Seneca Army Depot Activity
Romulus, New York

USACE – New York District
US Army, Engineering & Support Center
Huntsville, AL

Final, Revision 2 Work Plan Seneca PFAS Remedial Investigation

Seneca Army Depot Activity

Contract No. W912DY-20-D-0017
Task Order No. W912DY21F0310
EPA SITE ID# NY0213820830
NY Site ID# 8-50-006

August 2023

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT
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17 August 2023

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SUBJECT: Final (Revision 2) Work Plan Seneca PFAS Remedial Investigation, Former Seneca Army Depot Activity in Romulus, NY; EPA Site ID# NY0213820830 and NY Site ID# 8-50-006

Dear Mr. Morse, Ms. Sweet, and Mr. Sergott:

On behalf of the Army, please find attached for your review Revision 2 to the Final Work Plan for the Seneca per- and polyfluoroalkyl substances (PFAS) Remedial Investigation (RI) at the former Seneca Army Depot Activity (SEDA) in Romulus, New York (EPA Site ID# NY0213820830 and NY Site ID# 8-50-006).

EPA comments received via email on 17 July 2023 are addressed and provided in Appendix D.

This RI Work Plan serves as a supplement to the Final Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) and presents details on defining the nature and extent of media impacted by PFAS at five areas of concern (AOCs) within the former SEDA. The five AOCs include: Firehouse (Building 103), Fire Training and Demonstration Pad (SEAD-25), Fire Training Pit and Area (SEAD-26) and the Airfield comprised of two AOCs: Hot Pad Spill (SEAD-122D) and Plane Deicing Pads (SEAD-122E).

If you have any questions about the attached document, please call me at 917-575-1819.

Sincerely,

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FINAL, REVISION 2

WORK PLAN

FOR THE SENECA PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NEW YORK

Prepared for:

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Contract Number W912DY-20-D-0017
Task Order No. W912DY21F0310
EPA Site ID# NY0213820830
NY Site ID# 8-50-006

August 2023

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ACRONYM	DEFINITION	ACRONYM	DEFINITION
AFFF	Aqueous Film Forming Foams	OSD	Office of the Secretary of Defense
AEC	Anion Exchange Capacity	OSWER	Office of Solid Waste and Emergency Response
AOC	Area of Concern	PA	Preliminary Assessment
ARAR	Applicable or Relevant and Appropriate Requirements	Parsons	Parsons Government Services, Inc.
ASTM	American Society for Testing and Materials	PFAS	Poly- and perfluoroalkyl substances
BRAC	Base Realignment and Closure	PFAS##	Total PFAS, sum (Σ) of ## PFAS compounds
BTEX	Benzene, toluene, ethyl benzene, and total xylenes	PFBS	Perfluorobutane sulfonic acid
CEHNC	U.S. Army Engineering and Support Center - Huntsville	PFHxA	Perfluorohexanoic acid
CENAN	USACE New York District	PFHxS	Perfluorohexane sulfonic acid
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PFOA	Perfluorooctanoic acid
CoC	Chain of Custody	PFOS	Perfluorooctane sulfonic acid
CSM	Conceptual Site Model	PFNA	Perfluorononanoic acid
cy	Cubic Yards	PID	Planned Industrial Development/Warehousing Area
DoD	Department of Defense	ppt	Part per trillion
DQO	Data Quality Objective	QA	Quality Assurance
ELAP	Environmental Laboratory Accreditation Program	QC	Quality Control
ELLE	Eurofins Lancaster Laboratories Environment Testing, LLC	RAGS	Risk Assessment Guidance for Superfund
EPA	Environmental Protection Agency	RI	Remedial Investigation
ESI	Expanded Site Inspection	ROD	Record of Decision
ft	Feet	RSL	Regional Screening Levels
FS	Feasibility Study	SEDA	Seneca Army Depot Activity
HDPE	high-density polyethylene	SI	Site Inspection
HFPO-DA	hexafluoropropylene oxide dimer acid (GenX)	SL	Screening Levels
HGL	HydroGeoLogic, Inc.	SLERA	Screening Level Ecological Risk Assessment
HHRA	Human Health Risk Assessment	SOPs	Standard Operating Procedures
MCL	Maximum Contaminant Level	SW	Surface Water
MW	Monitoring Well	SWMU	Solid Waste Management Unit
MS	Matrix Spike	TDS	Total Dissolved Solids
MSD	Matrix Spike Duplicate	TOC	Total Organic Carbon
ng/L	Nanograms per litre	TPH	Total Petroleum Hydrocarbons
NPL	National Priorities List	UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
NYS	New York State	U.S.	United States
NYSDEC	New York State Department of Environmental Conservation	USACE	United States Army Corps of Engineers
NYSDOH	New York State Department of Health	VOC	Volatile Organic Compounds
NTU	Nephelometric Turbidity Unit		

PFAS Remedial Investigation Work Plan

Section 1 Introduction

1.0 OBJECTIVES

This Remedial Investigation (RI) Work Plan serves as a supplement to the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (HGL, 2023) and presents details on defining the nature and extent of media impacted by per- and polyfluoroalkyl substances (PFAS) at five areas of concern (AOCs) within the former Seneca Army Depot Activity (SEDA) where the presence of PFAS above screening levels has been confirmed by previous investigations (**Figure 1**). The five AOCs include: Firehouse (Building 103), Fire Training and Demonstration Pad (SEAD-25), Fire Training Pit and Area (SEAD-26) and the Airfield comprised of two AOCs: Hot Pad Spill (SEAD-122D) and Plane Deicing Pads (SEAD-122E). These AOCs were identified to have PFAS concentrations in groundwater above screening levels during a Site Inspection (SI) (Parsons, 2018) and Expanded SI (ESI) (Parsons, 2022a) and were recommended for further investigation. This work plan describes the methods that will be used to evaluate human health and environmental risk associated with the potential presence of PFAS at each AOC.

SEDA has been included on the federal facilities National Priorities List (NPL) since 1989. AOCs within SEDA are subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The United States Army Base Realignment and Closure (BRAC) Branch of the Deputy Chief of Staff G9, in coordination with the United States Army Corps of Engineers (USACE) [U.S. Army Engineering and Support Center – Huntsville (CEHNC) and New York District (CENAN)], is the lead agency responsible for environmental responses actions at the former SEDA. As the former SEDA is on the NPL list, the United States Environmental Protection Agency (EPA) is the lead regulatory support agency. The project decision structure also includes support from the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH).

Per Department of the Army Memorandum "Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances" (Army, 2018), Department of the Army Memorandum "Army Environmental Per- and Polyfluoroalkyl Substances (PFAS) Policy" (Army, 2021), Office of the Assistant Secretary of Defense (OSD) Memorandum "Addressing Per- and Polyfluoroalkyl Substances at Base Realignment and Closure Locations" (OSD, 2022a, 2022b) and CERCLA, the Army will:

- identify locations where there is a reasonable expectation that there may have been a release of perfluorooctanoic acid (PFOA) and/or perfluorooctane sulfonic acid (PFOS) and/or perfluorobutane sulfonic acid (PFBS) associated with former Department of Defense (DoD) mission-related actions;
- determine if there is unacceptable risk to human health and the environment; and
- address releases that pose an unacceptable risk including offsite migration.

In conjunction with the UFP-QAPP (HGL, 2023), this RI Work Plan defines the overall project objectives, summarizes the history of the sites, summarizes the results from the previous investigations including the SI and ESI, and describes the RI tasks that will be conducted to achieve the project objectives. The UFP-QAPP and RI Work Plan identify the equipment and methods necessary to perform the following tasks:

- Gather site-specific information to evaluate the fate and transport mechanisms related to PFAS to determine potential exposure pathways;
- Confirm from previous studies or, if necessary, update the topography, vegetation, soil characteristics, climate, and land use at the former SEDA and adjacent areas;
- Collect and evaluate biota, soil, sediment, surface water, stormwater, and groundwater samples for PFAS constituents utilizing industry best management practices to make defensible decisions;

- Determine the nature and extent (horizonal and vertical) of PFAS constituents in site media to levels determined by the Army such as calculated or published EPA regional screening levels (RSLs), or the DoD approved federal or state promulgated screening or cleanup levels (NYSDEC), or potential Applicable or Relevant and Appropriate Requirements (ARARs) in all applicable environmental media;
- Develop a comprehensive understanding of the fate and transport of PFAS at each AOC;
- Assess baseline cumulative risks to human and environmental receptors from PFAS constituents and other contaminants present at the AOCs;
- Determine if PFAS constituents are present at each site in quantities or concentrations that warrant additional evaluation as part of the Feasibility Study (FS) phase, and if so, what are the appropriate data quality objectives (DQOs).

1.1 PROJECT ACTION LEVELS / SCREENING LEVELS

The DoD has adopted a policy within the CERCLA process to compare analytical results for PFAS to risk-based human health screening levels (SLs) for soil and groundwater, as described in a memorandum from the OSD dated 06 July 2022 (OSD, 2022b). The 2022 OSD memorandum recommends using the May 2022 USEPA RSLs for screening soil and groundwater to be protective of human receptors. The USEPA RSLs were updated in November 2022, but there were no changes to the PFAS RSLs. The program under which this RI is being performed follows this DoD policy. The USEPA RSLs (presented to 2 significant figures) are consistent with the USEPA RSL table format rather than the values as presented in the memorandum. The SLs established in the OSD memorandum apply to six compounds: PFOS, PFOA, PFBS, perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA, Gen-X). Risk-based human health screening levels for surface water and sediment were also calculated using the May 2022 RSL calculator (USEPA, 2022). The SLs and derived project action levels (PALs) are intended for screening purposes only; an exceedance of an SL/PAL is not an indication of unacceptable risk. PALs are presented in Worksheet #15 of the Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) (HGL, 2023).

1.2 SITE DESCRIPTION AND BACKGROUND

A brief description of the four known PFAS contamination sites at the former SEDA is presented below. An installation-wide conceptual site model (CSM) is presented in Worksheet #10 of the UFP-QAPP (HGL, 2023). This CSM lists 34 suspected PFAS sites, which do not include the four known PFAS contamination sites that are the focus of this work plan. The installation-wide CSM discusses historical remedial actions at SEAD-25, SEAD-26, and SEAD-122D/E. Under the future use plan, SEAD-25, SEAD-26, and Firehouse Building 103 are all in an area designated as a Planned Industrial Development/Warehousing (PID) Area. Future use of the former airfield in the southwest corner of SEDA, an area which includes SEAD-122D/E, is expected to be the same as the current use as a training area (e.g., law enforcement driver training; county fire training, State Police firearms training). Some areas of the airfield adjacent to RI AOCs are used for growing corn. The corn is not for human consumption but is provided to the deer within the base.

1.2.1 PROJECT SETTING

SEDA is a 10,587-acre former military facility located approximately 40 miles south of Lake Ontario in Seneca County, New York (**Figure 1**). The facility is located between Seneca Lake and Cayuga Lake and is bordered by New York State Highway 96 to the east, New York State Highway 96A to the west, and sparsely populated farmland to the north and south. The facility was wholly-owned by the United States Government and was operated by the Department of the Army between 1941 and 2000 with the primary mission to receive, store, maintain, and supply military items. In 1995, SEDA was designated for closure under the DoD BRAC process.

1.2.2 SITE LOCATIONS

A PFAS SI Report identified SEAD-25 and SEAD-26 as locations were a PFAS release occurred and recommended that these sites proceed to an RI (Parsons, 2018). This SI Report also recommended no further action at SEAD-122E because the sum of detections for PFOA and PFOS did not exceed the then current EPA lifetime health advisory level of 70 nanograms per liter (ng/L) (parts per trillion [ppt]). The detections, however, are greater than the state of New York maximum contaminant level (MCL) of 10 ng/L. Based on comparison to the state MCL and the updated OSD (2022b) guidance, SEAD-122E proceeded to the RI stage. SEAD-122D was to be addressed separately in the Preliminary Assessment (PA)/SI; however, because the site is located within the extent of the area being investigated as part of the RI for SEAD-122E, the two sites are being addressed together as SEAD-122D/E. A PFAS ESI identified elevated PFAS concentrations at Firehouse Building 103 and this site was recommended to proceed to the RI stage (Parsons, 2022a). The AOCs covered in this PFAS RI work plan are:

- Firehouse – Building 103,
- SEAD-25 (Fire Training and Demonstration Pad),
- SEAD-26 (Fire Training Pit and Area), and
- Airfield (SEAD-122D – Hot Pad Spill and SEAD-122E – Plane Deicing Area).

During cleanup, a site may be divided into a number of distinct areas depending on the complexity of the problems associated with the site. These areas called operable units may address geographic areas of a site, specific site problems, or areas where a specific action is required. An example of a typical operable unit could include removal of drums and tanks from the surface of a site. All four AOCs with confirmed PFAS presence are proposed to be included in new Operable Unit (OU) 18: Per- and polyfluoroalkyl substances (PFAS).

Firehouse – Building 103

Firehouse Building 103 encompasses the surrounding pad and parking area around the building and Building 103 was a former fire department. The building is in a developed area of the installation on a block of land that is approximately 3 acres (**Figure 1**). There is limited background information available describing historical activities at Firehouse Building 103, but it is likely that PFAS-containing aqueous film-forming foams (AFFFs) were used at some point in its history. Shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 25 feet (ft) bgs, and there are 2 deep wells screened at 42 to 62 ft bgs (MWFH-09D) and 37.5 to 57.5 ft bgs (MWFH-10D) (Parsons, 2022a). Building 103 is currently owned by Seneca County but is unoccupied and not in use. The surrounding area includes maintained grass. There are subsurface stormwater features parallel to the north-south roads adjacent to the Firehouse. The stormwater is channeled south and then west where it outfalls into the open drainage ditch northwest of SEAD-25. No previous investigations were conducted at the Firehouse and the building was never designated as a solid waste management unit (SWMU). The AOCs described below are in the vicinity of the Firehouse (**Figure 2**). During the PFAS Historical Records Review (HGL, 2022), none of the AOCs described below were recommended for a PFAS SI because there was no evidence of a historical release and/or use of PFAS containing materials.

- SEAD- 30 is 620 feet southwest of the Firehouse. The location had a former waste oil UST used to store waste automotive oil from vehicle maintenance activities. The waste oil was used as a fuel supplement for boilers located within the Depot. The tank was removed in 1992 and the remedy was “No Further Action” in the Parsons (2003) ROD. No site investigation was conducted and confirmation sampling was not required during the tank removal.
- SEAD-33 is 360 feet southwest of the Firehouse and was the location of a former UST for storage of No. 6 fuel oil. Site soil was sampled for volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPH), but no exposure pathway was present. The remedy for this SWMU was “No Further Action (NFA)” in the Parsons (2003) ROD and the tank was removed in 2004.
- SEAD-36, 925 feet west of the Firehouse, two boilers capable of burning waste oil and fuel oil mixtures. There was no information to indicate waste oil was released and no site investigations were conducted. The site remedy in the ROD was “No Action” (Parsons, 2003).

- SEAD-39, 745 feet west of the Firehouse. Building 121 is a boiler plant where, prior to 1979, boiler blowdown was released onto the ground. The boiler blowdown is suspected of containing water, tannins, caustic soda (sodium hydroxide) and sodium phosphate. North of Building 121, an approximately 20 foot by 50 foot area of petroleum impacted soil was excavated at a depth of 0.5 to 1ft below ground surface and disposed of off-site as non-hazardous material. The area was regraded and clean fill was not applied. The remedy at SEAD-39 was NFA with Land Use Controls (LUCs) (Parsons, 2007).
- SEAD-42, 390 feet northwest of the Firehouse, Building 106 was a preventative medicine laboratory. No evidence of releases were observed and the site was considered a No Action SWMU (Parsons, 2003).

SEAD-25 Fire Training and Demonstration Pad

SEAD-25 is in the east-central portion of SEDA (**Figure 1**). The site is approximately 7 acres and comprises mostly undeveloped land with a centrally-located crushed shale pad (Parsons, 2022a). The site is bounded to the east by Administration Avenue, beyond which is undeveloped land covered by deciduous trees and a wetland area; to the south by Ordnance Drive beyond which is an open grassy field and a stand of coniferous trees; to the west by a drainage ditch trending from the northeast to the southwest with grassland, brush and conifers between the site and the ditch; and, to the north by grassland and brush. SEAD-25 was in use from the late 1960s to the late 1980s. The former pad was used for fire control training. During the 1980s, the pad was used twice for fire-fighting demonstrations, including one demonstration in 1982 or 1983, and one in 1987.

Based on the Parsons ES (1998) RI results, the primary groundwater impact was associated with two overlapping VOC plumes located in the overburden groundwater, both of which originated near the locations of petroleum hydrocarbon contaminated soil. Chlorinated ethenes and benzene, toluene, ethyl benzene, and total xylenes (BTEX) constituents were not detected in any of the six bedrock wells sampled during the RI at SEAD 25. The primary plume observed during the RI measured approximately 200 feet long and was composed of aromatic hydrocarbon compounds that are typically associated with gasoline (i.e., BTEX). Impacts to soil located in the adjacent drainage swales at SEAD-25 were also noted and were mainly associated with SVOCs, pesticides, and heavy metals. No COCs were identified in SEAD-25 surface water.

