic fill, were detected in exceedance of UUSCOs and RRSCOs.
- The results of the offsite investigation indicated that cVOCs included on the NYSDOH Soil Vapor Intrusion Matrices, including PCE, TCE, cis-1,2-DCE, vinyl chloride, 1,1,1-TCA, carbon tetrachloride, 1,1-DCE, and methylene chloride, were not detected in any offsite soil vapor samples.
- Based upon the results of the offsite investigation, there is a low likelihood that previously detected petroleum and cVOC impacts associated with Site operations have migrated offsite.

3.1 Human Exposure Pathways

The media of concern at the Site include potentially-impacted soil, groundwater and soil vapor. Potential exposure pathways include dermal contact, incidental ingestion and inhalation of vapors. The risk of dermal contact and incidental ingestion will be minimized through general safe work practices, a personal hygiene program and the use of PPE. The risk of inhalation will be minimized through the use of an air monitoring program for VOCs and particulates.

3.2 Chemical Hazards

Based on historic uses, the following contaminants of concern may be present at the Site:

Petroleum-Related VOCs

Page 6

- Benzene
- Ethylbenzene
- Toluene
- Xylenes
- MTBE

Chlorinated Solvents

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- Cis-1,2-Dichloroethene (cis-1,2-DCE)

SVOCs

• PAHs

Metals

- Copper
- Lead
- Mercury

Material Safety Data Sheets (MSDSs) for each contaminant of concern are included in Appendix C. All personnel are required to review the MSDSs included in this HASP.

3.3 Physical Hazards

The physical hazards associated with the field activities likely present a greater risk of injury than the chemical constituents at the Site. Activities within the scope of this project shall comply with New York State and Federal OSHA construction safety standards.

Head Trauma

To minimize the potential for head injuries, field personnel will be required to wear National Institutes of Occupational Safety and Health (NIOSH)-approved hard hats during field activities. Hats must be worn properly and not altered in any way that would decrease the degree of protection provided.

Foot Trauma

To avoid foot injuries, field personnel will be required to wear steel-toed safety shoes while field activities are being performed. To afford maximum protection, all safety shoes must meet American National Standards Institute (ANSI) standards.

Eye Trauma

Field personnel will be required to wear eye protection (safety glasses with side shields) while field activities are being performed to prevent eye injuries caused by contact with chemical or physical agents.

Noise Exposure

Field personnel will be required to wear hearing protection (ear plugs or muffs) in high noise areas (noise from heavy equipment) while field activities are being performed.

Page 7

Buried Utilities and Overhead Power Lines

Boring locations will be cleared by an underground utility locator service. In addition, prior to intrusive activities, the drilling subcontractor will contact the One Call Center to arrange for a utility mark-out, in accordance with New York State requirements. Protection from overhead power lines will be accomplished by maintaining safe distances of at least 15 feet at all times.

Thermal Stress

The effects of ambient temperature can cause physical discomfort, personal injury, and increase the probability of accidents. In addition, heat stress due to lack of body ventilation caused by protective clothing is an important consideration. Heat-related illnesses commonly consist of heat stroke and heat exhaustion.

The symptoms of heat stroke include: sudden onset; change in behavior; confusion; dry, hot and flushed skin; dilated pupils; fast pulse rate; body temperature reaching 105° or more; and/or, deep breathing later followed by shallow breathing.

The symptoms of heat exhaustion include: weak pulse; general weakness and fatigue; rapid shallow breathing; cold, pale and clammy skin; nausea or headache; profuse perspiration; unconsciousness; and/or, appearance of having fainted.

Heat-stress monitoring will be conducted if air temperatures exceed 70 degrees Fahrenheit. The initial work period will be set at 2 hours. Each worker will check his/her pulse at the wrist for 30 seconds early in each rest period. If the pulse rate exceeds 110 beats per minute, the next work period will be shortened by one-third.

One or more of the following precautions will reduce the risk of heat stress on the Site:

- Provide plenty of liquids to replace lost body fluids; water, electrolytic drinks, or both will be made available to minimize the risk of dehydration and heat stress
- Establish a work schedule that will provide appropriate rest periods
- Establish work regimens consistent with the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines
- Provide adequate employee training on the causes of heat stress and preventive measures

In the highly unlikely event of extreme low temperatures, reasonable precautions will be made to avoid risks associated with low temperature exposure.

<u>Traffic</u>

Field activities will occur near public roadways. As a result, vehicular traffic will be a potential hazard during these activities and control of these areas will be established using barricades or traffic cones. Additional staff will be assigned, as warranted, for the sole purpose of coordinating traffic. Personnel will also be required to wear high-visibility traffic vests while working in the vicinity of the public roadways and local requirements for lane closure will be observed as needed. All work in public rights-of-way will be coordinated with local authorities and will adhere to their requirements for working in traffic zones.

Hazardous Weather Conditions

All Site workers will be made aware of hazardous weather conditions, specifically including extreme heat, and will be requested to take the precautions described herein to avoid adverse health risks. All workers are encouraged to take reasonable, common sense precautions to avoid potential injury associated with possible rain or high wind, sleet, snow or freezing.

Slip, Trip and Fall

Areas at the Site may be slippery from mud or water. Care should be taken by all Site workers to avoid slip, trip, and fall hazards. Workers shall not enter areas that do not have adequate lighting. Additional portable lighting will be provided at the discretion of the HSO.

Biological Hazards

Drugs and alcohol are prohibited from the Site. Any on-site personnel violating this requirement will be immediately expelled from the site.

Any worker or oversight personnel with a medical condition that may require attention must inform the HSO of such condition. The HSO will describe appropriate measures to be taken if the individual should become symptomatic.

Due to the Site location in an urban area, it is highly unlikely that poisonous snakes, spiders, plants and insects will be encountered. However, other animals (dogs, cats, etc.) may be encountered and care should be taken to avoid contact.

4.0 COVID-19 HEALTH AND SAFETY

The following requirements apply to all Tenen employees working on project sites for the duration of the COVID-19 pandemic. These guidelines are based on information provided by the Centers for Disease Control, the Occupational Safety and Health Administration and the New York State "New York Forward" Covid-19 management plans. Information regarding the health status of Tenen employees will be kept confidential, with the exception of required notifications to health authorities. The following are guidelines. As with any potential workplace hazard, employees should report any concerns related to potential Covid-19 exposure to the Project Manager.

Communication/Reporting:

Employees should not report to work and should notify the Project Manager immediately in the event of the following:

- You are exhibiting flu-like symptoms (fever, body aches, cough, difficulty breathing). Contact your health care provider and follow their instructions.
- You do not exhibit symptoms but have a sick (i.e., diagnosed with Covid-19 or exhibiting flu-like symptoms) family member at home. Remember that the virus can be spread by asymptomatic individuals.
- You have been exposed to someone who has been diagnosed with Covid-19.

In each of the above cases, inform your Project Manager regarding others who may have been exposed in order to facilitate any necessary notification or contact tracing efforts.

Hygiene

- Wash hands frequently with soap and water for at least 20 seconds or use hand sanitizer with at least 60% alcohol if soap and water are not available. Key times for employees to clean their hands include:
 - Before and after work shifts
 - Before and after work breaks
 - After blowing the nose, coughing, or sneezing
 - After using the restroom
 - Before eating or preparing food
 - After putting on, touching, or removing face coverings
- Avoid touching the eyes, nose, and mouth with unwashed hands.
- Practice good respiratory etiquette, including covering coughs and sneezes.
- To the extent possible, avoid sharing tools and sampling equipment. Shared tools and equipment should be regularly disinfected.