The remedy in the ROD was excavation and LTM. BTEX impacted soil was excavated from the former pad area and the swale northwest of the former pad (Figure 5, grey dashed lines show excavation bounds). The pad area was excavated approximately 4.5 feet to the top of competent shale bedrock. The swale excavation extended to bedrock from the toe of slope on one bank to the toe of slope on the other bank and was not backfilled. The pad excavation was backfilled with approximately 793 cubic yards (cy) of on-site fill material and 168 cy of fill material obtained from an off-site source and restored to the existing grade. The on-site soil source was obtained from excavations conducted during underground utilities work within the Administrative Area along East Patrol Road, between 2nd Street and South Street, along Quarters Drive, a segment of 1st Avenue and 3rd Avenue (Figure 2). Backfill was also sourced from an off-site sand and gravel dealer, Dendis Sand and Gravel, located on State Route 96 in Junius, New York in Seneca County. (Parsons, 2006). LTM of the groundwater has been active since 2006 and has delineated BTEX impacts to two wells (MW25-2 and MW25-31) adjacent to the former fire training pad.

Existing shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 20 ft bgs, and there are 3 deep wells screened at 39 to 49 ft bgs (MW25-22D), 41 to 81 ft bgs (MW25-31D), and 44 to 54 ft bgs (MW25-34D) (Parsons, 2022a). Ongoing activities at this site are limited, except for some periodic maintenance of the grassland around the pad and monitoring wells. AOCs in proximity to SEAD-25 are described below:

Upgradient AOCs (neither will be investigated during the PFAS SI):

- SEAD-121F: Located approximately 340 feet north of SEAD-25, SEAD-121F involved the investigation of stained soil within Building 135. The open garage style building had a gravel floor and was used for the storage of vehicles and acid. VOCs, SVOCs and lead investigated in the soil did not exceed remedial goals and the site was recommended for NFA (Parsons ES, 1999).
- SEAD-121G: Located northeast and adjacent to SEAD-25, coal ash was disposed of just south of Building 123. SVOCs and metals were investigated in soil, but did not exceed residential remediation goals and the site was recommended for NFA (Parsons ES, 1999).

Side-gradient AOCs (all four AOCs to be investigated during the PFAS SI):

- SEAD-5: Approximately 200 feet north of SEAD-25 and west of SEAD-121F, between 1980 and roughly June 1992, sewage sludge from two Army wastewater treatment plants was stockpiled at this AOC. This area was also used as a location where the Depot's Department of Public Works (DPW) type storage and staging area for heavy equipment, materials and supplies was located. Based on investigation results, LUCs are emplaced on the SEAD (Parsons, 2021).
- SEAD-59: Approximately 500 feet northwest of SEAD-25, SEAD-59 was used for the disposal of construction debris and oily sludge. SEDA personnel have also indicated the area of SEAD-59 was used as the Army's version of a local "Department of Public Works" yard where vehicles and materials were staged, and as a result a large quantity of miscellaneous "roads and grounds" debris remains, and has become intermixed with the native soils. Based on investigation results, LUCs are emplaced on the SEAD (Parsons, 2021).
- SEADs 16/17: SEAD-16 and SEAD-17 are located approximately 1,200 feet west-northwest of SEAD-25 and were used for the demilitarization of various small arms munitions. Munitions were heated in a rotating kiln where they detonated. The site remedy involved excavation of contaminated soil and LTM of the groundwater for metals. LUCs are in place (Parsons, 2021).

Downgradient AOCs (at this time, the downgradient AOCs are not part of the PFAS SI):

- SEAD-121C: Located approximately 1,000 feet southwest of SEAD-25, the Defense Reutilization and Marketing Office (DRMO) Yard was used by the Army to store scrap metal, vehicles, and other items that were no longer needed for national defense, or that did not comply with legislative and regulatory requirements. The group using the yard was responsible for property reuse (including resale), hazardous property disposal (off site, at licensed/permitted facilities), precious metals recovery and recycling program support. Soil excavations were performed to address elevated levels of lead in soil. SEAD-121C is located within the area-wide PID LUC (Parsons, 2021). SEAD-121C remains an AOPI in the PFAS HRR (HGL, 2022) and will be re-evaluated for inclusion in the PFAS SI based on results for SI sites with the same classification group (i.e., Disposal Area).
- SEAD-27: Adjacent to the east side of SEAD-121C, SEAD-27 was used for steam cleaning to degrease metal working machines. A belowground, concrete tank was present above which track-mounted cars loaded with equipment requiring cleaning can be positioned and steam cleaned. There is no evidence that suggests groundwater infiltrated the accumulation pit. No COCs were identified in soil. The human health risk assessment determined that a LUC on groundwater use would be necessary. SEAD-27 is within the area-wide PID LUC zone.
- SEAD-28: Adjacent to the east side of SEAD-121C and south of SEAD-27, two underground waste oil storage tanks were located in SEAD-28. Confirmatory sampling during tank removals did not detect any contamination. The site remedy is NFA.

SEAD-26 Fire Training Pit and Area

SEAD-26, located in the southeastern portion of SEDA (**Figure 1**), was used for firefighting training during which various flammable materials were floated on water, ignited, and extinguished. Prior to 1977, the fire training area may have also been used for firefighting demonstrations. The site is characterized by an elevated, approximately 6-acre rectangular, grass-covered pad that contains a former fire training tower, an area that at one time held a storage trailer, a circular burning pit, and a former drum storage area. The centrally located circular burning pit had a diameter of approximately 75 feet and is surrounded by a 2-3 foot-high soil berm. Approximately 50 feet south of the former burning pit, former site features included two large, empty cylindrical steel tanks and a burned-out fuselage of a helicopter. A former drum storage area is located at the far southern end of the site. With the exception of the former fire tower, other former site features have been removed. Shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 21.5 ft bgs, and there are 3 deep wells screened at 42 to 57 ft bgs (MW26-23D), 50 to 100 ft bgs (MW26-28D), and 39 to 79 ft bgs (MW26-32D) (Parsons, 2022a). There are no ongoing maintenance activities at the site.

At SEAD-26, the primary contaminants detected included SVOCs and metals in the soil and sediments. In addition, low levels of volatiles were also detected in the groundwater at levels above NYSDEC GA Standards. However, the contaminants

that exceeded NYSDEC GA Standards in the groundwater were no longer found in the soil of SEAD-26 due to attenuation of the contaminants in the soil (Parsons ES, 1998).

The remedy in the ROD was excavation and LTM. Carcinogenic PAH impacted soil was excavated to a depth of 1 foot bgs at five areas within SEAD-26 (Figure 6 and 7, grey dashed lines). Approximately 828 cubic yards of soil were removed and disposed of off-site. Due to the shallow nature of the excavations, they did not require backfilling and were smoothed to grade.

Upgradient AOCs (not selected for investigation during the PFAS SI):

- SEAD-50/54: Located approximately 1,600 feet east of SEAD-26, SEAD-50/54 encompassed land that was formerly used for 160 aboveground storage tanks. The tanks were used to store dry materials (e.g., antimony and other strategic ores). All of the tanks have been removed. The results of the 1994 ESI indicated that elevated levels of contaminants were present at the AOC in soil. A removal action was conducted and the ROD remedy was NFA (Parsons, 2005).

Downgradient AOCs (selected for investigation during the PFAS SI):

- SEAD-64A: This AOC is 200 feet west, and separated by a railroad yard, from SEAD-26. SEAD-64A was used during the period from 1974 to 1979 when the on-site solid waste incinerator was not in operation. The types of wastes disposed at the site are suspected to be primarily household items. PAHs in soil and metals in groundwater exceeded the criteria at the time of sampling (Parsons ES, 1996). LUCs were emplaced as part of the remedy.

Airfield: SEAD-122D (Hot Pad Spill) and SEAD-122E (Plane Deicing Areas)

SEAD-122D and SEAD-122E are in the southwest corner of SEDA and include a former aircraft refueling area and three deicing areas at the former SEDA Airfield (**Figure 1**). The three deicing/refueling pads that comprise SEAD-122E are located along the western side of the northwest-southeast runway, and the aircraft refueling area (SEAD-122D) is located to the east near the southeastern end of the runway. Two of the deicing/refueling pads are located near either end of the runway, a third is located at the end of a short taxiway to the west of the middle portion of the runway, and a fourth pad is located on the east side of the runway near the southeastern end. The airfield is no longer operational, and the current use is as a training area (e.g., law enforcement driver training; county fire training, State Police firearms training). Some areas of the airfield adjacent to RI AOCs are used for growing corn. The corn is not for human consumption but is provided to the deer within the base. Surface soil surrounding SEAD-122D were investigated to determine if there were any impacts from the JP-4 fuel spill. Based on the results, SEAD-122D was recommended as a No Action SWMU. The selected remedy at SEAD-122E was no action with LUCs due to unacceptable cancer risk due to dermal contact to soil and ingestion of soil. The contributing COCs are carcinogenic PAHs in soils.

Upgradient AOCs (selected for investigation during the PFAS SI):

- SEAD-64D: Located 2,000 feet east of the northern SEAD-122E AOC, portions of SEAD-64D were used for garbage disposal from 1974 to 1979 when the SEDA solid waste incinerator was not in operation. The type of waste disposed at SEAD-64D was primarily household waste. The selected remedy at SEAD-64D was NFA with LUCs (Parsons, 2007).

Downgradient AOCs (not selected for investigation during the PFAS SI:

- SEAD-122A: Located 650 feet west of SEAD-122D, SEAD-122A was a skeet/trap range. Soil sampling did not indicate any detections over preliminary remediation goals and the site was recommended for NFA (Parsons ES, 1999).
- SEAD-122B: Approximately, 1,200 feet west of SEAD-122D and the southern portion of SEAD122E, SEAD-122B was a former small arms range. A treatability study and soil removal action was performed and the selected remedy was NFA with LUCs (Parsons, 2007).
- SEAD-122C: This AOC was located 1,600 feet west of SEAD-122D. Shooting targets and plywood were stored within a conex box. The site was classified as NFA (Parsons ES, 1999).

1.3 ENVIRONMENTAL SETTING

1.3.1 CLIMATE

A cool climate exists at SEDA with temperatures ranging from an average of 31°F in January to 69°F in July. Marked temperature differences are found between daytime highs and nighttime lows during the summer and portions of the transitional seasons. Precipitation is well distributed, averaging approximately 3 inches per month. This precipitation is derived principally from cyclonic storms, which pass from the interior of the county through the St. Lawrence Valley. Seneca, Cayuga, and Ontario Lakes provide a significant amount of the winter precipitation and moderate the local climate. The annual average snowfall is approximately 100 inches. Wind velocities are moderate, but during the winter months, there are numerous days with sufficient winds to cause blowing and drifting snow. The most frequently occurring wind directions are westerly and west southwesterly (Parsons, 2021).

1.3.2 TOPOGRAPHY AND SURFACE WATER

SEDA is located in an uplands area, where the elevation ranges from approximately 600 feet (ft.) National Geodetic Vertical Datum (NGVD 1929) along the western boundary of the Depot to nearly 760 feet NGVD 1929 in the central portion of the eastern boundary. The uplands area where SEDA is located forms a divide separating two of the New York Finger Lakes: Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. In general, the Airfield AOCs are located on the western side of the topographic divide and SEAD-25 and SEAD-26 are on the eastern side. The former Firehouse, SEAD-25 and SEAD-26 are located in the east-central portion of the former SEDA. The topography has low relief and slopes to the southwest (Firehouse, SEAD-25) and west (areas west of SEAD-25 and SEAD-26). The Airfield is located in the southwest corner of SEDA and is generally level with a gentle slope to the west.

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Surface water drainage in the area of the Fire House AOC is predominantly through underground stormwater infrastructure which collects and transports any overland flow in this area. The stormwater infrastructure roughly parallels the north-south roads in the former Administrative area accepting rain and melt water in catch basins along the roads and transporting runoff south and west (Figure 2). The underground infrastructure transitions to an open ditch just northeast of SEAD-25 (halfway between SWFH-03 and SW25-01). There are no surface water bodies in proximity to the Fire House AOC and no flooded areas were observed during the ESI field events.

SEAD-25 Fire Training and Demonstration Pad

Surface water (as overland flow from precipitation events) in the vicinity of SEAD-25 is also conveyed predominantly through drainage ditches installed as part of the SEDA infrastructure. Within the area of the former SEAD-25 burn pad (adjacent to wells MW25-2 and MW25-3), water will flow radially off this highpoint into ditches surrounding the pad and will be transported southwest (Figure 2). The open drainage ditch within the northwest AOC boundary accepts discharge from the stormwater system which transits the Administrative area. Several of the open drainage ditches combine approximately 3,000 ft downstream of the SEAD-25 boundary and transport the water west and northwest eventually forming Kendaia Creek approximately 1.5 miles downstream of surface water sample SW25-06. Kendaia Creek discharges into Seneca Lake approximately 2 miles west of the former SEDA boundary. The wooded area east of the SEAD-25 boundary is mapped as a Freshwater Forested/Shrub Wetland and the small field to the southwest is mapped as a Freshwater Emergent Wetland (USFWS, 2021). NYSDEC recognizes the drainage which includes surface water samples SW25-03, SW25-04, SW25-05, and SW25-06 and areas downstream as a Class C (suitable for fishing) waterbody. At the western SEDA boundary, where the drainage is named Kendaia Creek, the class remains as C, but the standard changes to TS (Trout Spawning) (NYSDEC, 2021b).

SEAD-26 Fire Training Pit and Area

Within the SEAD-26 boundary there are no surface water bodies; however, the site is surrounded by drainage ditch infrastructure that conveys stormwater to a series of west flowing drainages (Figure 3). The central and southern drainage ditch are shallow and only flow during or shortly after precipitation events draining the central and southern portions of SEAD-26. The two ditches extend approximately 1,500 ft west of the AOC and discharge into an ephemeral marshy area located east of Fayette Road. The northern, west-trending drainage begins at the west end of 7th Street and accepts flow from the northern third of the SEAD-26 AOC. A portion of this flow is diverted into a small pond whose outlet flows back into the westerly flowing drainage. This drainage flows west across Fayette Road into the igloo area where it joins a north-south trending, south flowing drainage identified as Indian Creek at the former SEDA boundary. South of SEDA, several drainages combine and flow southwest where they discharge into Seneca Lake. The westerly flowing drainage and Indian Creek are identified as Class C waterbodies and the area around the pond and to the northwest are mapped as freshwater forested/shrub wetlands (NYSDEC, 2021c; USFWS, 2021).

Airfield: SEAD-122D (Hot Pad Spill) and SEAD-122E (Plane Deicing Area)

There are no natural surface water bodies within the SEAD-122D or SEAD-122E AOC boundaries. Indian Creek bisects the southeastern corner of the Airfield parcel but is not downgradient of the AOCs and drainage ditches are not known to outflow into the creek. A series of open drainage ditches channel surface water flow away from airfield infrastructure. Most drainage ditches flow into marshy areas or uninhabited open areas to allow stormwater to disperse and infiltrate into the ground.

1.3.3 GEOLOGY

The typical geology beneath the AOCs and the local area is a thin mantle of glacial till overlying shale bedrock. Generally, the overburden consists of a thin layer of high fines content soils (where undisturbed) underlain by glacial till (unsorted clay, silt, sand and gravel) a few feet thick to approximately 15 feet in thickness that drains poorly. Minor amounts of fill are present within the former SEAD-25 pad area and within the SEAD-26 boundary, but the fill is difficult to distinguish from the native till and is likely the same material only reworked. Bedrock is soft, fissile, shale bedrock of the Moscow Formation for the RI AOCs in the eastern half of SEDA. The Ludlowville and Moscow Formation contact bisects the airfield with the northern and central SEAD-122E AOCs within the Ludlowville Formation and the southern SEAD-122E and SEAD-122D within the Moscow Formation. The shales within both formations have poor intergranular porosity and the flow of groundwater is expected to move through millimeter scale horizontal and vertical zones of porosity (bedding plane fractures and joints) on a localized scale (inches to several feet) (Merin, 1992; Parsons ES, 1998). The upper 10 feet of the bedrock typically has low rock quality designations (RQD) of less than 30%. RQD typically increases with depth (Parsons ES, 1998; Parsons, 2022b).

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The stratigraphy near the Firehouse is typically 5 to 10 feet of till overlying shale encountered at depths of 6 to 12 feet below ground surface (bgs). A bedrock low is present in the area of MWFH-04 with bedrock elevations increasing radially outward. Bedrock was observed within 3 feet of the surface at well MWFH-10D (Parsons, 2022a).

SEAD-25 Fire Training and Demonstration Pad

The stratigraphy within the SEAD-25 AOC consists of 1 to 2 feet of till and crushed shale fill at the ground surface localized to the area of the former burning pad and 2.5 to 9 feet of till which is thickest north and northeast of the former pad. A zone of weathered bedrock ranging in thickness between 0.5 and 4.5 feet is typically present above the shale bedrock. Bedrock isocontours from previous investigations and wells installed during the ESI indicate that the fire training pad at SEAD-25 occurs on a local natural high in the shale topography (Parsons, 1998; Parsons, 2022a). Outside the area of the AOC, bedrock elevations, and topography, decrease to the southwest.