Physical Distancing

- Minimize contact with others, maintaining a distance of at least six feet to the extent possible
- Employees should wear masks over their nose and mouth to prevent spread of the virus; this is especially important when a minimum 6-foot distance cannot be maintained.
- Maintain the 6-foot distance to the extent possible during sampling efforts and pickup and delivery of sampling equipment and containers.
- Keep job site meetings to a minimum and of short duration; limit the number of people involved and maintain social distance.

5.0 AIR MONITORING

The NYSDOH Generic Community Air Monitoring Plan (CAMP), included as Appendix 1A of DER-10, will be implemented during all ground-intrusive sampling activities.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring should be performed using equipment appropriate for the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- 1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
- 2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
- 3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down.
- 4. All 15-minute readings must be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

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

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10

particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

- 2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.
- 3. All readings must be recorded and be available for State (NYSDEC and NYSDOH) personnel to review.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protection equipment required for various kinds of site investigation tasks is based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, "General Description and Discussion of the Levels of Protection and Protective Gear" and the Centers for CDC COVID-19 "Guidelines on How to Protect Yourselves and Others".

Tenen field personnel and other site personnel will wear Modified Level D-1 personal protective equipment. During activities such as drilling, well installation, or sampling, where there is a chance of contact with contaminated materials, Modified Level D-2 equipment will be worn. The protection will be upgraded to Level C if warranted by the results of the air monitoring. A six-foot minimum distance between individuals (both workers and non-workers) will be maintained at all times. A description of the personnel protective equipment for Levels D and C is provided below.

Modified Level D-1Respiratory Protection:
Protective Clothing:Cloth face covering
Hard hat, steel-toed shoes, long pants, nitrile glovesModified Level D-2Respiratory Protection:
Protective Clothing:Cloth face covering
Hard hat, steel-toed shoes, coveralls/tyvek, nitrile glovesLevel CRespiratory Protection:
Protective Clothing:Air purifying respirator with organic vapor cartridges and filters.
Same as Modified Level D-2

7.0 EXPOSURE MONITORING

7.1 Hazardous Materials

Selective monitoring of workers in the exclusion area may be conducted, as determined by the HSO, if sources of hazardous materials are identified. Personal monitoring may be conducted in the breathing zone at the discretion of the Project Manager or HSO. All monitoring will comply with the CDCs Guidance on Social Distancing.

7.2___COVID-19

For any employee that may have come into contact with a person who has COVID-19, a 14-day quarantine will be imposed for that individual and any employee that individual was in contact with.

8.0 SITE ACCESS

Access to the Site during the investigation will be controlled by the Project Manager or HSO. Unauthorized personnel will not be allowed access to the sampling areas.

9.0 WORK AREAS

During any activities involving drilling or other subsurface disturbance, the work area must be divided into various zones to prevent the spread of contamination, clarify the type of protective equipment needed, and provide an area for decontamination.

The Exclusion Zone is defined as the area where potentially contaminated materials are generated as the result of drilling, sampling, or similar activities. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located adjacent to the Exclusion Zone. The Support Zone is the area where support facilities such as vehicles, a field phone, fire extinguisher and/or first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all Site workers will assemble in the event of an emergency. These zones shall be designated daily, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins.

Control measures such as "Caution" tape and traffic cones will be placed around the perimeter of the work area when work is being done in the areas of concern (i.e., areas with exposed soil) to prevent unnecessary access.

10.0 DECONTAMINATION PROCEDURES

Personnel Decontamination

Personnel decontamination (decon), if deemed necessary by the HSO, will take place in the designated decontamination area delineated for each sampling location. Personnel decontamination will consist of the following steps:

- Soap and potable water wash and potable water rinse of gloves;
- Tyvek removal;
- Glove removal;
- Disposable clothing removal; and
- Field wash of hands and face.

Equipment Decontamination

Sampling equipment, such as split-spoons and bailers, will be decontaminated in accordance with U.S. Environmental Protection Agency methodologies, as described in the work plan.

Disposal of Materials

Purged well water, water used to decontaminate any equipment and well cuttings will be containerized and disposed off-site in accordance with federal, state and local regulations.

11.0 GENERAL SAFE WORK PRACTICES

To protect the health and safety of the field personnel, all field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance.

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited, except in designated areas on the site. These areas will be designated by the HSO.
- Workers must wash their hands and face thoroughly on leaving the work area and before eating, drinking, or any other such activity. The workers should shower as soon as possible after leaving the site.
- Removal of potential contamination from PPE and equipment by blowing, shaking or any means that may disperse materials into the air is prohibited.
- Contact with contaminated or suspected surfaces should be avoided.
- The buddy system should always be used; each buddy should watch for signs of fatigue, exposure, and heat stress.
- Personnel will be cautioned to inform each other of symptoms of chemical exposure such as headache, dizziness, nausea, and irritation of the respiratory tract and heat stress.
- No excessive facial hair that interferes with a satisfactory fit of the face-piece of the respirator to the face will be allowed on personnel required to wear respiratory protective equipment.
- On-site personnel will be thoroughly briefed about the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communications methods.

12.0 EMERGENCY PROCEDURES

The field crew will be equipped with emergency equipment, such as a first aid kit and disposable eye washes. In the case of a medical emergency, the HSO will determine the nature of the emergency and will have someone call for an ambulance, if needed. If the nature of the injury is not serious—i.e., the person can be moved without expert emergency medical personnel—onsite personnel should drive injured person to a hospital. The nearest emergency room is located at the Greenwich Hospital located at 5 Perryridge Road, Greenwich, CT 06830. The phone number is (203) 863-3637. The route to the hospital is shown and detailed on the next page.

12.1 Route to Hospital



Driving directions to Greenwich Hospital from 27-45 North Main Street, Port Chester, New York.

Driving Directions

- 1. Head northeast on US-1 North/North Main Street towards Connecticut (2.6 mi).
- 2. Turn left onto Dearfield Drive (0.3 mi).
- 3. At the traffic circle, take the first exit onto Lake Avenue (0.1 mi).
- 4. Take the first left (62 ft). Destination will be on the right.

12.2 Emergency Contacts

There will be an on-site field phone. Emergency and contact telephone numbers are listed below:

911
(718) 918-5000
(800) 457-7362
(518) 402-8013
(917) 510-6767
(917) 744-5421

13.0 TRAINING

All personnel performing the field activities described in this HASP will have received the initial safety training required by 29 CFR, 1910.120. Current refresher training status also will be required for all personnel engaged in field activities.

All those who enter the work area while intrusive activities are being performed must recognize and understand the potential hazards to health and safety. All field personnel must attend a training program covering the following areas:

- potential hazards that may be encountered;
- the knowledge and skills necessary for them to perform the work with minimal risk to health and safety;
- the purpose and limitations of safety equipment; and
- protocols to enable field personnel to safely avoid or escape from emergencies.

Each member of the field crew will be instructed in the above objectives before he/she goes onto the site. The HSO will be responsible for conducting the training program.

14.0 MEDICAL SURVEILLANCE

All Tenen and subcontractor personnel performing field work involving drilling or other subsurface disturbance at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). The medical examination for Tenen employees will, at a minimum, be provided annually and upon termination of hazardous waste site work.

Appendix A Acknowledgement of HASP

ACKNOWLEDGMENT OF HASP

Below is an affidavit that must be signed by all Tenen Environmental employees who enter the site. A copy of the HASP must be on-site at all times and will be kept by the HSO.

AFFIDAVIT

I have read the Construction Health and Safety Plan (HASP) for the 27-45 North Main Street site in the Village of Port Chester, NY. I agree to conduct all on-site work in accordance with the requirements set forth in this HASP and understand that failure to comply with this HASP could lead to my removal from the site.

Signature:	Date:
Signature:	Date:

Appendix B

Injury Reporting Form (OSHA Form 300)

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.



Form approved OMB no. 1218-0176

U.S. Department of Labor Occupational Safety and Health Administration

State

'ou must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer,
lays away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health
are professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to
se two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this
orm. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name _____

City

Identify the person			Describe the case			Classify the case											
(A) Case	(B) Employee's name	(C) Job title	(D) Date of injury	(E) Where the event occurred	(F) Describe injury or illness, parts of body affected, CHECK ONLY ONE box for each case based on the most serious outcome for that case: Enter the number of that case based on the most serious outcome for the most serious outcome for the most series			CHECK ONLY ONE box for each case based on the most serious outcome for that case:			ch case tcome for Enter the number of days the injured or ill worker was: choose			heck the "Injury" column or hoose one type of illness:			
no.		(e.g., Welder)	or onset of illness	(e.g., Loading dock north end)	and object/substance that directly injured or made person ill (e.g., Second degree burns on			Remaine	d at Work			(M)	ry		oss		
					right forearm from acetylene torch)	Death	Days away from work	Job transfer or restriction	Other record- able cases	Away from work	On job transfer or restriction	Injury Skin disor	Respirato	Poisoning	Hearing l All other illnesses		
			,			(G)	(H)	(I)	(J)	(K)	(L)	(1) (2	.) (3)	(4)	(5) (6)		
			 month/day							days	days						
			/							days	days						
										days	days						
			/ month/day							days	a days						
			/							days	ays						
			/							days	a days						
			/							days	ays						
			/							days	a days						
			/ month/day							days	a days						
			/							days	a days						
			/							days	a days						
			/ month/day							days	a days						
			/							days	ays						
			month/day		Page totals		_		_								

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office. Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Page ____ of ____

(1) (2) (3) (4)

(5)

(6)

Injury

Appendix C Material Safety Data Sheets (MSDS)

Benzene - ToxFAQs[™]

CAS # 71-43-2

This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHTLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 1,000 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is benzene?

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and other synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

- Industrial processes are the main source of benzene in the environment.
- Benzene can pass into the air from water and soil.
- It reacts with other chemicals in the air and breaks down within a few days.
- Benzene in the air can attach to rain or snow and be carried back down to the ground.
- It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure.
- Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- Working in industries that make or use benzene.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries, but we do not know for certain that benzene caused the effects. It is not known whether benzene will affect fertility in men.



Agency for Toxic Substances and Disease Registry Division of Toxicology and Human Health Sciences

Benzene

CAS # 71-43-2

How likely is benzene to cause cancer?

Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the bloodforming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.

How can benzene affect children?

Children can be affected by benzene exposure in the same ways as adults. It is not known if children are more susceptible to benzene poisoning than adults.

Benzene can pass from the mother's blood to a fetus. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How can families reduce the risks of exposure to benzene?

Benzene exposure can be reduced by limiting contact with gasoline and cigarette smoke. Families are encouraged not to smoke in their house, in enclosed environments, or near their children.

Is there a medical test to determine whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is a test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood; however, since benzene disappears rapidly from the blood, this test is only useful for recent exposures. In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. The metabolite S-phenylmercapturic acid in urine is a sensitive indicator of benzene exposure. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 5 parts benzene per billion parts of water (5 ppb).

The Occupational Safety and Health Administration (OSHA) has set limits of 1 part benzene per million parts of workplace air (1 ppm) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR) 2007. Toxicological Profile for Benzene (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs[™] Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



1,2-DICHLOROETHENE CAS # 540-59-0, 156-59-2, and 156-60-5

Agency for Toxic Substances and Disease Registry ToxFAQs

September 1997

This fact sheet answers the most frequently asked health questions (FAQs) about 1,2-dichloroethene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to 1,2-dichloroethene occurs mainly in workplaces where it is made or used. Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired. *cis*-1,2-Dichloroethene has been found in at least 146 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA). *trans*-1,2-Dichloroethene was found in at least 563 NPL sites. 1,2-Dichloroethene was found at 336 sites, but the isomer (*cis*- or *trans*-) was not specified.

What is 1,2-dichloroethene?

(Pronounced 1,2-dī-klôr' ō-ĕth'ēn)

1,2-Dichloroethene, also called 1,2-dichloroethylene, is a highly flammable, colorless liquid with a sharp, harsh odor. It is used to produce solvents and in chemical mixtures. You can smell very small amounts of 1,2-dichloroethene in air (about 17 parts of 1,2-dichloroethene per million parts of air [17 ppm]).

There are two forms of 1,2-dichloroethene; one is called *cis*-1,2-dichloroethene and the other is called *trans*-1,2-dichloroethene. Sometimes both forms are present as a mixture.

What happens to 1,2-dichloroethene when it enters the environment?

- □ 1,2-Dichloroethene evaporates rapidly into air.
- □ In the air, it takes about 5-12 days for half of it to break down.
- □ Most 1,2-dichloroethene in the soil surface or bodies of water will evaporate into air.
- □ 1,2-Dichloroethene can travel through soil or dissolve in water in the soil. It is possible that it can contaminate groundwater.
- □ In groundwater, it takes about 13-48 weeks to break down.

□ There is a slight chance that 1,2-dichloroethene will break down into vinyl chloride, a different chemical which is believed to be more toxic than 1,2-dichloroethene.

How might I be exposed to 1,2-dichloroethene?

- □ Breathing 1,2-dichloroethene that has leaked from hazardous waste sites and landfills.
- Drinking contaminated tap water or breathing vapors from contaminated water while cooking, bathing, or washing dishes.
- □ Breathing 1,2-dichloroethene, touching it, or touching contaminated materials in the workplace.

How can 1,2-dichloroethene affect my health?

Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired; breathing very high levels can kill you.

When animals breathed high levels of *trans*-1,2dichloroethene for short or longer periods of time, their livers and lungs were damaged and the effects were more severe with longer exposure times. Animals that breathed very high

ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html

levels of trans-1,2-dichloroethene had damaged hearts.

Animals that ingested extremely high doses of *cis*- or *trans*-1,2-dichloroethene died.

Lower doses of *cis*-1,2-dichloroethene caused effects on the blood, such as decreased numbers of red blood cells, and also effects on the liver.

The long-term (365 days or longer) human health effects after exposure to low concentrations of 1,2-dichloroethene aren't known. One animal study suggested that an exposed fetus may not grow as quickly as one that hasn't been exposed.

Exposure to 1,2-dichloroethene hasn't been shown to affect fertility in people or animals.

How likely is 1,2-dichloroethene to cause cancer?

The EPA has determined that *cis*-1,2-dichloroethene is not classifiable as to its human carcinogenicity.

No EPA cancer classification is available for *trans*-1,2-dichloroethene.

Is there a medical test to show whether I've been exposed to 1,2-dichloroethene?

Tests are available to measure concentrations of the breakdown products of 1,2-dichloroethene in blood, urine, and tissues. However, these tests aren't used routinely to determine whether a person has been exposed to this compound. This is because after you are exposed to 1,2-dichloroethene, the breakdown products in your body that are detected with these tests may be the same as those that come from exposure to other chemicals. These tests aren't available in most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum allowable level of *cis*-1,2dichloroethene in drinking water at 0.07 milligrams per liter of water (0.07 mg/L) and *trans*-1,2-dichloroethene at 0.1 mg/L.

The EPA requires that any spills or accidental release of 1,000 pounds or more of 1,2-dichloroethene must be reported to the EPA.

The Occupational Health Safety and Health Administration (OSHA) has set the maximum allowable amount of 1,2-dichloroethene in workroom air during an 8-hour workday in a 40-hour workweek at 200 parts of 1,2-dichloroethene per million parts of air (200 ppm).

Glossary

Carcinogenicity: Ability of a substance to cause cancer.

CAS: Chemical Abstracts Service.

Fertility: Ability to reproduce.

Ingest: To eat or drink something.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Solvent: A chemical that can dissolve other substances.