SEAD-26 Fire Training Pit and Area

At SEAD-26, the Fire Training Pit and surrounding areas within the AOC are comprised mostly of fill that varies in thickness up to 14 feet; however, the fill/till contact was not distinct at most drilling locations making this contact uncertain. Below the fill is glacial till ranging in thickness between 1 foot and 2.5 feet. Outside the AOC, till was the uppermost unit and ranged in thickness from 0.5 to 12 feet. A weathered shale zone 0.5 to 5 feet thick was typically present above the shale bedrock (Parsons, 1998; Parsons, 2022a). The top of bedrock is highest within the AOC and consistently decreases, along with topography, towards the west (Parsons, 1998; Parsons, 2022a).

Airfield: SEAD-122D (Hot Pad Spill) and SEAD-122E (Plane Deicing Area)

The Airfield is characterized by a consistent thickness of till ranging between 8 and 15 ft above shale bedrock. Weathered bedrock was observed at a thickness of approximate 0.5 to 2 ft (Parsons, 2018). The bedrock has not been investigated.

1.3.4 HYDROGEOLOGY

Groundwater is found seasonally in the overburden/weathered bedrock zone (subject to precipitation); however, the water in the wells is not considered potable due to low well yield. Wells installed in the area would not meet the requirements for a standard well yield test which includes a minimum four-hour period of stabilized (± 0.5 feet) drawdown while pumping at a constant flow rate (NYSDOH, 2021). Recharge of the underlying shallow saturated zone is dependent on precipitation. Rainwater or snow melt slowly infiltrates into the till/weathered bedrock water bearing zone; however, during larger precipitation events, the infiltration rate is likely not high enough, and overland flow transports excess precipitation to local drainage ditches and low areas. During the PFAS ESI (Parsons, 2022a), wells installed in the upper water bearing zone were installed to depths typically 15 feet bgs or less and wells installed in the lower water bearing zone (shallow fractured bedrock) were to depths of approximately 60 feet bgs although two wells (MW26-28D and MW26-32D) were extended to a depth of 100ft and 80ft bgs, respectively, due to a lack of recharge. Within the lower water bearing zone, well yields were observed to be poor with slow recharge and are not considered potable based on their inability to meet the state regulations for water wells (NYSDOH, Appendix 5-B.4 (b) 1, 2, 3, Standards for Water Wells, 2021). Based on discussions with local drillers in the areas, wells at a depth of greater than 150 feet are typically needed to obtain sufficient well yields.

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The depth to groundwater near the Firehouse AOC ranged between 5 and 15 ft bgs depending on season. Groundwater flow direction is generally towards the southwest with some local variation. Groundwater elevations in well MWFH-10D were anomalously lower than surrounding wells suggesting that poor recharge in this well has inhibited the head developed in the well. A potential cause of this is the bedrock high at this location. Shallow groundwater flowing to the southwest may divert away from this location inhibiting the recharge of this section of bedrock. Hydraulic conductivity is assumed to be similar to those found during previous studies at SEAD-25 and SEAD-26, discussed below (Parsons, 2022a).

SEAD-25 Fire Training and Demonstration Pad

The depth to groundwater at SEAD-25 varies seasonally, but generally occurs at depths of between 2 to 12 feet below ground surface. During wet periods, some areas were observed to have water depths less than 1-foot bgs (e.g., MW25-22, MW25-25, MW25-26, MW25-30, March 2021). Hydraulic conductivities determined in earlier studies were found to range from 1.0×10^{-5} cm/sec to 3.4×10^{-3} cm/sec with an average of 6.1×10^{-4} cm/sec in the upper water bearing zone (Parsons ES, 1998). The radial groundwater flow centered on the former pad at SEAD-25 is believed to be a local phenomenon that is present because of the influence of the bedrock topographic mound below the former pad. Groundwater maps indicate a flattening of the water table outside the AOC developing into a southwest regional flow direction (outside the local area of SEAD-25) thus reducing the influence of the locally developed radial flow. During previous studies, vertical connection tests performed on six well pairs indicate that the till/weathered shale aquifer shows very small displacement, such that it was hard to measure (Parsons ES, 1998). Water elevations between shallow-deep wells pairs are generally similar with the exception of pair MW25-31/31D. This difference is interpreted to be the result of screening the well within a section of

rock with no fractures. Extremely poor recharge was encountered at this well during ESI sampling. Hydraulic conductivity in the lower water-bearing zone (bedrock) was found to range between 1.8 x 10^{-5} cm/sec to 7.2 x 10^{-4} cm/sec with an average of 3.3 x 10^{-4} cm/sec (Parsons, 2022a).

SEAD-26 Fire Training Pit and Area

At SEAD-26, the depth to groundwater varied from between 5 feet bgs in the spring to 17 feet bgs in the fall season. During wet periods, water was observed near the surface at wells MW26-16 and MW26-20. Hydraulic conductivities in the upper water-bearing zone were found in earlier studies to range from 1.5 x 10^{-3} cm/sec to 3.9 x10^{-3} cm/sec with an average of 2.5 x 10^{-3} cm/sec (Parsons ES, 1998). The higher conductivity at SEAD-26 versus SEAD-25, and values typical for till (1 x 10^{-4} to 1 x 10^{-10} cm/sec [Freeze and Cherry, 1976]) is attributed to the presence of the fill beneath the site [Note: The 1998 RI was limited to wells within the AOC]. The groundwater flow at SEAD 26 is consistently to the west. The pond and wetland area west of SEAD-26 are interpreted as discharge areas which accept some component of the shallow groundwater (Parsons, 2022a).

Airfield: SEAD-122D (Hot Pad Spill) and SEAD-122E (Plane Deicing Area)

Estimated depth to groundwater at the within the Airfield is ranges between 8 and 15 feet below ground surface, based on data collected during the SI (Parsons, 2018). The nature of the groundwater flow at the Airfield is uncertain, but is anticipated to follow the general trend of the land towards the west and Seneca Lake.

Drinking Water Resources

Based on the thin saturated thicknesses observed during groundwater gauging, excessive drawdown during sampling at minimal pumping rates (100-200 mL/min) and poor recharge (i.e., wells often had to be allowed to recharge overnight or longer), the upper water bearing zone is not expected to be a productive water supply (or potable) for drinking water. While there is likely to be some regional recharge of precipitation through the till/weathered bedrock shallow groundwater zone to the underlying shallow bedrock groundwater, vertical groundwater interaction between the upper and lower water bearing zones is not expected to be as significant as preferential groundwater flow within the shallow fractured and weathered bedrock zone along the top of the shale bedrock. Sedimentation found within the bedrock core fractures at shallower depths would inhibit/limit water flow from shallower depths (Mozola, 1951; Parsons, 2022a). Neither water bearing zone is expected to support a drinking water or irrigation water supply and are not considered potable sources of water. There are no drinking water wells within the RI AOCs and no known drinking water wells within the former SEDA boundary. There are unconfirmed local residences with drinking water wells outside the former SEDA boundary that are approximately 2 miles west of the Firehouse, SEAD-25, and SEAD-26 AOCs and within 0.25 miles of the Airfield parcel.

1.4 USE OF SECONDARY DATA

Existing PFAS data for the sites were evaluated for usability using the general procedures outlined in Worksheet #13 of the UFP-QAPP (HGL, 2023). PFAS data from the 2020-2021 ESI (Parsons, 2022a) meet usability requirements outlined in Worksheet #13; however, PFAS data from the 2017-2018 PFAS Site Investigation (SI) (Parsons, 2018) are not reliable due to the collection of groundwater samples from temporary wells at SEAD-26, SEAD-122D, and SEAD-122E therefore these data will not be used in the risk assessments.

1.5 CONCEPTUAL SITE MODEL AND DATA QUALITY OBJECTIVES

1.5.1 CONCEPTUAL SITE MODEL (CSM)

A CSM integrates existing information and working assumptions about the physical site conditions; the nature, occurrence, and distribution of chemicals; fate and transport processes; and the possibility of subsequent human and ecological exposure to the chemicals at, or potentially released from, the sites. Site specific CSMs are presented for each RI AOC in

Section 3. The CSMs are based on the current understanding of site history and conditions, and they will be updated as necessary based on ongoing input from field investigations.

Handling and/or use of AFFF has been inferred from former site history and the confirmed presence of PFAS in the environment in previous investigations (e.g., SI and ESI) at the former Firehouse, SEAD-25, SEAD-26 and the Airfield (SEAD-122D and 122E). A generalized CSM regarding AFFF released to the ground surface (including during fire training exercises or by accidental spills) is presented in Worksheet #10 of the UFP-QAPP (HGL, 2023). Preliminary site-specific CSMs are depicted in the Risk Assessment Work Plan (**Appendix A**) showing the potential pathways to human and ecological receptors. The site-specific CSMs identify contaminant sources, release mechanisms, affected media, and potential transport routes and additional detail regarding exposure scenarios and affected receptors. These site-specific CSMs will be revised based on the results of the investigation. Currently, no drinking water receptors are known to be impacted by PFAS at the four RI AOCs.

PFAS, specifically perfluoroalkyl acids (PFAAs) including perfluoroalkyl carboxylates (PFCAs) and perfluoroalkane sulfonates (PFSAs), are relatively mobile in groundwater, typically less volatile than many other groundwater contaminants, sometimes transported on airborne particles, and generated by transformation of precursors. The fate and transport for PFAS is highly dependent upon surface water and groundwater flow because at pHs typically found in the environment, PFCAs and PFSAs are present as anions and are highly soluble and mobile in water (ITRC, 2022). PFAS compounds typically analyzed during environmental investigations are not considered to be volatile and transport of PFAS impacts through vapor transport (e.g., impacts to indoor air related to soil gas or airborne particles) cannot yet be quantitatively evaluated under CERCLA in a risk assessment because there is no SW-846 method for measuring volatile PFAS and there are no toxicity values for the volatile PFAS. PFCAs and PFSAs are, however, highly soluble in water and as a result are easily transported in surface water and groundwater, potentially resulting in the transport and distribution of PFAS impacts downgradient of source areas. In addition, PFAS-contaminated sediment may be suspended in stormwater runoff and transported during storm events.

PFAS present in unsaturated soil or sediment will tend to associate with the organic carbon fraction present or will aggregate at the air-water, oil-water and soil-water interfaces within the vadose zone (Brusseau, 2018; Higgins and Luthy 2006; Guelfo and Higgins 2013). A potential driver of PFAS transport from surface soils to groundwater and surface water, downward leaching of PFAS within the soil vadose zone during precipitation events promotes dissolution of soil-bound contaminant mass with preferential mobility associated with shorter chain-length PFAS versus longer chain-length PFAS which are less mobile (Sepulvado et al., 2011).

1.5.2 DATA QUALITY OBJECTIVES (DQOS)

DQOs are pre-established goals that help monitor and assess project progress and provide benchmarks against which the quality of fieldwork and the resultant analytical data are evaluated. DQOs specify the type, quality, quantity, and uses of the data necessary to support investigation objectives. Program-level DQOs are presented in Worksheet #11 of the UFP-QAPP (HGL, 2023).

The sample designs that will be employed at the sites to fill data gaps associated with these DQOs are based on the investigation model for PFAS surface release sites, as described in Worksheet #17 and #18 of the UFP-QAPP (HGL, 2023) and in **Sections 2** and **3** below. Because the sites are on the RI investigation pathway site, the extent SLs described in Worksheet #15 will be used to evaluate the nature and extent of contamination in soil. The sample design specific to each site is presented in **Section 3** below.

Section 2 Description of Work

2.0 KEY ELEMENTS

A summary of the key elements of the PFAS RI approach are presented below. A detailed approach for each medium and RI AOC is presented in **Section 3**. Details on sampling and field procedures are presented in the UFP-QAPP (HGL, 2023) Attachment 2. The UFP-QAPP is presented under separate cover.

- **Field Sampling PFAS specific Procedures and Decontamination.** To avoid PFAS contamination, sources of contamination in the field and lab environments shall be identified and avoided.
- **Monitoring Well Installation.** New 2-inch monitoring wells will be installed using hollow stem auger and air hammer/air rotary techniques. All wells will be permanent constructed with stick-up surface completions, unless field conditions necessitate otherwise (e.g., installation in an area where there is vehicular traffic). Wells will be developed prior to sampling. Most wells will be installed in the upper water bearing zone (overburden); however, six bedrock wells will also be installed.
- **Monitoring Well Development.** Development will be performed by surging and purging the well, as appropriate, using either a bailer or pump. Groundwater parameters will be recorded before, during, and after well development. Following development, the monitoring wells will be allowed to equilibrate for a minimum of 48 hours prior to groundwater sampling.
- **Low-Flow Groundwater Sampling.** Sampling of all overburden wells (where depths are less than approximately 15ft bgs) will be conducted using a peristaltic pump with new clean high-density polyethylene (HDPE) tubing. Bedrock wells (or if well depths are greater than approximately 15ft bgs) will be sampled using a PFAS-free submersible or bladder pump. Low flow sampling techniques, modified to avoid PFAS cross-contamination, will be used to collect groundwater samples. Water quality parameters will be monitoring during purging of the well and before sampling.
- **PFAS-Free Definition.** All materials related to PFAS sampling, including sample bottles, will be certified PFAS-free by the provider or tested prior to use to document a lack of PFAS compounds. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The contracted laboratory will provide PFAS-free water defined as less than (<) the method detection limit (MDL) for the target compound analyzed. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS. The project team will determine the acceptability of an on-site source of water for decontamination and well development based on site-specific parameters such as drilling method and sample media. The onsite water source will be defined as PFAS-free if it meets the DoD QSM Table B-24 method blank requirement: "No analytes detected > ½ LOQ or > 1/10th the amount measured in any associated sample or 1/10th the regulatory limit, whichever is greater." The confirmation of PFAS-free water should always be performed prior to the commencement of work. If the potable water source is determined to be unacceptable an alternate source of water with acceptable PFAS levels will be utilized.
- **Soil Sampling.** Soil sampling will be conducted using a decontaminated hand auger. Surface soil samples (0 – 0.5ft bgs) will be collected beneath any vegetative layers. Subsurface soil will be collected from 2.0 to 4.0 ft bgs. Soil will be placed in stainless-steel bowl, homogenized, and placed into laboratory provided containers.
- **Surface Water Sampling.** Surface water samples will be collected from a variety of surface water bodies including streams, drainage ditches, and ponds to evaluate a range of surface water conditions at the RI AOCs. Multiple rounds of sampling will be conducted to document dynamic changes in this medium.
- **Sediment.** If sediment is present at a surface water sample location, a sediment sample will be collected at the same location. Surface water bodies are typically shallow enough that sediment can be collected by hand. Two rounds of sampling will be conducted to document dynamic changes in this medium. Pore water will be investigated using passive samplers.
- **Biota.** In coordination with the managed deer hunt, samples of deer muscle and liver will be collected from a selection of deer harvested from the deer hunt conducted at the Depot. The samples will be analyzed for PFAS and will be used to support the human health risk assessment.

- **Human Health and Ecological Risk.** The planned human health and ecological risk assessment approach is presented in the Risk Assessment Work Plan (**Appendix A**).
- **Well Inventory Survey**. A drinking water well survey will encompass the boundary of the former Depot and the area between the western boundary of the former Depot and Seneca Lake, approximately 1 to 1.5 miles to the west (downgradient) of the Depot. The well survey will identify the location of drinking water wells and the well construction details, if available. Data will be collected from sources such as: past Seneca investigations, online well databases (e.g., NYSDEC), town/county records, county water department, NYSDOH records, and interviews with major landowners. These data will be used during initial review of RI data and will be provided in the RI report.

2.1 ANALYTICAL METHODS

Analytical methods are fully defined in the UFP-QAPP (HGL, 2023). All media will be analyzed for PFAS using EPA Draft Method 1633 in accordance with DoD Quality Systems Manual (QSM) 5.4. The targeted list of PFAS includes 40 analytes which are presented in Worksheet #15 of the UFP-QAPP. Samples will be shipped to Eurofins Lancaster Laboratories Environment Testing, LLC (ELLE) which is Environmental Laboratory Approval Program (ELAP) certified for PFAS analyses.

In addition to PFAS, sample analyses may include the following:

- Aqueous samples: total organic carbon (TOC), total dissolved solids (TDS), total suspended solids (TSS), anion exchange capacity (AEC), and metals/cations (aluminum, calcium, iron, magnesium, manganese, sodium, and potassium).
- Soil samples: TOC, pH, AEC, metals/cations (aluminum, calcium, iron, magnesium, manganese, sodium, and potassium).

Sample-specific analytical methods will be conducted at key locations such as source areas, groundwater to surface water discharge areas, and plume cores. These locations are identified in the AOC specific sampling matrices in **Chapter 3**.

2.2 DATA VALIDATION

Data verification will be performed on 100% of the analytical data produced for this project. Data verification consists of checking laboratory reports for completeness to ensure that all samples submitted were analyzed for the methods requested on the Chain of Custody (CoC) and that all required target analytes were reported. A detailed summary of data verification procedures can be found in Worksheets #34 and #35 of the UFP-QAPP (HGL, 2023). Validation of the data collected will be performed in accordance with the UFP-QAPP. A detailed summary of data validation procedures can be found in Worksheets #36 and #37 of the UFP-QAPP (HGL, 2023). Data Validation Reports will be produced for each laboratory data package.