References

This ToxFAQs information is taken from the 1996 Toxicological Profile for 1,2-Dichloroethene produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Federal Recycling Program



Copper (Cu) is an element and metal. It is found in rocks, soils, water, and air. Copper is an essential nutrient for humans and is in many foods. It's also essential to animals and

What is copper?

plants. Copper and substances containing copper are used in many industries in the U.S.. Copper can be found in materials and products such as wiring, plumbing, pesticides, cookware, and dietary supplements, among others. Copper scrap can be combined with other metals to make brass and bronze pipes. In the U.S., copper is mined and recovered from metal through smelting.

What happens to copper in the environment?

- Copper is released from natural sources, such as windblown dusts, decaying vegetation, and from • human activities like municipial solid waste management and fossil fuel burning.
- In air, copper usually attaches to particles (particulate matter) and can travel far from its source. •
- In water, copper will usually attach to soils if possible, or dissolve. •
- Copper attaches to soils, where it can be taken up by plants.
- Mollusks, such as clams and ovsters, can build up copper in their • bodies.
- Copper does not break down in the environment. •

How can I be exposed to copper?

- People ingest copper from drinking water and food, inhale copper from air, and may touch copper or • products that contain copper.
- Drinking water can contain high levels of copper if your home has copper pipes and acidic water. This is ٠ more likely to occur in new or recently renovated buildings/homes using copper plumbing.
- Blue copper sulfate crystals are available to purchase and have been accidentally ingested by people • who confused them for candy or toys.
- ٠ You may be exposed to copper fumes if you work or live near a site that uses copper in mining, agriculture, or in a facilitity that processes copper.
- Soils near mines, processing facilities, or waste dump sites may have a lot of copper. ٠

How can copper affect my health?

It is essential for people to ingest small amounts of copper everyday in food and water. Ingesting too much or too little copper can lead to illness and/or disease. Ingesting a high amount of copper, usually in drinking water, can cause vomiting, nausea, abdominal pain, and/or diarrhea. Ingesting higher than recommended amounts of copper every day over time, such as in water or in copper supplements, can lead to severe illness, such as kidney and liver damage.

Breathing in copper dusts, sprays, or crystals can irritate your nose and throat, and cause dizziness and headaches. People who have ingested these substances have gotten very sick and/or died.

Copper is essential to the development of babies and children, and is found in breastmilk. Babies and children are expected to have symptoms similar to adults when exposed to high levels of copper in air, water, or food. If you have a disorder that causes copper to build up in your body, like Wilson's disease, you may be especially vulnerable to high copper levels in air, food, or water.

Agency for Toxic Substances and Disease Registry Office of Innovation and Analytics, Toxicology Section

Copper - ToxFAQs™





Ingesting copper in food is necessary for human health. Too much copper can be harmful.

Copper

Can copper cause cancer?

The U.S. Department of Health and Human Services (DHHS) has not evaluated the carcinogenicity (whether it causes cancer) of copper.

The U.S. Environmental Protection Agency (EPA) has not classified if copper is carcinogenic (cancer causing) to humans.

The International Agency for Research on Cancer (IARC) has not evaluated the carcinogenicity of copper. IARC lists copper 8-hydroyquinoline as a group 3 agent indicating the carcinogenicity in humans cannot be classified due to lack of cancer studies in humans and animals.

Can I get a medical test to check for copper?

There are tests to measure the amount of copper in your blood, urine, nails, and hair. Your medical provider can help decide if a test is needed and which is the most appropriate for you. High levels of copper in these tests can show if you have been exposed to a lot of copper or if there is a problem with copper regulation in the body. These tests will not predict if you will have health problems. These tests are not part of standard health tests that are done at your doctor's office and are done through a special lab. If you think you may have been exposed to high levels of copper, talk to your doctor, nurse, or clinic, or call poison control.

How can I protect my family from copper exposure?

If your water is metallic or bitter in taste or smell, and/or is green-blue in color this may be a sign that there is too much copper in your drinking water. If you have copper piping, it can leach into water if your home is new or recently renovated, or if your water is corrosive. Regularly cleaning or flushing out your system can help avoid this. There are tests available to check if your water is corrosive or if copper levels in your water are high.

Safely store copper powders, crystals, or dusts away from children, pets, or other adults.

Monitor your copper intake if you are adding more copper to your diet, such as by taking dietary supplements with copper, to make sure you are not eating too much. Talk to your doctor, nurse, or clinic to figure out if you are taking the proper amount of copper.

If you work with copper, wear the necessary protective clothing and equipment, and always follow safety procedures. Shower and change your clothes before going home each day.

Want more information?

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at <u>https://wwwn.cdc.gov/dcs/ContactUs/Form</u>



Go to ATSDR's Toxicological Profile for Copper

Go to ATSDR's Toxic Substances Portal: http://www.atsdr.cdc.gov/substances/index.asp

If you have any more questions or concerns, you can also find & contact your ATSDR Regional Representative at <u>http://www.atsdr.cdc.gov/DRO/dro_org.html</u>

Ethylbenzene- ToxFAQs™

CAS # 100-41-4

This fact sheet answers the most frequently asked health questions (FAQs) about ethylbenzene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Breathing lower levels has resulted in hearing effects and kidney damage in animals. Ethylbenzene has been found in at least 829 of 1,699 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is ethylbenzene?

Ethylbenzene is a colorless, flammable liquid that smells like gasoline.

It is naturally found in coal tar and petroleum and is also found in manufactured products such as inks, pesticides, and paints.

Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

What happens to ethylbenzene when it enters the environment?

- Ethylbenzene moves easily into the air from water and soil.
- It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.
- In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water.
- Ethylbenzene can move through soil into groundwater.
- In soil, it is broken down by bacteria.

How might I be exposed to ethylbenzene?

• If you live in a city or near many factories or heavily traveled highways, you may be exposed to ethylbenzene in air.

- Releases of ethylbenzene into the air occur from burning oil, gas, and coal and from industries using ethylbenzene.
- Ethylbenzene is not often found in drinking water. Higher levels may be found in residential drinking water wells near landfills, waste sites, or leaking underground fuel storage tanks.
- Exposure can occur if you work in an industry where ethylbenzene is used or made.
- Exposure can occur if you use products containing it, such as gasoline, carpet glues, varnishes, and paints.

How can ethylbenzene affect my health?

Exposure to high levels of ethylbenzene in air for short periods can cause eye and throat irritation. Exposure to higher levels can result in dizziness.

Irreversible damage to the inner ear and hearing has been observed in animals exposed to relatively low concentrations of ethylbenzene for several days to weeks.

Exposure to relatively low concentrations of ethylbenzene in air for several months to years causes kidney damage in animals.

How likely is ethylbenzene to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that ethylbenzene is a possible human carcinogen.


Ethylbenzene

CAS # 100-41-4

How does ethylbenzene affect children?

There are no studies evaluating the effects of ethylbenzene exposure on children or immature animals. It is likely that children would have the same health effects as adults. We do not know whether children would be more sensitive than adults to the effects of ethylbenzene.

We do not know if ethylbenzene will cause birth defects in humans. Minor birth defects and low birth weight have occurred in newborn animals whose mothers were exposed to ethylbenzene in air during pregnancy.

How can families reduce the risk of exposure to ethylbenzene?

- Use adequate ventilation to reduce exposure to ethylbenzene vapors from consumer products such as gasoline, pesticides, varnishes and paints, and newly installed carpeting.
- Sometimes older children sniff household chemicals, including ethylbenzene, in an attempt to get high. Talk with your children about the dangers of sniffing chemicals.
- Household chemicals should be stored out of reach of children to prevent accidental poisoning. Always store household chemicals in their original containers; never store them in containers that children would find attractive to eat or drink from, such as old soda bottles. Gasoline should be stored in a gasoline can with a locked cap.

Is there a medical test to show whether I've been exposed to ethylbenzene?

Ethylbenzene is found in the blood, urine, breath, and some body tissues of exposed people. The most common way to test for ethylbenzene is in the urine. This test measures substances formed by the breakdown of ethylbenzene. Because these substances leave the body very quickly, this test needs to be done within a few hours after exposure occurs.

These tests can show you were exposed to ethylbenzene, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to ethylbenzene in drinking water at concentrations of 30 mg/L for 1 day or 3 mg/L for 10 days is not expected to cause any adverse effects in a child.

The EPA has determined that lifetime exposure to 0.7 mg/L ethylbenzene is not expected to cause any adverse effects.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 100 ppm for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Toxicological Profile for Ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs[™] Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Lead - ToxFAQs[™]

What is lead?

Lead is a metal found naturally in the earth's crust. It can be found in all parts of our environment, including air, water, and soil. Lead can combine with other chemicals to make different compounds.

Lead is used in the production of batteries, ammunition, and metal products (solder and pipes). Because of health concerns, the use of lead in paints, ceramic products, caulking, and pipe solder has been dramatically reduced. The use of lead as an additive to automobile gasoline was banned in 1996 in the United States.

What happens to lead in the environment?

- Lead is an element, so it does not break down.
- When lead is released into the air, it may be transported long distances before it lands and stays on the ground.
- Once on the ground, lead can often stick to soil particles.
- Lead in soil can get into groundwater, but the amount of lead that moves into groundwater will depend on the lead compound and soil type.

How can I be exposed to lead?

- Eating food or drinking water that contains lead.
- Drinking water from pipes that were soldered with lead can cause exposure.
- Spending time or living in homes with lead-based paints can result in exposure when the paint breaks down and forms dust, which can get on your hands, or into your mouth and nose and be swallowed.
- Spending time in areas where the soil is contaminated with lead.
- Working in a job where lead is used or participating in certain hobbies where lead is used, such as making stained glass.
- Using healthcare products from other countries, alternative treatments, or folk remedies.

How can lead affect my health?

The effects of lead are the same whether it enters the body by breathing it in or eating it. Lead can affect almost every organ and system in your body. The nervous system is the main target for lead poisoning in children and adults. Long-term exposure can result in decreased learning, memory, and attention, and weakness in fingers, wrists, or ankles. Lead exposure can cause anemia (low iron in the blood) and damage to the kidneys. It can also cause increases in blood pressure, particularly in middle-aged and older individuals. Exposure to high lead levels can severely damage the brain and kidneys and can cause death. In pregnant women, exposure to high levels of lead may cause a miscarriage. In men, it can cause damage to reproductive organs.

Agency for Toxic Substances and Disease Registry Division of Toxicology and Human Health Sciences Lead can cause health problems in almost every organ and system in your body.





Lead

How can lead affect children?

Children are more vulnerable to lead poisoning than adults because their nervous system is still developing. Children can be exposed to lead in their environment and before birth from lead in their mother's body. At lower levels of exposure, lead can decrease mental development, especially learning, intelligence, and behavior. Physical growth may also be decreased. A child who swallows large amounts of lead may develop anemia, severe stomachache, muscle weakness, and brain damage. Exposure to lead during pregnancy can also result in premature births. Some effects of lead poisoning in a child may continue into adulthood.

Can lead cause cancer?

Several agencies and organizations both in the United States and internationally have reviewed studies and made an assessment about whether lead can cause cancer.

- The Department of Health and Human Services (HHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens (causing cancer in people).
- The U.S. Environmental Protection Agency (EPA) has classified lead as a probable human carcinogen.
- The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans, and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

Can I get a medical test to check for lead?

A blood test is available to measure the amount of lead in your blood. Blood tests are commonly used to screen children for lead poisoning. Your doctor can draw blood samples and send them to appropriate laboratories for analysis. If you think you or anyone in your family has been exposed to lead, contact your doctor, nurse, or poison control center.

How can I protect my family from lead exposure?

- Avoid exposure to sources of lead.
- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint.
- If your home contains lead-based paint (built before 1978), or if you live in an area contaminated with lead, wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house to remove lead dust and lead tracked in soil.
- Certain water pipes may contain lead, so if you know that pipes have lead solder, you should avoid drinking from that source.
- Check for lead in some products such as toys and jewelry and avoid such products.
- Lead is sometimes in candies imported from other countries or traditional home remedies; find out if yours has any lead and avoid using these products or giving them to children.
- You can learn more about preventing lead poisoning here: <u>https://www.cdc.gov/nceh/lead/faqs/lead-faqs.htm</u>

Want more information?

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at <u>https://wwwn.cdc.gov/dcs/ContactUs/Form</u> Go to ATSDR's <u>Toxicological Profile for Lead</u>

CDC Lead Poisoning Prevention Program https://www.cdc.gov/nceh/lead/default.htm

Environmental Protection Agency https://www.epa.gov/lead/protect-your-family-exposures-lead

Go to ATSDR's Toxic Substances Portal: <u>https://wwwn.cdc.gov/TSP/index.aspx</u>

If you have any more questions or concerns, you can also find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Mercury - ToxFAQs[™]

What is mercury?

Mercury is a naturally occurring element with a chemical symbol of Hg. Elemental mercury is a silver liquid at room temperature that can also evaporate into the air as a gas or become a solid at very low temperatures. It can combine with other substances to form solid compounds that are categorized into two groups: inorganic mercury salts and organic mercury compounds. Mercury and mercury compounds are odorless.



Mercury is used in a number of industries and products. It is primarily used in the manufacture of electronics, fluorescent-lighting, and production of chlorine-caustic soda. It is also used in dental products (fillings), although uses in dentistry are being phased-out. Other historical uses of mercury (batteries; thermometers and other scientific and medical devices; electronic switches and lighting applications; paints and pigments; fungicides and pesticides) have been eliminated or drastically reduced.

What happens to mercury in the environment?

Because mercury is a naturally occurring element, it can be found in the air, water, or soil. It can also be found in the environment due to industrial releases to air and water. Industrial releases to air have steadily decreased over the past few decades.

Mercury does not break down in the environment. In air, mercury may spread far from where it was released. Mercury seldom appears as a silver liquid in the environment. In water, mercury can evaporate into the air. In soil, it can adhere (stick) to soil and sediments (dirt deposits at the bottom of bodies of water). One type of organic mercury compound called methylmercury can build up in plants and fish.

How can I be exposed to mercury?

Most people are exposed to organic mercury compounds (typically methylmercury) in food (such as fish, seafood, rice) or to elemental mercury from dental fillings. Food is the most common form of exposure. Most people are not exposed to inorganic mercury salts. Industrial and dental workers who use mercury are primarily exposed to elemental mercury. Some cultures use mercury in traditional medicines or religious practices, although this is not recommended or approved for use in the United States.

How can mercury affect my health?

All forms of mercury can affect the nervous system and the kidneys. Workers exposed to elemental mercury vapor and people who eat foods with high levels of methylmercury experienced tremors, incoordination, impaired vision, impaired learning and memory, and mood changes. Some children born in communities that ate food with high levels of organic mercury had learning, sensory, and movement problems. In people exposed to high levels of methylmercury Mercury can affect the nervous system and kidneys. The health effects from exposure to mercury depend on a number of factors including the amount and form of mercury, route and length of exposure, and age.

in their diets, birth defects have occurred. Some humans and animals that ate mercury compounds had high blood pressure and alterations in their immune systems. Animals that breathed elemental mercury vapor or ate organic or inorganic mercury compounds in their diets showed nervous system effects and/or kidney damage. Animals that ate high levels of mercury compounds showed decreased fertility and/or birth defects.



Mercury

Can mercury cause cancer?

Rats that ate an inorganic mercury compound for a long period of time developed stomach or thyroid cancer. Rats and mice that aate organic mercury compounds for a long period of time developed kidney cancer.