Section 3 Sampling Strategy by Area of Concern

The RI consists of site preparation activities including the mobilization/demobilization of field team personnel and equipment, utility clearance, and surface/subsurface soil, groundwater, surface/stormwater, sediment, and biota sampling for PFAS analysis. This section provides an overview of the RI approach during the field investigation followed by AOC-specific section with details concerning sampling rationale, sample locations, and proposed analyses. Specific sampling methodology and analytical methods including specific procedures for PFAS-related investigations are provided in the UFP-QAPP (HGL, 2023) along with field standard operation procedures (SOPs) (Attachment 2 of the UFP-QAPP).

3.0 GENERAL SAMPLING APPROACH

3.0.1 Soil Sampling

Surface soil samples will be collected to aid in understanding of PFAS migration pathways via leaching to groundwater, overland runoff to surface water and/or wind transport and to support risk assessments as applicable. To accomplish this, surface soil samples (0-0.5 feet bgs) will be collected from suspected source areas where AFFF may have been released and along ephemeral surface water flow paths (e.g., ditches, swales) and select areas where surface water accumulates and where AFFF may have previously migrated. Samples collected from stormwater conveyance features such as the Firehouse and Airfield drainage ditches and swales will be considered surface soil samples rather than sediment as these features do not support ecological receptors associated with aquatic habitats (e.g., benthic organisms).

Subsurface samples will be collected at a depth of 2.0 to 4.0 ft bgs to further support risk assessments as applicable. Subsurface locations will be determined after the results of the surface soil samples are received and will target surface soil locations with maximum PFAS concentrations. Soil sampling techniques are presented in the UFP-QAPP, Attachment 2 Standard Operating Procedures (HGL, 2023). Rationale and soil sample matrices for each AOC are presented in **Sections 3.1.5, 3.2.5, 3.3.5,** and **3.4.5**.

3.0.2 Monitoring Well Installation and Development

As described below, additional groundwater monitoring wells will be installed to address data gaps identified in the ESI (Parsons, 2022a), further define the nature and extent of PFAS contamination in groundwater, and to provide data to support risk assessments. Proposed monitoring well locations, sample matrices and their rationale are presented in the AOC specific sections (3.1.3, 3.2.3, 3.3.3, and 3.4.3) below. Proposed well construction details and development techniques are presented in Attachment 2 of the UFP-QAPP (HGL, 2023). Development of a groundwater well should not be started until 48 hours after the well has been grouted. Following development, the monitoring wells will be allowed to equilibrate for a minimum of 48 hours prior to groundwater sampling. Monitoring wells will be surveyed by a NY licensed surveyor and tied into the existing ESI well network.

3.0.3 Groundwater Sampling

Groundwater samples will be collected to address data gaps identified in the ESI (Parsons, 2022a), define the nature and extent of PFAS contamination, and to gather data to support risk assessments. Two rounds of groundwater sampling will be performed. The first round will include all newly installed monitoring wells, and the round will include select existing monitoring wells at the Firehouse, SEAD-25, and SEAD-26. The existing wells that will be a part of the first RI round are selected based on their position within the PFAS plume or at upgradient locations to confirm there are no potential upgradient site inputs. The first round will provide a seasonal look at the extent of the PFAS plume which can be compared to existing ESI data to see if concentrations have changed and determine plume stability; expand the PFAS dataset for the existing wells by using EPA Draft Method 1633; allow comparison with data from new monitoring wells that is temporally the same; and provide data to allow comparison with nearby surface water samples that are collected contemporaneously.

A second round of groundwater sampling will be conducted and will include new wells installed during the RI. Between the ESI data and the two RI rounds, every monitoring well will be sampled at least two times, which will cover seasonal

variations. In addition to analyzing groundwater samples for PFAS (Draft Method 1633), the first round of groundwater samples will include the analytical list specified in Section 2.1. Each sampling round will be preceded by synoptic groundwater gauging event (which will include all existing ESI wells and new RI wells) to determine groundwater elevations.

Every reasonable attempt to minimize the presence of suspended particulates will be taken during well installation, well development and while groundwater sampling. There is a potential for suspended solids to accumulate PFAS, specifically some long-chain PFAS constituents, if not prepared thoroughly at the laboratory (ITRC, 2022). It is the goal of the project team to collect groundwater samples with turbidity values less than 10 nephelometric turbidity units (NTUs). However, should the sample turbidity be greater than 10 NTUs with no means of collecting an aliquot at a lower turbidity, then the sample will be collected, and the laboratory will be notified of the potential for high total suspended solids (TSS) on the CoC. According to Draft Method 1633, aqueous samples containing less than 50mg of suspended solids per 500mL sample may be processed without modification to the preparation protocol. Through the regular course of Draft Method 1633, the laboratory will determine if an aqueous sample contains more than 50mg/500mL of TSS and should a groundwater sample produce a TSS concentration greater than 50mg/500mL, the project team will be notified immediately for direction on how to proceed. If resampling is not an option and at the concurrence of the USACE chemist, the lab may be instructed to centrifuge the sample and decant the aqueous portion for processing separately from the solid pellet. The aqueous and solid phases will be extracted and analyzed according to the appropriate matrix protocol specified within Draft Method 1633, with the aqueous phase results considered as the dissolved PFAS concentrations and the PFAS results from the solids pellet completing the measurement for each groundwater sample to yield "total" PFAS concentrations.

Rationale for monitoring well locations, sample matrices and analytical methods proposed for each sample are presented in the AOC specific sections (3.1.4, 3.2.4, 3.3.4, and 3.4.4) below. Groundwater samples will be collected in accordance with the SOPs presented in Attachment 2 of the UFP-QAPP (HGL, 2023). Each sample will be collected into laboratory-supplied HDPE bottleware and submitted to the contract laboratory for analysis. All sample containers will be PFAS-free. Field QA/QC samples will be collected in accordance with Worksheet #20 of the UFP-QAPP (HGL, 2023).

3.0.4 Surface Water Sampling

Surface water and stormwater samples will be collected to aid in understanding the PFAS transport pathways via surface/stormwater runoff and to support ecological risk assessments. To accomplish this, surface/stormwater samples will be collected from along permanent and ephemeral surface water flow paths (e.g., ditches, swales that only have water after storm events) leading from areas of known PFAS impacts and areas where surface water accumulates. Care will be taken while sampling surface water and stormwater to minimize the presence of suspended particulates.

Proposed surface water and stormwater sample methods, locations, and rationale for proposed locations are presented in the AOC specific sections (3.1.6, 3.2.6, 3.3.6, and 3.4.6) below. Surface water sampling SOPs are presented in Attachment 2 of the UFP-QAPP (HGL, 2023).

3.0.5 Sediment Sampling

Sediment samples will be collected from 0 to 6-inches bgs from areas determined to convey surface water that may support ecological receptors associated with aquatic habitats aquatic to aid in understanding of PFAS migration pathways via surface water and to support ecological risk assessments. If a proposed sampling location is determined not likely (i.e., continuous inundation of less than 1 month) to support aquatic habitats (e.g., benthic organisms) it will be considered as surface soil in the risk assessments.

Pore water samples are proposed to be collected from within the pond west of SEAD-26. These samples will help address questions regarding groundwater/surface water exchange, refinement of plume discharge zones to support CSM enhancements, and potential ecological risk. Pore water will be collected using passive samplers installed into the sediment. Pore water samples are not proposed for the other RI sites because the drainage ditches are not expected to have enough sediment as many of the ditches are at, or close, to the bedrock surface.

Proposed surface water and stormwater sample methods, locations, and rationale for proposed locations are presented in the AOC specific sections (3.1.6, 3.2.6, 3.3.6, and 3.4.6) below. Sediment sampling SOPs are presented in Attachment 2 of the UFP-QAPP (HGL, 2023).

3.0.6 Biota Sampling

Studies have shown that PFAS may bioaccumulate. PFAS in soil can accumulate into plants, soil invertebrates, and animals, such as deer, that forage at the sites. There is a deer population that is contained at Seneca through a mostly-intact perimeter fence. A deer hunt is conducted annually to manage the deer population at SEDA. PFAS in surface water and sediment can accumulate into fish and benthic invertebrates; however, the surface water bodies at SEDA are too small to support sport fish. Small fish, however, could be consumed by birds and mammals. Benthic invertebrates also could be consumed by wildlife. Biota samples will be collected to support human health risk assessments for the RI AOCs and will include tissue and liver samples collected from the installation deer population. Samples will be collected from the muscle and liver tissue of the deer, and these samples will be analyzed for PFAS using EPA Draft Method 1633.

Additional details on biota sampling and proposed biota sample species, locations, and rationale are presented in **Section 3.5**. The SOP for sampling biota is presented in **Appendix B** of this Work Plan.

3.0.7 Hydraulic Conductivity Testing

In-situ hydraulic conductivity tests (i.e., slug tests) will be performed on a select number of monitoring wells. These tests will provide data on characteristics of the water bearing zones which will be used to refine the CSM. Conductivity testing will be conducted in accordance with the SOPs in the UFP-QAPP. Each slug test (falling and rising head tests) will be conducted in accordance with the American Society for Testing and Materials (ASTM) D4044/D4044M-15. A pressure transducer/data logger will be placed into each well and a mechanical slug will then be lowered into the well to displace a known and fixed volume of water. The slug will be constructed of stainless steel or PVC pipe (filled with sand, capped, and sealed) and will be of an appropriate size to cause sufficient water displacement depending on water column in the well and well diameter. The transducer will continuously record the water level in the monitoring well as the hydraulic head is decreased during the falling head test. Data logging will continue as the hydraulic head increases during the rising head test in response to removal of the slug until the water level within the monitoring well has again reached equilibrium. The slug test data will be analyzed using the Bower-Rice (1976) method and the results will be presented in both tabular and graphical form. Wells to be tested for hydraulic conductivity are identified below in the AOC-specific sections.

3.1 FIREHOUSE – BUILDING 103

3.1.1 Previous PFAS Sampling

Prior to the PFAS ESI, Building 103, formerly used as a Firehouse, was never the subject of previous environmental investigations and was never assigned a SEAD identifier. Investigated between May 2019 and March 2021 for PFAS as part of the ESI, the presence of PFAS above the selected SLs at the time of the investigation was confirmed in soil, groundwater and stormwater (Parsons, 2022a).

- Three locations within the suspected Firehouse source area were sampled for soil. All three locations were sampled at a depth of 2.5 to 3 feet bgs. One location was sampled at a shallower depth of 0.2 to 2 feet bgs due to the presence of fill material. All soil samples were analyzed using the synthetic precipitation leaching procedure (SPLP) and the leachate was analyzed for PFAS.
  - All of the deeper depth soil samples had exceedances of the SLs (10 ng/L) for PFOA and PFOS with maximum concentrations of 160 ng/L and 13 ng/L, respectively.
  - A maximum total Σ21-PFAS ($PFAS_{21}$) concentration of 503 ng/L was detected in the soil sample located between monitoring wells MWFH-04 and MWFH-05, the wells with the highest PFAS concentrations in groundwater.

- Two rounds of groundwater sampling were conducted at ten overburden monitoring wells and two bedrock wells. PFAS detections in six of the overburden wells exceeded SLs (10 ng/L). The bedrock wells did not have exceedances of the SLs for PFOA or PFOS.
  - The highest concentrations of PFOA (4,100 ng/L) and PFOS (7,700 ng/L) were observed in samples collected from wells MWFH-04 (screened 8-18 feet bgs) and MWFH-05 (screened 10-20 feet bgs) located 175 feet northwest and 100 feet north, respectively, of the former Firehouse.
  - Maximum total $PFAS_{21}$ in overburden groundwater was 42,260 ng/L in well MWFH-04.
  - Maximum total $PFAS_{21}$ in bedrock groundwater was 23.4 ng/L in well MWFH-10D located approximately 500 feet downgradient of the Firehouse.
- Two rounds of stormwater samples were collected at three locations from the subsurface stormwater infrastructure.
  - PFOS was detected (18 ng/L and 27 J+ ng/L) above the SL (10 ng/l) in the furthest downgradient location during both rounds of sampling.
  - Total $PFAS_{21}$ was detected at a maximum concentration of 65.7 ng/L.

3.1.2 Conceptual Site Model

PFAS is present at the Firehouse AOC in shallow soil, overburden groundwater and the stormwater infrastructure. Soil impacts were observed in shallow soil up to 3 ft bgs west of Building 103. Maximum PFAS concentrations in overburden groundwater were observed northwest of Building 103. PFAS impacts were not observed in the bedrock water-bearing zone. Data gaps include delineation of the extent of contamination in surface and subsurface soil, further definition of the extent of PFAS in the overburden groundwater to the southwest and south of the Firehouse, undefined extent of PFAS impacts in groundwater to the east of the Firehouse and an undefined deep groundwater extent between the Firehouse and SEAD-25.

3.1.3 Monitoring Wells

Five shallow wells and two deep wells will be installed during the RI to further define the downgradient nature and extent. One shallow well (MWFH-12) will be installed west of existing well MWFH-04 and two shallow wells (MWFH-13 and MWFH-15) will be installed to the south/southwest of MWFH-02. One shallow well (MWFH-16) will be installed east of the Firehouse to define the eastern nature and extent. The furthest downgradient well (MWFH-15) to the southwest and the well to the east (MWFH-16) will be paired with a bedrock well to delineate the extent of contamination in the lower water-bearing zone. These locations were selected based on data gaps identified in the 2022 PFAS ESI and are presented on **Figure 2**.

3.1.4 Groundwater Sampling

One full round of groundwater samples will be collected from 15 wells; 8 existing wells and 7 new wells (**Figure 2**, **Table 1**). A second round of groundwater sampling will be performed at the 7 new wells. Five wells will be tested for hydraulic conductivity. A sample matrix with sample identification, QC requirements, and proposed analytes are presented in **Table 1**.

3.1.5 Soil Sampling

Soil samples will be collected at twenty locations in order to delineate the extent of surface soil contamination in the source area and support the risk assessments (**Figure 3**). Surface soil samples will be 0-0.5 ft. After the surface soil analytical results are received, eight subsurface samples will be collected at a depth of 2.0 to 4.0 ft bgs. Additionally, while installing the five new overburden well locations, surface (0 to 0.5 ft bgs) and subsurface (2 to 4 ft bgs) soil samples will be collected. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 2.**

3.2 SEAD-25 FIRE TRAINING AND DEMONSTRATION PAD

3.2.1 Previous PFAS Sampling

SEAD-25 was investigated for PFAS during the PFAS SI (Parsons, 2018) and PFAS ESI (Parsons, 2022a). During the SI, the investigation focused on the former training area where groundwater from 12 existing wells was analyzed for a targeted suite of 14 PFAS compounds. Twelve of 14 PFAS compounds were detected at SEAD-25. PFOS and PFOA were detected in all 12 wells sampled at SEAD-25. The combined concentrations of PFOS and PFOA exceeded the EPA lifetime health advisory level (70 ng/L) in all 12 wells. The maximum detection of PFOS was 8,300 ng/L in well MW25-8. The maximum detection of PFOA was 89,000 J ng/L in well MW25-2.

During the PFAS ESI, additional perimeter wells were added to delineate the extent of PFAS contamination and soil and surface water samples were collected (Parsons, 2022a).

- Three locations within the suspected SEAD-25 source area were sampled for soil. All three locations were sampled at a depth of 2.5 to 3 feet bgs. Two locations were sampled at a shallower depth of 0.2 to 2 feet bgs due to the presence of fill material. All soil samples were analyzed using SPLP and the leachate was analyzed for PFAS.
  - All of the soil samples within SEAD-25 had exceedances of the SLs (10 ng/L) for PFOA and PFOS. Maximum concentrations of PFOA (1,100 ng/L) were found within the formerly excavated pad area and maximum concentrations of PFOS (1,900 ng/L and 2,400 ng/L) were found outside and west of the former pad area.
  - The maximum $PFAS_{21}$ concentrations (approximately 3,500 ng/L) were found in soil west and outside of the excavated area of the former training pad.
- An additional round of groundwater sampling was conducted at the 12 existing wells that were previously sampled during the SI. Two rounds of groundwater sampling were conducted at 15 overburden monitoring wells and three bedrock wells which were installed during the ESI. PFAS detections in six of the overburden wells exceeded SLs (10 ng/L). The bedrock wells did not have exceedances of the SLs for PFOA or PFOS.
  - All 12 of the existing wells and six of the perimeter wells had exceedances of the SLs for PFOA and PFOS.
  - Maximum PFOA (580,000 ng/L, MW25-2) and PFOS (12,000 ng/L, MW25-8) concentrations were detected within existing wells located in the former pad area.
  - Outside the source area, PFAS was generally detected in the downgradient (southwest) direction with maximum concentrations of PFOA (1,300 ng/L, MW25-22) and PFOS (140 ng/L, MW25-21) in the two downgradient wells closest to the source area.
  - East of the SEAD-25 training pad and south of the Firehouse, PFOA and PFOS were detected (61 and 11 ng/L, respectively) in two wells near the SEDA boundary.
  - Maximum total $PFAS_{21}$ in overburden groundwater was 687,670 ng/L detected in MW25-2 adjacent to the pad excavation.
  - Maximum total $PFAS_{21}$ in bedrock groundwater was 13.7 ng/L in well MW25-34D located approximately 3,500 feet downgradient of SEAD-25.
- Two rounds of surface water sampling were conducted within the open drainage ditches adjacent and downgradient of SEAD-25.
  - The maximum concentrations of PFOA (115 ng/L) and PFOS (62 ng/L) were detected approximately 700 feet west of the former pad area.
  - Surface water detections above the SLs were detected as far as 2,000 feet downgradient of SEAD-25 with a maximum total $PFAS_{21}$ of 161 ng/L.
  - PFOA and PFOS were not detected above SLs in surface water (SW25-03) traveling from offsite into the SEAD-25 'watershed'.