The <u>U.S. Department of Health and Human Services (DHHS)</u> has not evaluated the potential of mercury or mercury compounds to cause cancer in people.

The <u>U.S. Environmental Protection Agency (EPA)</u> has determined that mercuric chloride (inorganic mercury salt) and methylmercury (organic mercury compound) are possible human carcinogens (cause cancer). The EPA did not classify the potential of elemental mercury to cause cancer in humans.

The <u>International Agency for Research on Cancer (IARC)</u> classified methylmercury compounds as possibly carcinogenic to humans. IARC designated inorganic mercury and elemental mercury as not classifiable for causing cancer in humans.

Can I get a medical test to check for mercury?

Mercury can be measured in your blood, urine, hair, or toenails. However, tests cannot determine which form of mercury you were exposed to. Tests also cannot predict whether you will have health problems. If you think you have been exposed to mercury, call your doctor, nurse, or poison control center.

How can I protect myself and my family from mercury?

People should avoid eating fish that contain high levels of methylmercury. This is particularly important for pregnant women and children. Follow your state's health advisories that tell you about whether it is okay to eat fish or wildlife caught in contaminated areas. Avoid all contact with spills of the liquid form of elemental mercury (the type of mercury found in old thermometers). If a spill occurs, refer to https://www.atsdr.cdc.gov/dontmesswithmercury for safe clean-up practices. Most people don't need to take any special steps to avoid exposure to inorganic mercury salts in their daily lives. Keep children from playing in areas near hazardous waste sites to avoid coming in contact with mercury.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at <u>https://wwwn.cdc.gov/dcs/ContactUs/Form</u>

Go to ATSDR's Toxicological Profile for mercury: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=115&tid=24

Go to ATSDR's Toxic Substances Portal: <u>https://wwwn.cdc.gov/TSP/index.aspx</u>

Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html



Methyl *tert*-Butyl Ether (MTBE)-ToxFAQs™

What is MTBE?

Methyl tert-butyl ether (MTBE) is a flammable, colorless liquid with a disagreeable odor.

MTBE was added to gasoline in the 1980s to increase fuel efficiency and decrease pollution. When MTBE started to be detected in groundwater, several states banned its use in gasoline and it has not been added to gasoline in the United States since 2005. However, MTBE is still made in the United States and exported to other countries.

MTBE can also be used to dissolve gallstones in patients for which surgical options are too risky. Patients treated in this way have MTBE delivered directly to their gall bladders through special tubes that are surgically inserted. MTBE has not been approved for medical use in the United States since 2015, but is still used as a non-surgical option in some countries.

What happens to MTBE in the environment?

MTBE quickly evaporates from open containers and surface water, so it is commonly found as a vapor in the air. Small amounts of MTBE may dissolve in water and get into underground water. MTBE can quickly move through the soil; therefore, once in the soil, it can also make its way to underground water. MTBE breaks down quickly in the air and it does not significantly build up in plants or animals.

How can I be exposed to MTBE?

When MTBE stopped being added to gasoline, the amount found in the environment dramatically decreased. Most people are therefore not likely to come in contact with this chemical. The most likely way that you could be exposed to MTBE is by breathing contaminated air or drinking contaminated water or living near a hazardous waste site. If your water has MTBE in it, activities such as showering or bathing can expose you to this chemical. Workers who produce MTBE for export may also be exposed.

How can MTBE affect my health?

MTBE is quickly taken in by your body after breathing or eating it. The liver rapidly breaks most of it down and it is released into the urine. Breathing gasoline with MTBE in it has caused some people to experience headaches, nausea or vomiting, dizziness, a feeling of spaciness, and coughing.

Since MTBE is no longer added to gasoline in the United States, your risk of exposure is low.

Since gasoline contains many chemicals, it is not clear if the effects were due only to MTBE. In other studies, people exposed to low levels of MTBE for a short period of time did not have any of these effects. Studies using animals to look at possible health effects found that animals that breathed high levels of MTBE were less active and showed reduced reflexes and coordination, difficulty breathing, and liver effects.

There is no information on how drinking water or bathing in water that is contaminated with MTBE will affect a person's health. In studies where rats and mice ate high amounts of MTBE, the animals had gastrointestinal irritation and damage to the liver and male reproductive organs.

Agency for Toxic Substances and Disease Registry Office of Innovation and Analytics, Toxicology Section





Can MTBE cause cancer?

There are no studies that show that MTBE causes cancer in people. Breathing high levels of MTBE for a long period of time caused liver cancer in mice. Eating high levels of MTBE for a long period of time caused testicular cancer, lymphomas, and leukemia in rats. Drinking high levels of MTBE dissolved in water for long periods did not cause cancer in mice.

The International Agency for Research on Cancer (IARC) determined that MTBE was not classifiable as to its ability to cause cancer in people. The Department of Health and Human Services and U.S. Environmental Protection Agency (EPA) have not classified MTBE's cancer-causing risk.

Can I get a medical test to check for MTBE?

There are tests available to measure MTBE and its breakdown product in your breath, blood, and urine. MTBE does not stay in your body long, so these tests need to be done soon after exposure (up to 1–2 days). These tests cannot predict whether you will have health problems from the exposure to MTBE. Doctor's offices do not routinely offer these tests. If you think you have been exposed to this or any other chemical, talk to your doctor or nurse or call poison control.

How can I protect myself and my family from MTBE?

If your drinking water is supplied by a public water system, you can contact them for information on MTBE levels in the water. If you have a private well for water, your local health department may be able to tell you if MTBE has been found in water in your area. You may also want to get your water tested by a certified laboratory.

Children should avoid playing near industrial or hazardous waste sites to prevent exposures to chemicals including MTBE.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at <u>https://wwwn.cdc.gov/dcs/ContactUs/Form</u>

Go to ATSDR's Toxicological Profile for MTBE: <u>https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=228&tid=41</u>

Go to ATSDR's Toxic Substances Portal: <u>https://wwwn.cdc.gov/TSP/index.aspx</u>

Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs[™]

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl'ĭ-sī'klĭk ăr'ə-măt'ĭk hī'drə-kar'bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.

- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.



Agency for Toxic Substances and Disease Registry Division of Toxicology and Human Health Sciences

Polycyclic Aromatic Hydrocarbons

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m³). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m³ averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m³ for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs[™] Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Tetrachloroethylene - ToxFAQs™

CAS # 127-18-4

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing and in the aerospace industry. Exposure to very high concentrations of tetrachloroethylene can cause dizziness headaches, sleepiness, incoordination confusion, nausea, unconsciousness, and even death. Tetrachloroethylene has been found in at least 949 of the 1,854 National Priorities List sites identified by U.S. Environmental Protection Agency (EPA).

What is tetrachloroethylene?

Tetrachloroethylene is a nonflammable colorless liquid. Other names for tetrachloroethylene include perchloroethylene, PCE, perc, tetrachloroethene, and perchlor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part in 1 million parts of air (1 ppm) or more.

Tetrachloroethylene is used as a dry cleaning agent and metal degreasing solvent. It is also used as a starting material (building block) for making other chemicals and is used in some consumer products.

What happens to tetrachloroethylene when it enters the environment?

- Tetrachloroethylene can be released into air, water, and soil at places where it is produced or used.
- Tetrachloroethylene breaks down very slowly in the air and so it can be transported long distances in the air. Half of the amount in the air will degrade in approximately 100 days.
- Tetrachloroethylene evaporates quickly from water into air. It is generally slow to break down in water.
- Tetrachloroethylene may evaporate quickly from shallow soils or may filter through the soil and into the groundwater below. It is generally slow to break down in soil.

How might I be exposed to tetrachloroethylene?