3.2.2 Conceptual Site Model

The PFAS impacts to shallow groundwater are concentrated around the former SEAD-25 site boundary and fire training pad area and approximately 500 ft downgradient to the west and southwest of the site. The ESI defined a shallow groundwater plume extending southwest of SEAD-25 with plume extents bounded to the west, southwest, and south by

wells with PFAS concentrations below the New York state (NYS) MCL. Impacts were not observed in the deeper water bearing zone at the source area or downgradient of the source area. Groundwater advection of PFAS into nearby drainage ditches is interpreted to be a cause of the PFAS concentrations observed in the surface water downgradient of the site. The PFAS compounds are then dispersed further downgradient than the extent of the groundwater plume via stormwater drainage ditch infrastructure. Subsurface soil from the source area indicates leaching and infiltration through the vadose zone are mechanisms for transport of PFAS into the groundwater. Source area soil was not fully delineated during the ESI and sediment within downgradient drainages was not sampled. Other data gaps identified in the ESI include: the nature of the interaction of the PFAS plume with the surface water drainage northwest of SEAD-25; the extent of the PFAS plume toe to the southwest and its interaction with nearby surface water features; the effects of local radial flow at the SEAD-25 pad and the extent of PFAS contamination east of the pad; delineation of the southern or eastern extent of PFAS contamination originating from the Firehouse or SEAD 25, respectively and additional characterization of the downgradient extent of PFAS impacts to surface water to determine if the impacts are of concern to future receptors.

Part of the remedy at SEAD-25 included excavation of soil from the former fire training pad located at the center of the AOC and removal of sediment in the drainage ditch northwest of SEAD-25. The soil in the vicinity of the former training pad was excavated to bedrock (approximately 4.5 feet bgs) and was disposed of off-site thus removing a portion of PFAS-impacted soil available to leach to the groundwater. The former pad area was backfilled with a mixture of an off-site source and soil sourced from the Administrative area as described in Section 1.2.2. Soil from the Administrative area may have been sourced from near the former Firehouse and therefore redistributed PFAS mass to SEAD-25. The resultant change in soil geochemistry and source of PFAS at SEAD-25 likely will alter the transformation of precursors at the site and may change the expected concentrations and PFAS signature exhibited at the site. As noted in Section 1.2.2, SEAD-26 was also subject to small excavations as part of the site remedy. These excavations were shallow (1 ft bgs) and were not backfilled thus only a small reduction in PFAS mass sorbed to the soil is likely.

3.2.3 Monitoring Wells

Monitoring well installation will include the addition of two till/overburden monitoring wells (MW25-36, MW25-38) that straddle the drainage feature northwest of well MW25-19 and one piezometer (MW25-37) located in the drainage ditch (**Figure 4**). This group of wells will monitor groundwater/surface water interaction and delineate the western extent of the SEAD-25 plume. One till/overburden well (MW25-35) will be installed directly southwest of MW25-22 (a localized PFAS maximum southwest of the source area) and north of an east-west trending drainage channel to further define the southwest extent of the PFAS plume and assess if the surface water feature is a transport mechanism for contaminant migration away from SEAD-25. Two till/overburden wells (MW25-39, MW25-40) will be installed east of SEAD-25 near the SEDA boundary. The location of these wells will be finalized after the groundwater results are received from existing wells MW25-24 and MW25-33 and the surface water sampling from within the wetland east of SEAD-25. If these new data indicate the presence of PFAS, the two wells will be installed to delineate the eastern extent of the SEAD-25 and/or southern extent of the Firehouse plume and determine if the impacts extend towards sensitive receptors in this area.

3.2.4 Groundwater Sampling

The first round of sampling will include the six newly installed wells plus eighteen select existing wells which were previously sampled during the ESI (**Figure 4**, **Table 3**). A second round of sampling will include the six new wells installed during the RI. Hydraulic conductivity testing will be conducted at six wells to estimate groundwater hydraulic conductivity. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 3**.

3.2.5 Soil Sampling

Thirty locations will be used to delineate the extent of surface soil contamination in the source area and support the risk assessments (**Figure 5**). Surface soil samples will be 0-0.5 ft. After the surface soil analytical results are received, ten subsurface samples will be collected at a depth of 2.0 to 4.0 ft bgs and will target surface soil locations that had elevated PFAS concentration. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 4**.

3.2.6 Surface Water and Sediment Sampling

Thirteen surface water samples and thirteen sediment samples are proposed to be collected downgradient of SEAD-25 (**Figure 4**). The additional surface water and sediment sampling will aid in delineating the nature and extent of PFAS contamination adjacent to and downgradient of the source area and in a wetland east of the source area. Stormwater in the infrastructure exiting the administration area into the SEAD-25 drainage ditch was shown during the ESI to be impacted by PFAS. A surface water and sediment pair (SWSD25-00) will be collected at the outfall from the administration area as it enters the SEAD-25 drainage ditch (**Figure 4**). Four rounds of surface water sampling are proposed for locations not previously sampled and that likely sustain water throughout the year (SWSD25-07, -08, -09) (**Table 5**). Two rounds of surface water sampling are proposed for previously sampled locations or locations that are not wet year-round (SWSD25-00 thru -06; SWSD25-10, -11, -12; note SWSD25-03 will be sampled during the Parsons SEDA Background Study). Two rounds of sediment sampling are proposed. Permanent water features include the ditches southwest of SEAD-25 (sampling locations SD25-00, SWSD25-01, -02, -04 through -09) and the wetland east of SEAD-25 (sampling locations SWSD25-10 through -12). Ephemeral drainages include the drainage directly east and south of the SEAD-25 pad and the drainage ditch entering the base from the east (location SWSD25-03). These drainages likely only accumulate surface water following substantial rainfall events. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 5**.

3.3 SEAD-26 FIRE TRAINING PIT AND AREA

3.3.1 Previous PFAS Sampling

SEAD-26 was investigated for PFAS during the PFAS SI (Parsons, 2018) and PFAS ESI (Parsons, 2022a). During the SI, the focus of the investigation was within the SEAD boundary and eight temporary direct push wells were installed. PFAS presence was confirmed in the SI. During the ESI, 8 overburden monitoring wells were installed within the SEAD boundary in proximity to suspected source areas. One bedrock well was installed downgradient of the former bentonite lined pit. An additional 13 overburden wells were installed downgradient (west) of the SEAD-26 source area to delineate the extent of PFAS contamination. Two bedrock wells were installed in the downgradient direction along the suspected plume core. Soil was sampled from the location of former site features that were interpreted as suspected source areas (e.g., location of fire training features) and two rounds of surface water sampling was performed downgradient of the source area.

- Five locations within identified SEAD-26 site features were sampled for soil. All five locations were sampled at a depth of 2.5 to 3 feet bgs. Two locations were sampled at a shallower depth of 0.2 to 2 feet bgs due to the presence of fill material. All soil samples were analyzed using SPLP and the leachate was analyzed for PFAS.
  - Four of the five soil sampling locations within SEAD-26 had exceedances of the SLs (10 ng/L) for PFOA and PFOS (at both the shallow and deeper sampling depth). Maximum concentrations of PFOA (280 ng/L) and PFOS (1,500 ng/L) were detected within the former bentonite lined pit.
  - The maximum $PFAS_{21}$ concentrations (approximately 3,300 ng/L) were found in soil within the former bentonite lined pit.
  - The next highest concentration of PFOA (39 ng/L) and PFOS (470 ng/L) and total $PFAS_{21}$ (711 ng/L) was detected in soil downgradient of the former bentonite lined pit.
- Temporary wells were not resampled during the ESI due to data quality. Permanent wells were installed adjacent to SI locations with exceedances of SLs. Two rounds of groundwater sampling were conducted at 20 overburden monitoring wells and three bedrock wells which were installed during the ESI. PFAS detections in 11 of the overburden wells exceeded SLs (10 ng/L). The bedrock wells were non-detect for PFOA and PFOS.
  - Seven of nine wells within the SEAD-26 AOC had exceedances of SLs. PFOA and PFOS did not exceed SLs in the upgradient well and total $PFAS_{21}$ was less than 2 ng/L.
  - Maximum PFOA (1,200 ng/L, MW26-28) and PFOS (2,450 ng/L, MW26-28) concentrations were detected downgradient of the former bentonite lined pit. Total $PFAS_{21}$ at MW26-28 was 14,364 ng/L.
  - Four of 11 downgradient wells had exceedances of the SLs for PFOA and PFOS.

  - Outside the source area, the plume core extends west of the former bentonite lined pit. Concentrations of PFOA (11 ng/L, MW26-23) were above SLs approximately 2,100 feet downgradient of the former bentonite lined pit.
  - A former drum storage area is located at the southern end of SEAD-26. PFOA (110 ng/L, MW26-30) and PFOS (110 ng/L, MW26-30) were detected above SLs in two wells. The western extent of the PFAS contamination is not bound.
  - Maximum total $PFAS_{21}$ in overburden groundwater was 14,364 ng/L detected in MW26-28 downgradient of the former bentonite lined pit.
  - Maximum total $PFAS_{21}$ in bedrock groundwater was 10.1 ng/L in well MW26-23D located 2,100 feet downgradient of the former bentonite lined pit.
- Two rounds of surface water sampling were conducted at six locations within the open drainage ditches adjacent and downgradient of SEAD-26. Two locations were only sampled once after precipitation events.
  - The maximum concentrations of PFOA (650 ng/L) and PFOS (2,100 ng/L) were detected in an unimproved drainage ditch which drains the area west of the former bentonite lined pit. This location was sampled after a precipitation event.
  - The surface water location west of the drum storage also had PFOA (28 ng/L) and PFOS (18 ng/L) above the SLs.
  - Other surface water locations were below SLs. The sampling location furthest downgradient (approximately 3,300 feet from the source area) had maximum total $PFAS_{21}$ of approximately 45 ng/L.

3.3.2 Conceptual Site Model

The ESI confirmed PFAS impacts above SLs in the shallow groundwater within the SEAD-26 boundaries and extending in a narrow plume to the west approximately 2,500 ft downgradient of the site boundary. Impacts were not observed in the deeper water-bearing zone at the source area or downgradient of the source area. Shallow soil to a depth of 3 ft bgs in proximity to former site training features was found to be impacted with PFAS. Portions of the source area soil PFAS mass may have been reduced during the RA when several small areas were excavated to a depth of 1 ft bgs and were not backfilled (**Figure 6**). Surface water located in two drainage ditches flowing west from SEAD-26 contained elevated concentrations of PFAS. The source of water for the two drainage ditches is the southern half of the SEAD-26 site. Data gaps include further characterization of soil in the source area; sediment sampling within downgradient surface water features; additional characterization of surface water pathways downgradient of the source area; further delineation of the horizontal PFAS impacts to shallow groundwater west of wells MW26-30 and MW26-31 (southern end of SEAD-26); and additional investigation of the downgradient extent of PFAS impacts to surface water west of sample location SW26-06 (**Figure 6**).

3.3.3 Monitoring Wells

To bound the extent of PFAS contamination downgradient (west) of wells MW26-30 and MW26-31 at the southern end (drum storage area) of SEAD-26, two shallow wells (MW26-33, MW26-34) due west of the Drum Storage Area are proposed to delineate the western boundary (**Figure 6**).

3.3.4 Groundwater Sampling

One round of groundwater sampling will be conducted at 19 existing wells sampled during the ESI and the two new wells installed during the RI (**Figure 6**, **Table 6**). A second round of groundwater sampling will target the two new wells. Slug testing will be conducted at six wells to estimate groundwater hydraulic conductivity. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 6**.

3.3.5 Soil Sampling

Thirty locations will be used to delineate the extent of surface soil contamination in the source area and support the risk assessments (**Figure 7**). Surface soil samples will be 0-0.5 ft. After the surface soil analytical results are received, twelve

subsurface samples will be collected at a depth of 2.0 to 4.0 ft bgs. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 7**.

3.3.6 Surface Water and Sediment Sampling

Ten paired surface water and sediment locations are proposed at locations which target areas with elevated concentration identified in the ESI, areas at the plume toe, and the downgradient wetland. Four rounds of surface water sampling are proposed for two new locations that have water year-round (SWSD26-07, -08) (**Figure 6**). Two rounds of surface water sampling are proposed for eight previously sampled locations or locations with ephemeral water (SWSD26-04, -05, -06, -09 through -13). Locations SWSD26-11, SWSD26-12, and SWSD26-13 will be placed in the wetland west of the pond. There locations will be determined based upon field conditions. Two rounds of sediment sampling will be conducted. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 8**.

3.3.7 Pore Water Sampling

Two sediment pore water samples are proposed to be collected from the pond downgradient of SEAD-26 (**Figure 6**). The samples are proposed to be collected using a diffusion-based equilibrium passive sampler that has been developed and validated for targeted PFAS in sediment pore water (e.g., SiREM PFASsive™ sampler). Upon retrieval, the water from PFASsive™ is treated as a water sample and the PFAS can be concentrated and measured using EPA Draft Method 1633 without the need for additional extraction steps required when sorbents are present. The equilibrium sampler will be left deployed for approximately 4 weeks. The inclusion of a reverse tracer allows for the determination of the extent of equilibrium during deployment. The samples will be analyzed at Eurofins – Sacramento, a DoD ELAP certified laboratory. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 8** and additional information on the pore water method is included in **Appendix C**.

3.4 AIRFIELD: SEAD-122D (HOT PAD SPILL) AND SEAD-122E (PLANE DEICING AREA)

3.4.1 Previous PFAS Sampling

The Airfield was investigated for PFAS during the SI which included the installation of 23 temporary one-inch wells (Parsons, 2018). The wells were installed around the perimeters of the SEAD-122D and SEAD-122E AOCs and spatially around the former airfield. The SL at the time of the SI was the EPA lifetime health advisory (70 ng/L). Soil and surface water were not sampled.

- PFOS was detected in five wells with a maximum concentration of 6.4 ng/L (TMW-122E-24; downgradient of SEAD-122E); below the SL of the SI (70 ng/L) and the SL (10 ng/L) of the ESI.
- PFOA was detected in 18 wells with a maximum concentration of 15 ng/L (TMW-122E-14; within SEAD-122D). This was below the SL of the SI, but above the SL used during the ESI.
- Total Σ14-PFAS ($PFAS_{14}$) was detected at a maximum concentration (83.5 ng/L; TWM-122E-24) at a location downgradient (northwest) of the central SEAD-122E AOC.

3.4.2 Conceptual Site Model

During the PFAS SI (Parsons, 2018), only overburden groundwater was sampled for PFAS within the Airfield. One well (TWM-122E-14) exceeded the current NYS MCL for PFOA, and three of the SI wells (TWM-122E-10, -12, and -24) had detections of PFAS compounds that are consistent with an AFFF source. The deep water-bearing zone was not investigated during the SI. Further characterization of the airfield was not completed following the SI since the concentrations were below the PFAS SLs at the time. The existing data from the SI now exceed the state MCL in some locations. Based on data from the temporary wells, which indicates PFOA levels and transformation products (e.g., perfluorohexanoic acid [PFHxA] and perfluorohexanesulfonic acid [PFHxS]) suggestive of an AFFF source, a PFAS source that exceeds state criteria could exist at SEAD-122E/SEAD-122D. As such, the shallow water-bearing zone was not fully investigated to support an RI and the lower water-bearing zone (bedrock) has not been characterized. No permanent surface water bodies are present around

SEAD-122E; however, stormwater drainage features are present in some areas. Site soil has not been characterized for PFAS presence. Additionally, Building 2305 (Fire Station, Airfield), identified in the HGL (2022) HRR and downgradient of the central SEAD-122E pad, will be investigated as it may also be a source of PFAS based on its former use. Additionally, a Seneca County fire training tower is located south of the central SEAD-122E pad and will also be investigated due to the potential use of AFFF (**Figure 8**).

3.4.3 Monitoring Wells

No permanent monitoring wells are present within the Airfield. Sixteen monitoring wells (14 shallow and 4 bedrock) are proposed and will target areas downgradient of the SEAD-122D/122E AOCs or areas identified in the SI as having elevated concentrations (i.e., TWM-122E-14 and TWM-122E-24) (**Figure 8**). Two wells are proposed downgradient of the north and south SEAD-122E AOCs (**Figure 8**). Four wells are proposed downgradient of the central SEAD-122E AOC. Four wells are proposed for the SEAD-122D AOC (**Figure 8**). Two locations (MW122E-10, -11) are proposed to delineate potential non-DoD sources located adjacent to the central SEAD-122E AOC and one location (MW122E-09) is proposed to delineate downgradient of Building 2305 (Firehouse). The lower water bearing zone (bedrock) was not investigated previously for PFAS. Four bedrock wells are proposed and their locations will be selected to target locations with elevated PFAS concentration in the overburden.

3.4.4 Groundwater Sampling

Two rounds of groundwater sampling (18 wells in each round) are proposed [Note: the first round of sampling in the bedrock wells will be after analytical results from the shallow wells are received]. Slug testing will be performed at seven shallow wells and two bedrock wells to determine groundwater hydraulic conductivity. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 9**.