- When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.
- When you drink water containing tetrachloroethylene, you are exposed to it. You might also be exposed to tetrachloroethylene that is released into the air during showering and bathing.
- People residing near contaminated sites or dry cleaning locations may be exposed to higher levels than the general population.
- People working in the dry cleaning industries or using metal degreasing products may be exposed to elevated levels of tetrachloroethylene.

How can tetrachloroethylene affect my health?

Breathing high levels of tetrachloroethylene for a brief period may cause dizziness or drowsiness, headache, and incoordination; higher levels may cause unconsciousness and even death.

Exposure for longer periods to low levels of tetrachloroethylene may cause changes in mood, memory, attention, reaction time, and vision.

Studies in animals exposed to tetrachloroethylene have shown liver and kidney effects, and changes in brain chemistry, but we do not know what these findings mean for humans.



Division of Toxicology and Human Health Sciences

Tetrachloroethylene

CAS # 127-18-4

How likely is tetrachloroethylene to cause cancer?

Studies in humans suggest that exposure to tetrachloroethylene might lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma.

In animals, tetrachloroethylene has been shown to cause cancers of the liver, kidney, and blood system.

The Department of Health and Human Services (DHHS) considers tetrachloroethylene to be reasonably anticipated to be a human carcinogen. EPA considers tetrachloroethylene likely to be carcinogenic to humans by all routes of exposure. The International Agency for Research on Cancer (IARC) considers tetrachloroethylene probably carcinogenic to humans.

How can tetrachloroethylene affect children?

It is not known whether children are more susceptible than adults to the effects of tetrachloroethylene.

A few studies in humans have suggested that exposure to tetrachloroethylene increased the numbers of babies with birth defects, but these studies were not large enough to clearly answer the question. Studies in animals exposed by inhalation or stomach tube have not shown clear evidence of specific birth defects.

How can families reduce the risk of exposure to tetrachloroethylene?

- Tetrachloroethylene has been found in low levels in some food. You can minimize the risk of your family's exposure by peeling and thoroughly washing fruits and vegetables before cooking.
- Use bottled water if you have concerns about the presence of tetrachloroethylene in your tap water. You may also contact local drinking water authorities and follow their advice.

- Prevent children from playing in dirt or eating dirt if you live near a waste site that has tetrachloroethylene.
- Tetrachloroethylene is widely used as a scouring solvent that removes oils from fabrics, as a carrier solvent, as a fabric finish or water repellant, and as a metal degreaser/cleaner. Follow instructions on product labels to minimize exposure to tetrachloroethylene.

Is there a medical test to determine whether I've been exposed to tetrachloroethylene?

Tetrachloroethylene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of tetrachloroethylene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because tetrachloroethylene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average permissible exposure limit of 100 ppm, an acceptable ceiling exposure limit of 200 ppm, and a maximum peak of 300 ppm (not to be exceeded for more than 5 minutes of any 3-hour period).

The National Institute for Occupational Safety and Health (NIOSH) recommends that workplace exposure to tetrachloroethylene be minimized due to concerns about its carcinogenicity.

Reference

This ToxFAQs[™] information is taken from the 2019 Toxicological Profile for Tetrachloroethylene produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs[™] on the web: <u>www.atsdr.cdc.gov/ToxFAQs</u>

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Trichloroethylene - ToxFAQs™

CAS # 79-01-6

This fact sheet answers the most frequently asked health questions (FAQs) about trichloroethylene. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Trichloroethylene is used as a solvent for cleaning metal parts. Exposure to very high concentrations of trichloroethylene can cause dizziness headaches, sleepiness, incoordination, confusion, nausea, unconsciousness, and even death. Trichloroethylene has been found in at least 1,051 of the 1,854 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is trichloroethylene?

Trichloroethylene is a colorless, volatile liquid. Liquid trichloroethylene evaporates quickly into the air. It is nonflammable and has a sweet odor.

The two major uses of trichloroethylene are as a solvent to remove grease from metal parts and as a chemical that is used to make other chemicals, especially the refrigerant, HFC-134a.

What happens to trichloroethylene when it enters the environment?

- Trichloroethylene can be released to air, water, and soil at places where it is produced or used.
- Trichloroethylene is broken down quickly in air.
- Trichloroethylene breaks down very slowly in soil and water and is removed mostly through evaporation to air.
- It is expected to remain in groundwater for long time since it is not able to evaporate.
- Trichloroethylene does not build up significantly in plants or animals.

How might I be exposed to trichloroethylene?

- · Breathing trichloroethylene in contaminated air.
- Drinking contaminated water.
- Workers at facilities using this substance for metal degreasing are exposed to higher levels of trichloroethylene.
- If you live near such a facility or near a hazardous waste site containing trichloroethylene, you may also have higher exposure to this substance.

Agency for Toxic Substances and Disease Registry

How can trichloroethylene affect my health?

Trichloroethylene was once used as an anesthetic for surgery. Exposure to moderate amounts of trichloroethylene may cause headaches, dizziness, and sleepiness; large amounts may cause coma and even death. Eating or breathing high levels of trichloroethylene may damage some of the nerves in the face. Exposure to high levels can also result in changes in the rhythm of the heartbeat, liver damage, and evidence of kidney damage. Skin contact with concentrated solutions of trichloroethylene can cause skin rashes. There is some evidence exposure to trichloroethylene in the work place may cause scleroderma (a systemic autoimmune disease) in some people. Some men occupationally-exposed to trichloroethylene and other chemicals showed decreases in sex drive, sperm quality, and reproductive hormone levels.

How likely is trichloroethylene to cause cancer?

There is strong evidence that trichloroethylene can cause kidney cancer in people and some evidence for trichloroethylene-induced liver cancer and malignant lymphoma. Lifetime exposure to trichloroethylene resulted in increased liver cancer in mice and increased kidney cancer and testicular cancer in rats.

The Department of Health and Human Services (DHHS) considers trichloroethylene to be a known human carcinogen. The International Agency for Research on Cancer (IARC) classified trichloroethylene as carcinogenic to humans. The EPA has characterized trichloroethylene as carcinogenic to humans by all routes of exposure.



Division of Toxicology and Human Health Sciences

Trichloroethylene

CAS # 79-01-6

How can trichloroethylene affect children?

It is not known whether children are more susceptible than adults to the effects of trichloroethylene.

Some human studies indicate that trichloroethylene may cause developmental effects such as spontaneous abortion, congenital heart defects, central nervous system defects, and small birth weight. However, these people were exposed to other chemicals as well.

In some animal studies, exposure to trichloroethylene during development caused decreases in body weight, increases in heart defects, changes to the developing nervous system, and effects on the immune system.

How can families reduce the risk of exposure to trichloroethylene?

- Avoid drinking water from sources that are known to be contaminated with trichloroethylene. Use bottled water if you have concerns about the presence of chemicals in your tap water. You may also contact local drinking water authorities and follow their advice.
- Prevent children from playing in dirt or eating dirt if you live near a waste site that has trichloroethylene.
- Trichloroethylene is used in many industrial products. Follow instructions on product labels to minimize exposure to trichloroethylene.

Is there a medical test to determine whether I've been exposed to trichloroethylene?

Trichloroethylene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of trichloroethylene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because trichloroethylene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure.

Has the federal government made recommendations to protect human health?

The EPA set a maximum contaminant goal (MCL) of 0.005 milligrams per liter (mg/L; 5 ppb) as a national primary drinking standard for trichloroethylene.

The Occupational Safety and Health Administration (OSHA) set a permissible exposure limit (PEL) of 100 ppm for trichloroethylene in air averaged over an 8-hour work day, an acceptable ceiling concentration of 200 ppm provided the 8 hour PEL is not exceeded, and an acceptable maximum peak of 300 ppm for a maximum duration of 5 minutes in any 2 hours.

The National Institute for Occupational Safety and Health (NIOSH) considers trichloroethylene to be a potential occupational carcinogen and established a recommended exposure limit (REL) of 2 ppm (as a 60-minute ceiling) during its use as an anesthetic agent and 25 ppm (as a 10-hour TWA) during all other exposures.

Reference

This ToxFAQs[™] information is taken from the 2019 Toxicological Profile for Trichloroethylene produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs[™] on the web: <u>www.atsdr.cdc.gov/ToxFAQs</u>

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Toluene - ToxFAQs™

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. It occurs naturally in crude oil and in the tolú tree. Toluene is produced in the process of making gasoline and other fuels from crude oil and in making coke from coal.



Toluene is a good solvent (a substance that can dissolve other substances). It is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. Toluene is also used in the manufacture of other chemicals, nylon, and plastics. It is also added to gasoline along with benzene and xylene to improve octane ratings.

What happens to toluene in the environment?

Toluene can enter the air from car exhaust or when materials that contain it (such as paints or fingernail polish) are used. It can get into surface waters (like lakes and streams), groundwater, or soil if solvents or petroleum products are accidently spilled, or from leaking underground storage tanks at gasoline stations and other facilities. When toluene-containing products are placed in landfills or waste disposal sites, toluene can enter the soil or water near the waste site.

Toluene does not usually stay in the environment long. In surface water or soil, it will readily evaporate into the air or be degraded by bacteria. In the air, toluene rapidly breaks down by reacting with other chemicals or oxygen in the air. Below the surface, microorganisms will break down toluene.

How can I be exposed to toluene?

You may be exposed to toluene by breathing contaminated air or touching products that contain this chemical. Car exhaust contains toluene; therefore, if you spend time in or near vehicles or traffic, you may be exposed to this chemical. People who work with gasoline, paint, or dyes may be exposed to higher levels of toluene than most people.

Toluene is not frequently detected in drinking water or food. People that abuse (inhale) certain products such as glue or paint thinner can be exposed to toluene.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levels can cause headaches, dizziness, tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms usually disappear when exposure stops. Toluene can be found in gasoline products, paints, stain removers, and fingernail polish. Breathing toluene can cause headaches, dizziness, and nausea.

Long-term daily exposure to toluene in the workplace may cause some hearing and color vision loss. Repeatedly breathing toluene from glue or paint thinners may permanently damage the brain.

Exposure to high levels of toluene during pregnancy, such as those associated with solvent abuse, may lead to developmental effects, such as reduced mental abilities and growth in children.

In animal studies, the effects of toluene were similar to those seen in humans. In addition, it was found that animals that drank toluene also had decreased immune responses.

Agency for Toxic Substances and Disease Registry Office of Innovation and Analytics, Toxicology Section



Toluene

Can toluene cause cancer?

Studies in workers and animals exposed to toluene generally show that toluene does not cause cancer.

The <u>U.S. Department of Health and Human Services (DHHS)</u> has not evaluated the carcinogenicity (ability to cause cancer) of toluene.

The <u>U.S. Environmental Protection Agency (EPA)</u> has determined that there is inadequate information to assess the carcinogenicity of toluene.

The <u>International Agency for Research on Cancer (IARC)</u> has determined that toluene is not classifiable as to its carcinogenicity in humans.

Can I get a medical test to check for toluene?

Toluene and its breakdown products can be measured in blood and urine. These tests are only useful if done within several days after exposure. These tests cannot predict whether you will have health problem from exposure to toluene.

How can I protect myself and my family from toluene?

To reduce exposure to toluene, you should use products that contain it (such as paints, nail polish, glues, inks, and stain removers) in well-ventilated areas. When not in use, these products should be tightly covered to prevent evaporation into the air and, if possible, stored in a shed or an outside location. Always store household chemicals in their original labeled containers.

Have your tap water tested if you are concerned it may have toluene and, if necessary, take steps to protect yourself. Keep children from eating or playing in the dirt if you live near a waste site.

Sometimes, older children sniff household chemicals in an attempt to get high. Talk with children about the dangers of sniffing chemicals.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at <u>https://wwwn.cdc.gov/dcs/ContactUs/Form</u>

Go to ATSDR's Toxicological Profile for Toluene: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=161&tid=29

Go to ATSDR's Toxic Substances Portal: <u>https://wwwn.cdc.gov/TSP/index.aspx</u>

Find & contact your ATSDR Regional Representative at <u>http://www.atsdr.cdc.gov/DRO/dro_org.html</u>

Division of Toxicology and Environmental Medicine ToxFAQsTM

This fact sheet answers the most frequently asked health questions (FAQs) about xylene. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. Xylene has been found in at least 840 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is xylene?

There are three forms of xylene in which the methyl groups vary on the benzene ring: *meta*-xylene, *ortho*-xylene, and *para*-xylene (*m*-, *o*-, and *p*-xylene). These different forms are referred to as isomers.

Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar. Chemical industries produce xylene from petroleum. It is one of the top 30 chemicals produced in the United States in terms of volume.

Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

What happens to xylene when it enters the environment?

 $\hfill\square$ Xylene evaporates quickly from the soil and surface water into the air.

□ In the air, it is broken down by sunlight into other less harmful chemicals in a couple of days.

It is broken down by microorganisms in soil and water.
Only a small amount of it builds up in fish, shellfish, plants, and other animals living in xylene-contaminated water.

How might I be exposed to xylene?

□ Using a variety of consumer products including gasoline, paint varnish, shellac, rust preventatives, and cigarette smoke. Xylene can be absorbed through the respiratory tract and through the skin.

□ Ingesting xylene-contaminated food or water, although these levels are likely to be very low.

□ Working in a job that involves the use of xylene such as painters, paint industry workers, biomedical laboratory workers, automobile garage workers, metal workers, and furniture refinishers.

How can xylene affect my health?

No health effects have been noted at the background levels that people are exposed to on a daily basis.

High levels of exposure for short or long periods can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

XYLENE CAS # 1330-20-7



August 2007

XYLENE CAS # 1330-20-7

ToxFAQsTM Internet address is http://www.atsdr.cdc.gov/toxfaq.html

How likely is xylene to cause cancer?

Both the International Agency for Research on Cancer (IARC) and the EPA have found that there is insufficient information to determine whether or not xylene is carcinogenic.

How can xylene affect children?

The effects of xylene have not been studied in children, but it is likely that they would be similar to those seen in exposed adults. Although there is no direct evidence, children may be more sensitive to acute inhalation exposure than adults because their narrower airways would be more sensitive to swelling effects.

Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, and delayed growth and development. In many instances, these same concentrations also cause damage to the mothers. We do not know if xylene harms the unborn child if the mother is exposed to low levels of xylene during pregnancy

How can families reduce the risks of exposure to xylene?

□ Exposure to xylene as solvents (in paints or gasoline) can be reduced if the products are used with adequate ventilation and if they are stored in tightly closed containers out of the reach of small children.

□ Sometimes older children sniff household chemicals in attempt to get high. Talk with your children about the dangers of sniffing xylene.

□ If products containing xylene are spilled on the skin, then the excess should be wiped off and the area cleaned with soap and water.

Is there a medical test to determine whether I've been exposed to xylene?

Laboratory tests can detect xylene or its breakdown products in exhaled air, blood, or urine. There is a high degree of agreement between the levels of exposure to xylene and the levels of xylene breakdown products in the urine. However, a urine sample must be provided very soon after exposure ends because xylene quickly leaves the body. These tests are not routinely available at your doctor's office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA set a limit of 10 parts xylene per million parts drinking water (10 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 100 parts xylene per million parts of workplace air (100 ppm) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Xylene (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Federal Recycling Program



Appendix D NYSDOH Generic CAMP

New York State Department of Health Generic Community Air Monitoring Plan

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all <u>ground intrusive</u> activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during <u>non-intrusive</u> activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

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

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

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

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

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m³ above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m³ above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m³ of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009