3.4.5 Soil Sampling

Thirty surface (0 to 0.5 ft bgs) soil samples are proposed and will be distributed between the different airfield AOCs targeting areas where AFFF may have runoff or accumulated (**Figure 9**). Surface soil sample locations will be proposed to delineate the source at the pads as well as nearby non-DoD PFAS contributions, as appropriate. Ten subsurface soil locations are proposed. Subsurface locations will target areas with elevated PFAS concentration in surface soil at locations where surface soil samples were collected. The subsurface samples will be collected at 2.0 to 4.0 ft bgs. Additionally, surface (0 to 0.5 ft bgs) and subsurface (2.0 to 4.0 ft bgs) soil samples will be collected while installing the 14 shallow monitoring well locations. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 10**.

3.4.6 Surface Water and Sediment Sampling

Eight surface water and six sediment locations are proposed at the locations shown on **Figure 8**. The two locations at the central SEAD-122E AOC are expected to only have water present during and after precipitation events therefore no sediment samples are proposed. Due to the expected ephemeral nature of the drainages, two rounds of surface water and sediment sampling are proposed. Ephemeral drainages on the airfield flood with snowmelt in the spring before the ground thaws. For most of the rest of the year the ephemeral drainages on the airfield are expected to be dry; however, surface water can accumulate following substantial extended rainfall events or thunderstorms in summer. Surface water and sediment at the airfield may be considered stormwater and ditch soil, as appropriate, dependent on field conditions observed during the RI and historical knowledge. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 11**.

3.5 BIOTA SAMPLING

3.5.1 Previous PFAS Sampling

Deer tissue has never been sampled for PFAS at the Seneca Army Depot.

3.5.2 Conceptual Site Model

No quantitative analysis of PFAS contamination in deer has been performed at the Depot, however deer are potentially exposed to PFAS by consuming plants and by drinking water at the site that may be contaminated with PFAS. Deer are harvested and consumed by hunters every year and PFAS is suspected to bioaccumulate in deer which potentially creates a human health risk to any humans consuming deer harvested at the Depot. Biota sampling of muscle and liver tissue in deer will be collected to characterize the magnitude of the risk associated with consuming deer harvested at the Depot. Muscle and liver tissue were chosen as the most likely deer parts to be consumed by hunters.

3.5.3 Deer Tissue Sampling

Fifteen deer will be sampled for PFAS in muscle and liver tissue. These deer will be harvested by local hunters at the Depot. If possible, deer will be selected representing different areas at the depot based on location harvested. Because deer hunting season occurs once a year in the fall, the deer sampled will be harvested at approximately the same time period. Coordination with local hunters, landowners and NYSDEC will be conducted and sample teams will work with the hunters and NYSDEC to ensure samples are collected correctly and in a timely manner. In total 100-200 grams of both muscle and liver tissue will be removed from each deer harvested resulting in thirty total samples (**Appendix B**). A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 12**.

Section 4 Risk Assessment Methodology

The baseline risk assessment will be conducted in accordance with the CERCLA process. The EPA and NYSDEC are the regulatory authorities for PFAS characterization at SEDA. The human health and ecological risk assessments will be conducted in accordance with Risk Assessment Guidance for Superfund [RAGS] (EPA, 1989; EPA, 2004; EPA, 2009); Office of Solid Waste and Emergency Response [OSWER] directives; and Ecological RAGS (EPA, 1997).

4.0 HUMAN HEALTH RISK ASSESSMENT

Based on the information presented in the SI and ESI reports, contaminated media at the four PFAS contamination sites include surface soil, surface water, and groundwater. Neither subsurface soil nor sediment was sampled during the SI and ESI. Contamination in surface soil could have leached to subsurface soil or eroded to become sediment in nearby drainage ditches. PFAS contamination in groundwater that discharges to surface water could partition onto sediment. The planned RI will characterize the PFAS contamination in surface soil (0 – 0.5 ft bgs), subsurface soil (2.0 – 4.0 ft bgs), sediment, surface water, and groundwater. Additionally, deer are routinely harvested for consumption and will be evaluated as well.

The human health risk assessment (HHRA) will follow standard risk assessment practices and procedures (EPA, 1989; EPA, 2004; EPA, 2009) and is outlined in the Risk Assessment Work Plan which is appended to this RI work plan (**Appendix A**).

4.1 ECOLOGICAL RISK ASSESSMENT

The assessment of potential ecological risks will be performed in accordance with Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final (EPA, 1997) and current EPA guidance documents. The process to be followed for the Screening Level Ecological Risk Assessment (SLERA) is outlined in the Risk Assessment Work Plan which is appended to this RI work plan (**Appendix A**).

Section 5 Schedule

Fieldwork is expected to begin in spring 2023. A summary schedule of the RI activities is presented below. Note that each work activity is connected to the next activity, and this schedule is subject to change if any delays are encountered.

- April 2023
  - Drilling, well installation and well development
  - Surface soil sampling
  - Surface water and sediment sampling
- May 2023
  - Drilling, well installation and well development
  - Groundwater sampling (Round 1)
- June 2023
  - Bedrock drilling, well installation and well development
  - Groundwater sampling
  - Subsurface soil sampling
- September 2023
  - Groundwater sampling (Round 2)
  - Surface water and sediment sampling (Round 2)
  - Pore water passive sampler installation
  - Slug testing
- October 2023
  - Biota sampling

    - Surface water sampling (Round 3)
    - Pore water passive sampler recovery
- November 2023
    - Surface water sampling (Round 4)
- February 2024
    - Draft RI and Risk Reports

Section 6 Reporting

The results of the investigation field activities will be documented in an RI Report prepared in accordance with CERCLA and USACE guidance. The RI reports will describe the scope and objectives of the project, field work performed, rationale, data analyzed, QA/QC procedures, conclusions, and recommendations. The results of the human health and ecological risk assessments will be presented in attachments to the RI report. Depending on the findings of the RI field investigation and the risk assessments, the RI may advise that additional data collection is needed to address data gaps to complete the RI or inform a potential Feasibility Study. The documents will be produced in a draft final version for regulatory review.

Section 7 References

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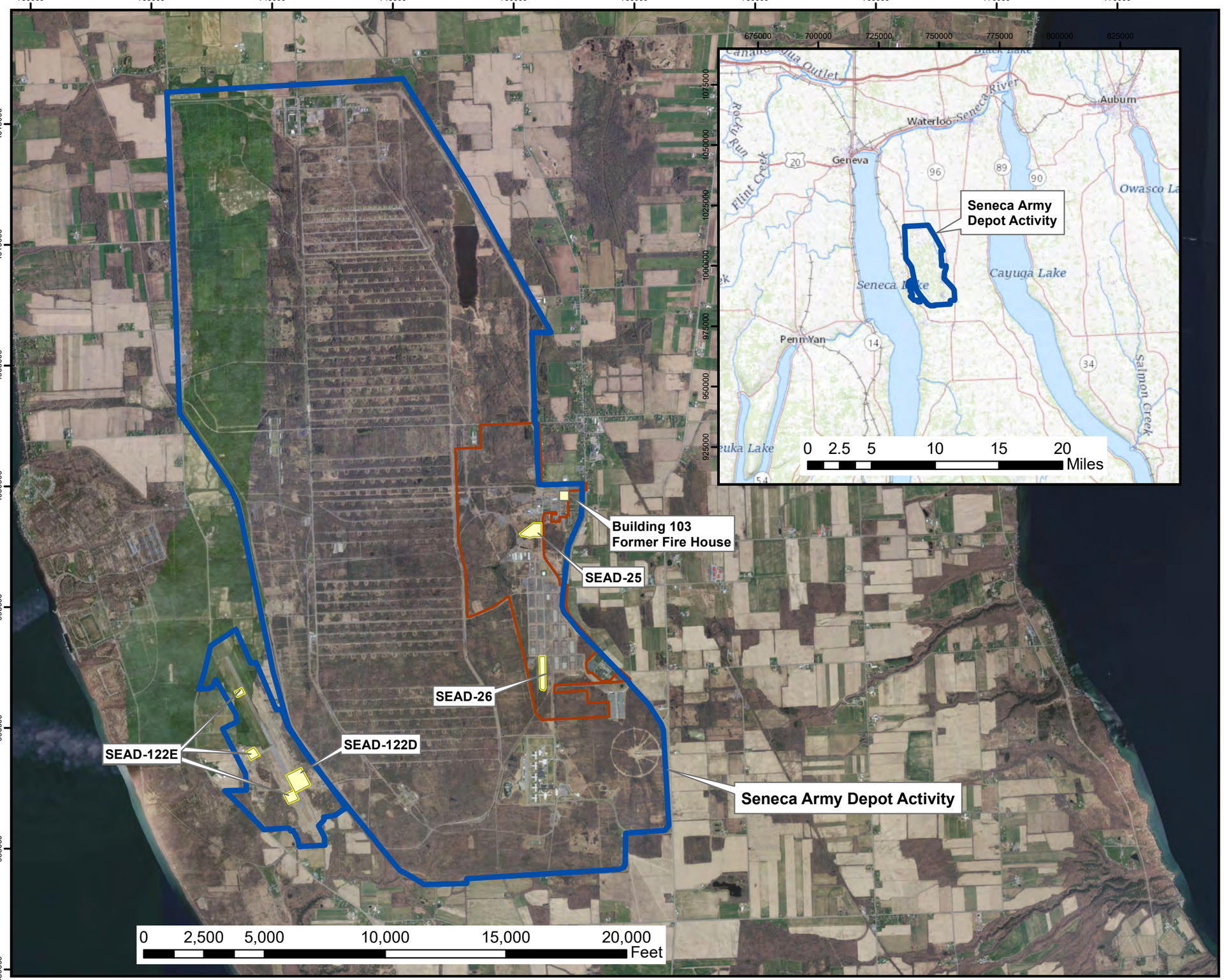
FIGURES



Legend

- Depot Boundary
- RI Areas of Concern
- Approximate PID Area Boundary where GW use is prohibited

Note:
Land use controls in place prohibit the use of groundwater within the Planned Industrial / Office Development (PID) and Warehousing Area and within the Airfield parcel which envelopes SEAD-122D and SEAD-122E.

DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 1:
RI SITE LOCATIONS

Scale As Shown	May 2022

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: O:\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_Site_Location.mxd

Legend

ESI Samples (Red symbol if exceedance)

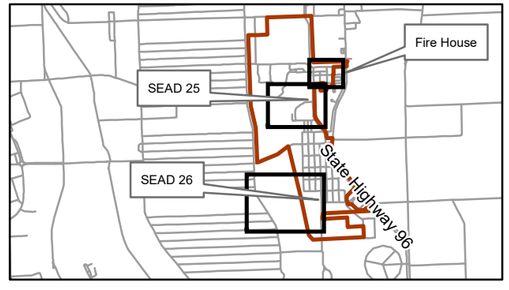
- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Shallow Bedrock Well
- ESI Stormwater Sample Location
- SEAD Boundary
- Groundwater Flow Direction
- Stormwater Drainage
- Surface Water Flow Direction
- Road
- Approximate PID Area Boundary where GW use is prohibited
- Former Fire House

Notes:

1) Symbol red if PFOA or PFOS >= 10 ng/L during ESI.
2) All well locations tentative based on accessibility and utility locations. Final determination to be made in the field.
3) Drainage pathway locations approximate. Storm drainage flow direction is to the south and southwest.
4)Existing wells with labels will be sampled once during the RI. Newly installed wells will be sampled twice.
ng/L = nanograms per liter



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 2: FIREHOUSE – PROPOSED GROUNDWATER SAMPLING LOCATIONS

1 inch = 150 feet	January 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: \\MABOS07FS01\Projects\PIT\Projects\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_FH_GWSW_v2a.mxd

751400 751600 751800 752000 752200 752400

999800 999600 999400 999200 999000

East Patrol Road
East Patrol Road
East Patrol Road
Warehouse Street
Center Street
Quarters Drive
1st Avenue
2nd Avenue
3rd Avenue
State Highway 96

SBFH-01 SBFH-02 SBFH-03 SBFH-04 SBFH-05 SBFH-06 SBFH-07 SBFH-08 SBFH-09 SBFH-10 SBFH-11 SBFH-12 SBFH-13 SBFH-14 SBFH-15 SBFH-16 SBFH-17 SBFH-18 SBFH-19 SBFH-20 SBFH-21 SBFH-22 SBFH-23 SBFH-24 SBFH-25

MWFH-01 MWFH-02 MWFH-03 MWFH-04 MWFH-05 MWFH-09D MWFH-10D MWFH-12 MWFH-13 MWFH-14 MWFH-15 MWFH-15D MWFH-16 MWFH-16D

SEAD-42 SEAD-39 SEAD-33 SEAD-30

Former Fire House

0 65 130 260 390 520 Feet

Legend

ESI Samples (Red symbol if exceedance)

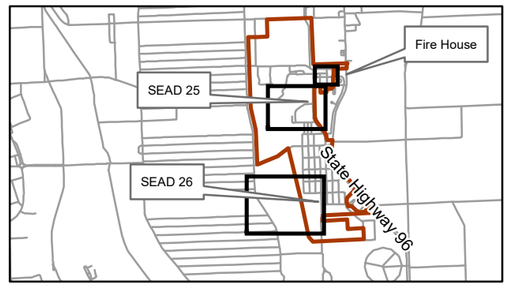
- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW
- Proposed Surface Soil Sample
- Proposed Soil Samples Collected during Well Installation

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Shallow Bedrock Well
- ESI Soil Sample
- SEAD Boundary
- Former Fire House
- Stormwater Drainage
- Groundwater Flow Direction
- Road
- Surface Water Flow Direction
- Approximate PID Area Boundary where GW use is prohibited

Notes:

1) Twenty surface soil samples will be collected from 0 to 0.5 ft bgs. Locations tentative based on field conditions.
2) Eight subsurface (1.5 to 2 ft bgs) locations will be selected based on surface soil sampling results. Subsurface locations will target elevated surface soil concentrations.
3) Surface and subsurface soil samples will be collected during well installation at the identified locations.
4) Symbol red if PFOA or PFOS >= 10 ng/L during ESI.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

N

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 3: FIREHOUSE – PROPOSED SOIL SAMPLING LOCATIONS

1 inch = 100 feet	January 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

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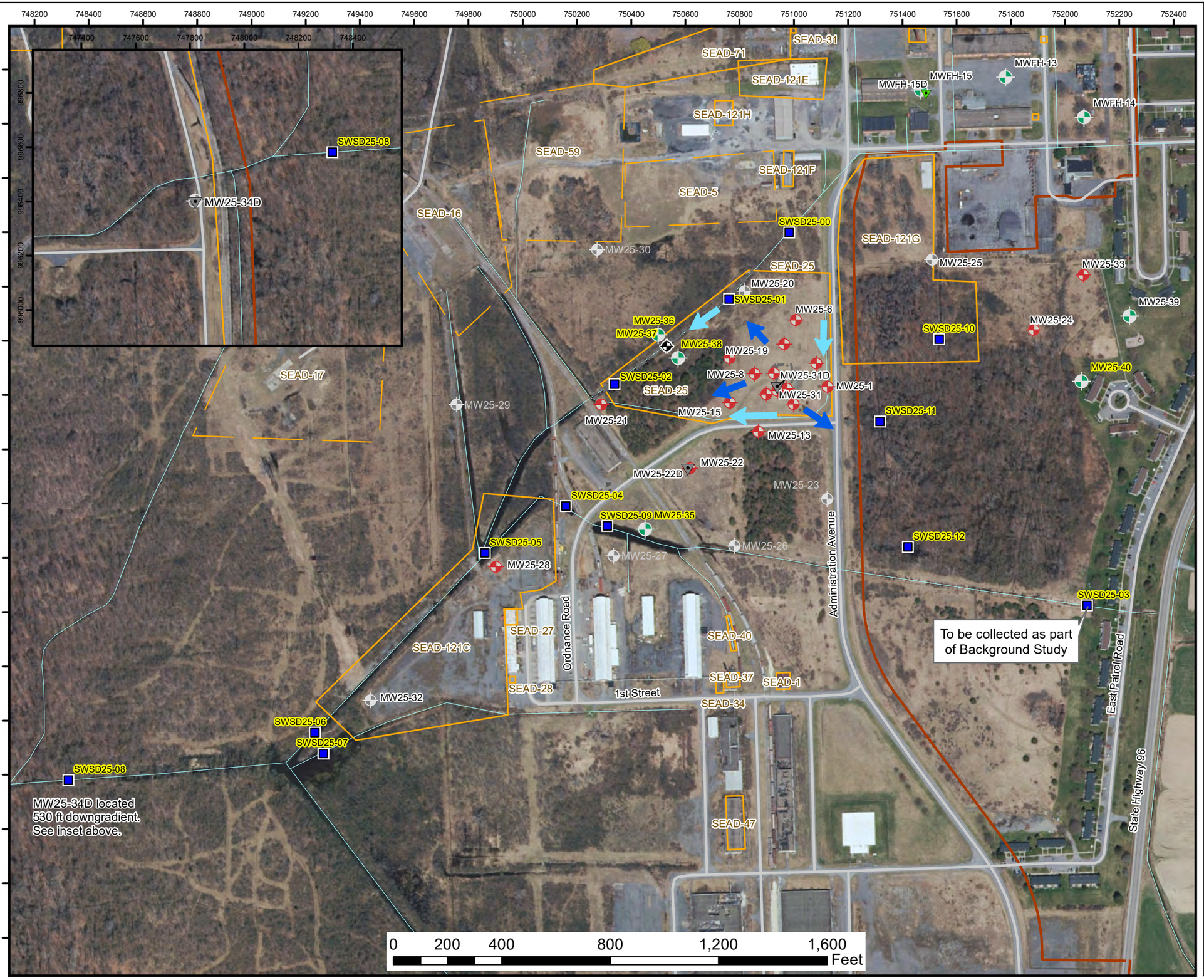


Legend

ESI Sample (Red symbol if exceedance)

- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW
- Proposed Paired Surface Water and Sediment Sample

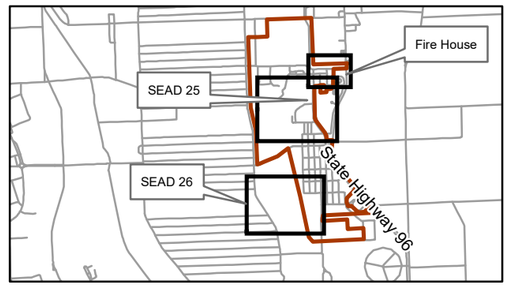
Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Shallow Bedrock Well
- Proposed Piezometer

- RA Excavation Extents
- SEAD (dashed PFAS SI applies)
- Stormwater Drainage
- Approximate PID Area Boundary where GW use is prohibited
- Road
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:

1) Symbol red if PFOA or PFOS >= 10 ng/L during ESI.
2) All well locations tentative based on accessibility and utility locations. Final determination to be made in the field.
3) Drainage pathway locations approximate. Storm drainage flow direction is to the south and southwest.
4) Predominant groundwater flow direction is radial near the RA excavation area (former SEAD-25 pad) transitioning towards the southwest outside the SEAD-25 AOC.
5) Eighteen existing wells wells with white labels will be sampled once during the RI. Newly installed wells (yellow labels) will be sampled twice.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 4: SEAD-25 – PROPOSED GROUNDWATER, SURFACE WATER AND SEDIMENT LOCATIONS

1 inch = 350 feet	April 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

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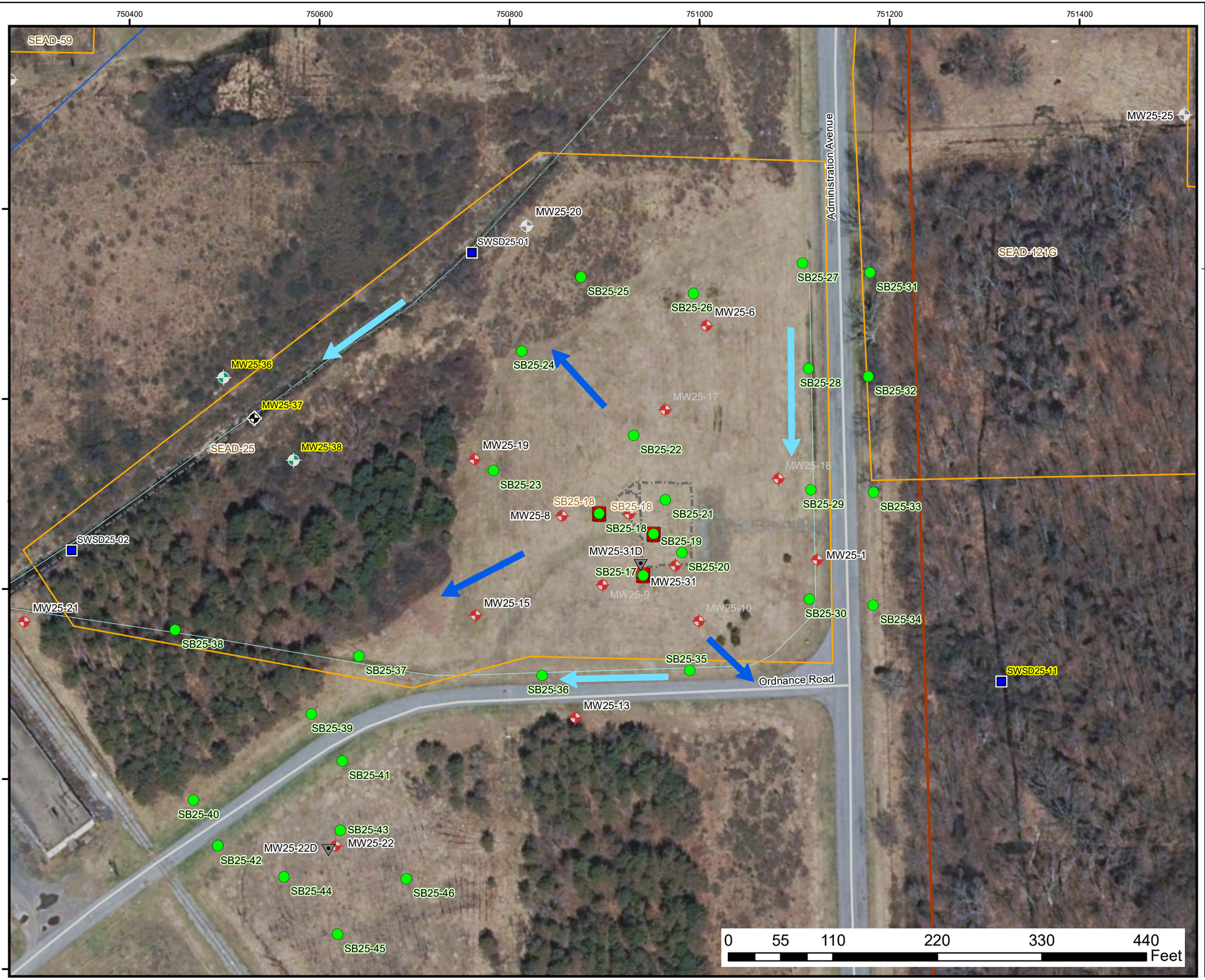


Legend

ESI Samples (Red symbol if

- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW
- Proposed Paired Surface Water and Sediment
- ESI Soil Sample

Proposed RI Locations

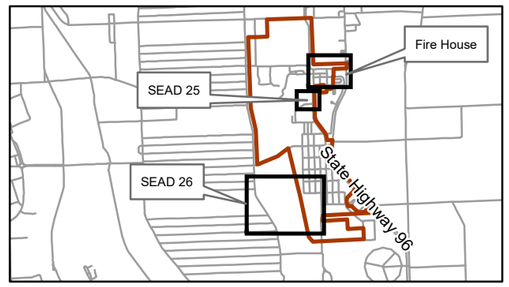
- Proposed Till / Weathered Bedrock Well
- Proposed Shallow Bedrock Well
- Proposed Piezometer
- Proposed Surface Soil Sample

- RA Excavation Extents
- SEAD Boundary
- Stormwater Drainage
- Road
- Approximate PID Area Boundary where GW use is prohibited
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:

1) Thirty surface soil samples will be collected from 0 to 0.5 ft bgs. Locations tentative based on field conditions.

2) Ten subsurface (1.5 to 2 ft bgs and above water table) locations will be selected based on surface soil sampling results. Subsurface locations will target elevated surface soil concentrations.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 5: SEAD-25 – PROPOSED SOIL SAMPLING LOCATIONS

1 inch = 100 feet	January 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

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748000 748500 749000 749500 750000 750500 751000 751500

993500 993000 992500 992000 991500 991000

SWSD26-06
SWSD26-08
SWSD26-05
SWSD26-07
SWSD26-04
SWSD26-09
SWSD26-10
PW26-01
PW26-02
MW26-25
MW26-24
MW26-23D
MW26-23
MW26-20
MW26-15
MW26-18
MW26-16
MW26-32D
MW26-13
MW26-28D
MW26-28
MW26-27
MW26-12
MW26-26
MW26-29
MW26-33
MW26-34
MW26-30
MW26-31
MW26-19
SEAD-121I
SEAD-26
SEAD-64A
SEAD-53
Dumpster
Fire Tower
Trailer
Container
Burned Automobiles
Former Bentonite Lined Pit
Autos
Storage Area
Helicopter Fuselage
Former Drum Storage Area

0 187.5 375 750 1,125 1,500 Feet

DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

Legend

ESI Samples (Red symbol if exceedance)

- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW
- Surface Water Sample (Red symbol if exceedance)

Temporary Monitoring Wells (Abandoned) (Red symbol if exceedance during SI)

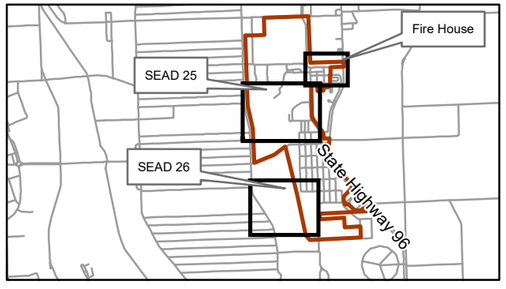
- Existing Till / Weathered Bedrock MW

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Paired Surface Water and Sediment Sample
- Porewater Sample

- Federal Wetlands
- RA Excavation Extents
- Former SEAD 26 Features
- SEAD Boundary
- Approximate PID Area Boundary where GW use is prohibited
- Drainage
- Road
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:
1) Symbol red if PFOA or PFOS >= 10 ng/L during ESI.
2) All well locations tentative based on accessibility and utility locations. Final determination to be made in the field.
3) Drainage pathway locations approximate. Storm drainage flow direction is to the west.
4) Nineteen existing wells with labels will be sampled once during the RI. Newly installed wells will be sampled twice .
5) Sampling locations SWSD26-11, -12 and -13 will be located in the wetland west of the pond and will be placed based on field conditions.
ng/L = nanograms per liter



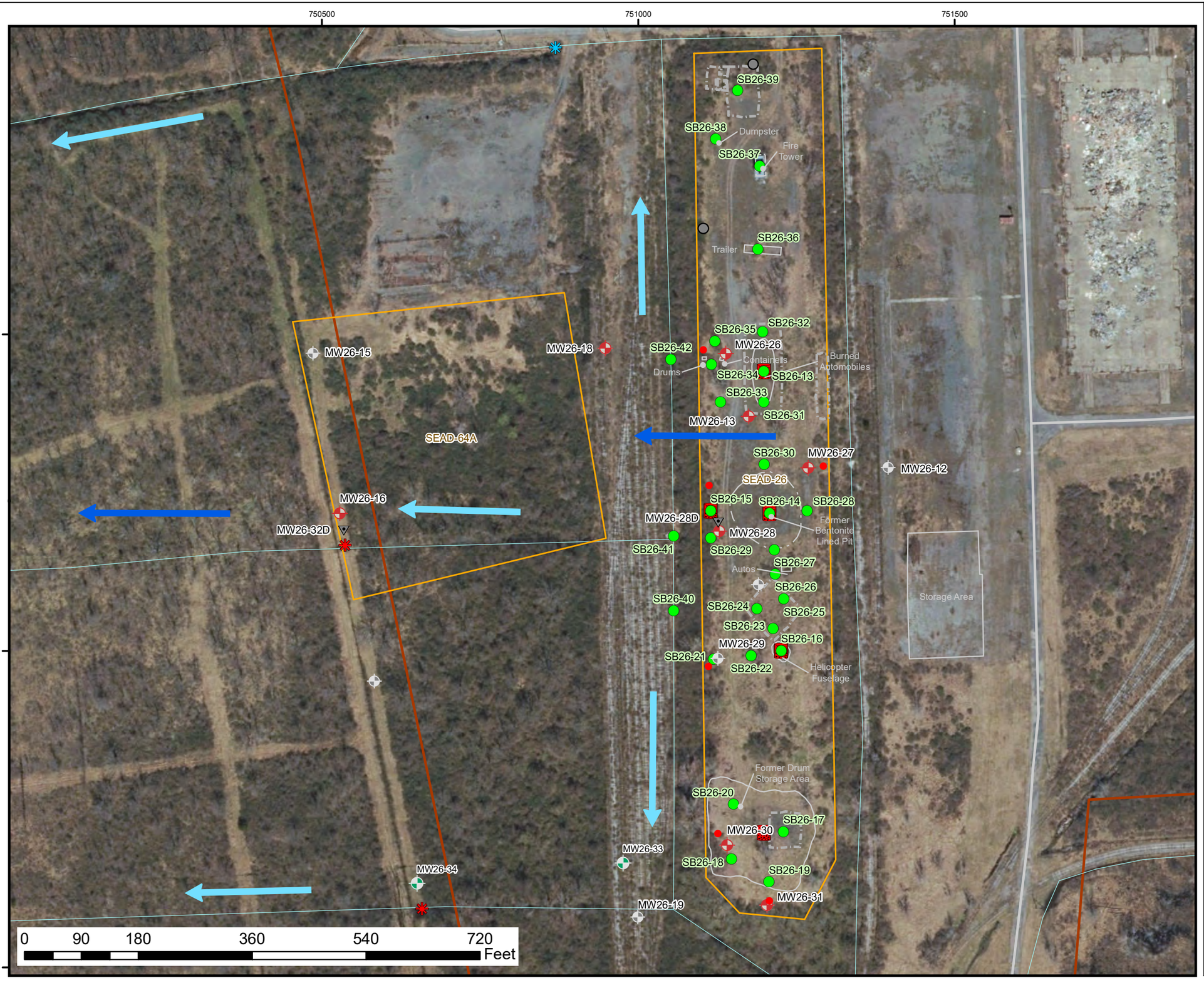
SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 6: SEAD-26 – PROPOSED GROUNDWATER, SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

1 inch = 300 feet	January 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: \\MABOS07FS01\Projects\PIT\Projects\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_S26_PadArea_GWSW_v2.mxd



Legend

ESI Samples (Red symbol if exceedance)

- Existing Till / Weathered Bedrock MW
- Existing Shallow Bedrock MW
- ESI Soil Sample
- Surface Water Sample (Red symbol if exceedance)

Temporary Monitoring Wells (Abandoned) (Red symbol if exceedance during SI)

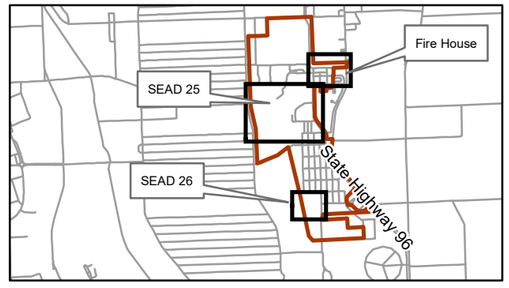
- Existing Till / Weathered Bedrock MW

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Soil Sample Locations
- RA Excavation Extents
- Former SEAD 26 Features
- SEAD Boundary
- Drainage Feature
- Approximate PID Area Boundary where GW use is prohibited
- Road
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:

1) Thirty surface soil samples will be collected from 0 to 0.5 ft bgs. Locations tentative based on field conditions.
2) Twelve subsurface (1.5 to 2 ft bgs) locations will be selected based on surface soil sampling results. Subsurface locations will target elevated surface soil concentrations.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 7: SEAD-26 – PROPOSED SOIL SAMPLING LOCATIONS

1 inch = 150 feet	May 2022

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: \\MABOS07FS01\Projects\PIT\Projects\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_S26_PadArea_SO.mxd

736000 736500 737000 737500 738000 738500 739000 739500 740000 740500 741000 741500 742000 742500 743000

992000 991500 991000 990500 990000 989500 989000 988500 988000 987500 987000 986500

SWSD122E-01
MW122E-04
MW122E-05
SEAD-64D
Regional Groundwater Flow Direction
MW122E-06
SWSD122E-02
TMW-122E-24
SW122E-03
MW122E-07
MW122E-08
SW122E-04
MW122E-11
MW122E-09
Former Fire House
MW122E-10
County Fire Training Area
SWSD122D-01
MW122D-01
MW122D-02
MW122D-03
SEAD-122A
TMW-122E-14
MW122D-04
SWSD122D-02
MW122E-12
SWSD122E-05
SEAD-122C
MW122E-13
SWSD122E-06

0 375 750 1,500 2,250 3,000 Feet

Legend

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Paired Surface Water and Sediment Sample
- Proposed Surface Water Sample

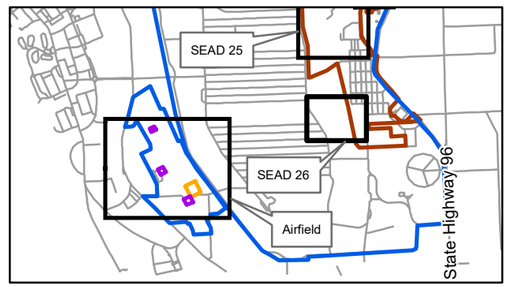
2018 SI Temporary Wells

- Groundwater Sample (PFOA or PFOS >= 10 ng/L)
- PFAS Sample Below State MCL

- SEAD-122D
- SEAD-122E
- SEAD (dashed PFAS SI)
- Drainage Feature
- Road
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:

1) Four bedrock wells will be installed at locations with maximum PFAS concentrations in overburden groundwater.
2) Surface water (SW) and sediment (SD) samples to be collected in drainage ditches and drainage outfalls.
3) If permanent water is not present in stormwater conveyances, stormwater samples will be collected after a precipitation event and sediment will be considered surface soil as these features do not support ecological receptors.
4) Regional groundwater flow is interpreted to be towards the southwest.
5) Stormwater flow will tend to flow away from airport infrastructure. SEAD 122D will drain to the NW and SE. The southern SEAD 122E AOC will drain to the SE. The central and northern SEAD 122E AOCs will drain west and have outfalls that discharge stormwater offsite.
6) The groundwater at all proposed well locations will be sampled twice.
7) All well locations tentative based on accessibility and utility locations. Final determination to be made in the field.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

N

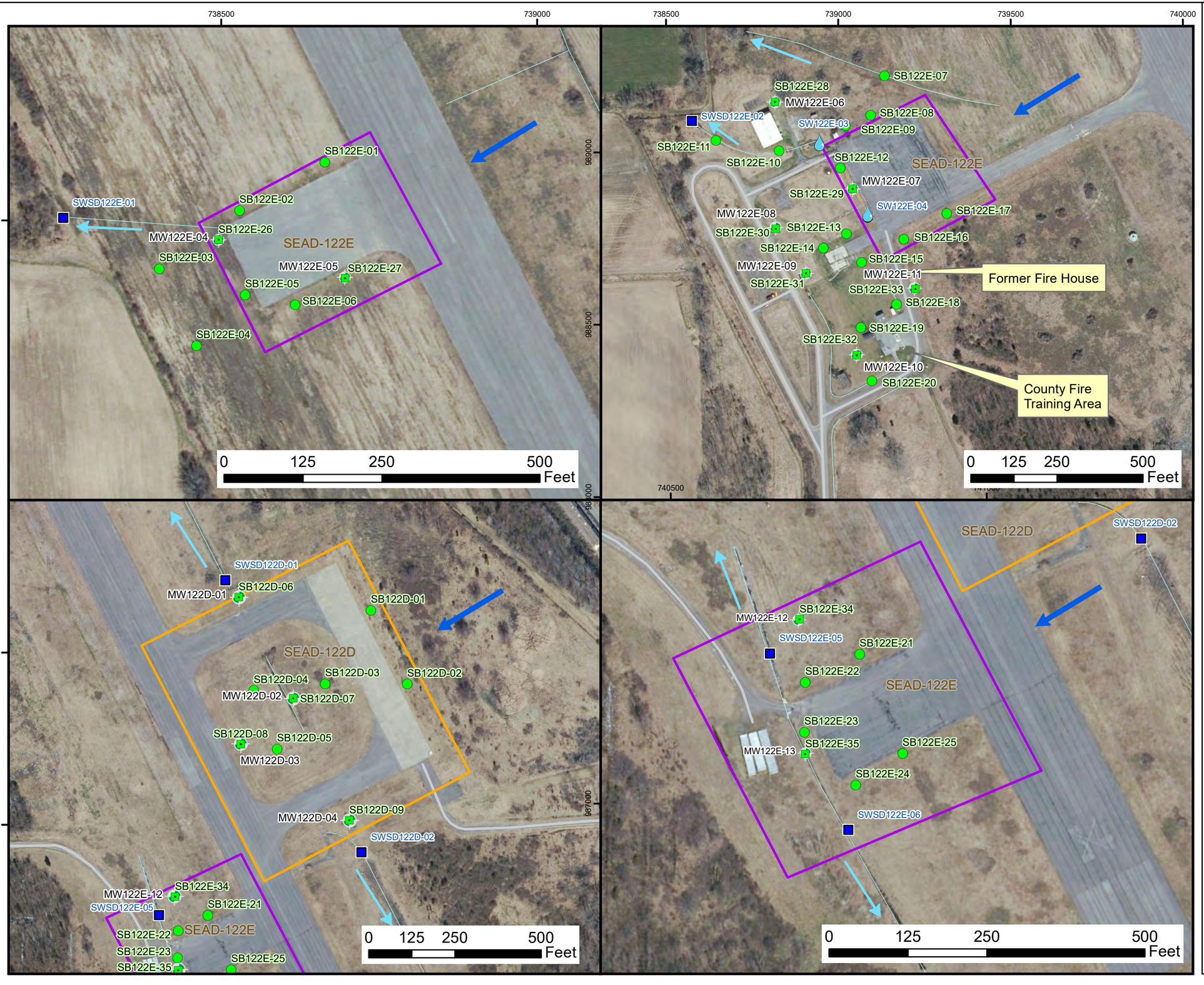
SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 8: AIRFIELD – PROPOSED GROUNDWATER, SURFACE WATER AND SEDIMENT LOCATIONS

1 inch = 600 feet	January 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: \\MABOS07FS01\Projects\PIT\Projects\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_Airfield_GWSW_v3.mxd



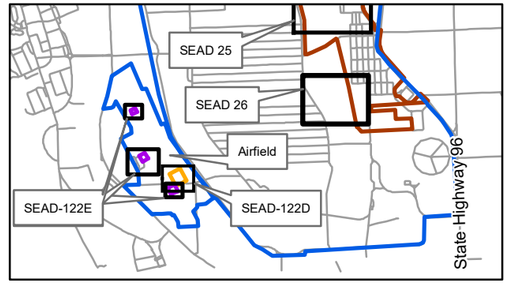
Legend

Proposed RI Locations

- Proposed Till / Weathered Bedrock Well
- Proposed Paired Surface Water and Sediment Sample
- Proposed Surface Water Sample
- Proposed Surface Soil Sample
- Proposed Soil Samples Collected during Well Installation
- SEAD-122D
- SEAD-122E
- Drainage Feature
- Road
- Groundwater Flow Direction
- Surface Water Flow Direction

Notes:

1) Thirty surface soil samples will be collected from 0 to 0.5 ft bgs. Locations tentative based on field conditions.
2) Ten subsurface (1.5 to 2 ft bgs) locations will be selected based on surface soil sampling results. Subsurface locations will target elevated surface soil concentrations.
3) Surface and subsurface soil samples will be collected during well installation at the identified locations.



DATA SOURCES
-Image: ESRI, 2016
-Parsons: Sample Locations, Boundaries

SENECA ARMY DEPOT ACTIVITY
PFAS EXPANDED SITE INVESTIGATION

FIGURE 9: AIRFIELD – PROPOSED SOIL SAMPLING LOCATIONS

Scale As Shown	February 2023

Coordinate System: NAD 1983 StatePlane New York Central FIPS 3102 Feet

PATH: \\MABOS07FS01\Projects\PIT\Projects\Huntsville - MEGA\Seneca_HGL_PFAS\Deliverables\05 GIS\RI\Maps\RI_WP\PFAS_RIWP_Airfield_SO_v2a.mxd

TABLES

TABLE 1
FIREHOUSE PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
MWFH-02	FHRI20001	GW	SA	1	X	X	X	X	X
MWFH-03	FHRI20002	GW	SA	1	X				
MWFH-04	FHRI20003	GW	SA	1	X	X	X	X	X
MWFH-05	FHRI20004	GW	SA	1	X	X	X	X	
MWFH-06	FHRI20005	GW	SA	1	X				
MWFH-09	FHRI20006	GW	SA	1	X	X	X	X	
MWFH-9D	FHRI20007	GW	SA	1	X				
MWFH-10D	FHRI20008	GW	SA	1	X				
MWFH-12	FHRI20009	GW	SA	1	X				
MWFH-13	FHRI20010	GW	SA	1	X	X	X	X	X
MWFH-14	FHRI20011	GW	SA	1	X	X	X	X	
MWFH-15	FHRI20012	GW	SA	1	X				X
MWFH-15D	FHRI20013	GW	SA	1	X				X
MWFH-16	FHRI20014	GW	SA	1	X				
MWFH-16D	FHRI20015	GW	SA	1	X				
TBD	FHRI20016	GW	DU	1	X				
TBD	FHRI20017	GW	DU	1	X				
TBD	FHRI200##-MS FHRI200##-MSD	GW	MS/MSD	1	X				
MWFH-12	FHRI20018	GW	SA	2	X				
MWFH-13	FHRI20019	GW	SA	2	X				
MWFH-14	FHRI20020	GW	SA	2	X				
MWFH-15	FHRI20021	GW	SA	2	X				
MWFH-15D	FHRI20022	GW	SA	2	X				
MWFH-16	FHRI20023	GW	SA	2	X				
MWFH-16D	FHRI20024	GW	SA	2	X				
TBD	FHRI20025	GW	DU	2	X				
TBD	FHRI200##-MS FHRI200##-MSD	GW	MS/MSD	2	X				
QC Blank Format									
n/a	FHRI000##	AQ	EB	n/a	X				
TBD	FHRI010##	AQ	FB	n/a	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Field and equipment blanks will be collected daily as specified in the UFP-QAPP (HGL, 2023).

4) Existing wells *italicized* . New wells **bold**.

AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
GW = groundwater
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample

TABLE 2
FIREHOUSE PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Surface Soil Samples									
SBFH-01	FHRI10001-0.0-0.5	SO	SA	0-0.5	X				
SBFH-02	FHRI10002-0.0-0.5	SO	SA	0-0.5	X				
SBFH-03	FHRI10003-0.0-0.5	SO	SA	0-0.5	X				
SBFH-04	FHRI10004-0.0-0.5	SO	SA	0-0.5	X				
SBFH-05	FHRI10005-0.0-0.5	SO	SA	0-0.5	X				
SBFH-06	FHRI10006-0.0-0.5	SO	SA	0-0.5	X				
SBFH-07	FHRI10007-0.0-0.5	SO	SA	0-0.5	X				
SBFH-08	FHRI10008-0.0-0.5	SO	SA	0-0.5	X				
SBFH-09	FHRI10009-0.0-0.5	SO	SA	0-0.5	X				
SBFH-10	FHRI10010-0.0-0.5	SO	SA	0-0.5	X				
SBFH-11	FHRI10011-0.0-0.5	SO	SA	0-0.5	X				
SBFH-12	FHRI10012-0.0-0.5	SO	SA	0-0.5	X				
SBFH-13	FHRI10013-0.0-0.5	SO	SA	0-0.5	X				
SBFH-14	FHRI10014-0.0-0.5	SO	SA	0-0.5	X				
SBFH-15	FHRI10015-0.0-0.5	SO	SA	0-0.5	X				
SBFH-16	FHRI10016-0.0-0.5	SO	SA	0-0.5	X				
SBFH-17	FHRI10017-0.0-0.5	SO	SA	0-0.5	X				
SBFH-18	FHRI10018-0.0-0.5	SO	SA	0-0.5	X				
SBFH-19	FHRI10019-0.0-0.5	SO	SA	0-0.5	X				
SBFH-20	FHRI10020-0.0-0.5	SO	SA	0-0.5	X				
TBD	FHRI10021-0.0-0.5	SO	DU	0-0.5	X				
TBD	FHRI10022-0.0-0.5	SO	DU	0-0.5	X				
TBD	FHRI100##-MS FHRI100##-MSD	SO	MS/MSD	0-0.5	X				
Subsurface Soil Samples									
TBD	FHRI10023-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	FHRI10024-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	FHRI10025-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	FHRI10026-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	FHRI10027-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	FHRI10028-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	FHRI10029-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	FHRI10030-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	FHRI10031-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	FHRI100##-2.0-4.0-MS FHRI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				

TABLE 2
FIREHOUSE PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Soil Samples Collected from new Monitoring Well Locations									
SBFH-21/MWFH-12	FHRI10021-0.0-0.5	SO	SA	0-0.5	X				
SBFH-21/MWFH-12	FHRI10021-2.0-4.0	SO	SA	2.0-4.0	X				
SBFH-22/MWFH-13	FHRI10022-0.0-0.5	SO	SA	0-0.5	X				
SBFH-22/MWFH-13	FHRI10022-2.0-4.0	SO	SA	2.0-4.0	X				
SBFH-23/MWFH-14	FHRI10023-0.0-0.5	SO	SA	0-0.5	X				
SBFH-23/MWFH-14	FHRI10023-2.0-4.0	SO	SA	2.0-4.0	X				
SBFH-24/MWFH-15	FHRI10024-0.0-0.5	SO	SA	0-0.5	X				
SBFH-24/MWFH-15	FHRI10024-2.0-4.0	SO	SA	2.0-4.0	X				
SBFH-25/MWFH-16	FHRI10025-0.0-0.5	SO	SA	0-0.5	X				
SBFH-25/MWFH-16	FHRI10025-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	FHRI10026-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	FHRI100##-2.0-4.0-MS FHRI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				
QC Blank Format									
TBD	FHRI000##	AQ	FB	n/a	X				
n/a	FHRI010##	AQ	EB	n/a	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Soil samples from multiple depths have a Top and Bottom depth value incorporated in the sample ID, such as FHRI10001-0.0-0.5 and FHRI10001-2.0-4.0. These would represent two soil boring samples collected at location FHRI10001; one sample at a depth of 0.0-0.5 ft bgs, and the other sample at a depth of 2.0-4.0 ft bgs. If shallower depths are being sampled, inches may be used such as FHRI10001-0-06 and FHRI10001-18-24.

4) Samples selected for additional analyses will target suspected source areas.

AQ = aqueous
DU = duplicate
EB = equipment blank
FB = field blank sample
ft bgs = feet below ground surface
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SO = soil sample

TABLE 3
SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
MW25-1	25RI20001	GW	SA	1	X				
MW25-6	25RI20002	GW	SA	1	X				
MW25-8	25RI20003	GW	SA	1	X	X	X	X	
MW25-13	25RI20004	GW	SA	1	X				
MW25-15	25RI20005	GW	SA	1	X	X	X	X	
MW25-19	25RI20006	GW	SA	1	X				
MW25-20	25RI20007	GW	SA	1	X				
MW25-21	25RI20008	GW	SA	1	X				
MW25-22	25RI20009	GW	SA	1	X	X	X	X	X
MW25-22D	25RI20010	GW	SA	1	X				
MW25-24	25RI20011	GW	SA	1	X				
MW25-25	25RI20012	GW	SA	1	X				
MW25-28	25RI20013	GW	SA	1	X	X	X	X	X
MW25-31	25RI20014	GW	SA	1	X	X	X	X	X
MW25-31D	25RI20015	GW	SA	1	X				X
MW25-32	25RI20016	GW	SA	1	X				X
MW25-33	25RI20017	GW	SA	1	X				X
MW25-34D	25RI20018	GW	SA	1	X				
MW25-35	25RI20019	GW	SA	1	X	X	X	X	
MW25-36	25RI20020	GW	SA	1	X				
MW25-37	25RI20021	GW	SA	1	X				
MW25-38	25RI20022	GW	SA	1	X				
MW25-39	25RI20023	GW	SA	1	X				
MW25-40	25RI20024	GW	SA	1	X				
TBD	25RI20025	GW	DU	1	X				
TBD	25RI20026	GW	DU	1	X				
TBD	25RI20027	GW	DU	1	X				
TBD	25RI200##-MS 25RI200##-MSD	GW	MS/MSD	1	X				
TBD	25RI200##-MS 25RI200##-MSD	GW	MS/MSD	1	X				
TBD	25RI200##-MS 25RI200##-MSD	GW	MS/MSD	1	X				
n/a	25RI000##	AQ	EB	1	X				
TBD	25RI010##	AQ	FB	1	X				

TABLE 3
SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
MW25-35	25RI20028	GW	SA	2	X				
MW25-36	25RI20029	GW	SA	2	X				
MW25-37	25RI20030	GW	SA	2	X				
MW25-38	25RI20031	GW	SA	2	X				
MW25-39	25RI20032	GW	SA	2	X				
MW25-40	25RI20033	GW	SA	2	X				
TBD	25RI20034	GW	DU	2	X				
TBD	25RI200##-MS 25RI200##-MSD	GW	MS/MSD	2	X				
QC Blank Format									
n/a	25RI000##	AQ	EB	n/a	X				
TBD	25RI010##	AQ	FB	n/a	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Field and equipment blanks will be collected daily as specified in the UFP-QAPP (HGL, 2023).

4) Existing wells *italicized* . New wells **bold**.

AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
GW = groundwater
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
TBD = to be determined

TABLE 4

SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Surface Soil Samples									
SB25-17	25RI10001-0.0-0.5	SO	SA	0-0.5	X				
SB25-18	25RI10002-0.0-0.5	SO	SA	0-0.5	X				
SB25-19	25RI10003-0.0-0.5	SO	SA	0-0.5	X				
SB25-20	25RI10004-0.0-0.5	SO	SA	0-0.5	X				
SB25-21	25RI10005-0.0-0.5	SO	SA	0-0.5	X				
SB25-22	25RI10006-0.0-0.5	SO	SA	0-0.5	X				
SB25-23	25RI10007-0.0-0.5	SO	SA	0-0.5	X				
SB25-24	25RI10008-0.0-0.5	SO	SA	0-0.5	X				
SB25-25	25RI10009-0.0-0.5	SO	SA	0-0.5	X				
SB25-26	25RI10010-0.0-0.5	SO	SA	0-0.5	X				
SB25-27	25RI10011-0.0-0.5	SO	SA	0-0.5	X				
SB25-28	25RI10012-0.0-0.5	SO	SA	0-0.5	X				
SB25-29	25RI10013-0.0-0.5	SO	SA	0-0.5	X				
SB25-30	25RI10014-0.0-0.5	SO	SA	0-0.5	X				
SB25-31	25RI10015-0.0-0.5	SO	SA	0-0.5	X				
SB25-32	25RI10016-0.0-0.5	SO	SA	0-0.5	X				
SB25-33	25RI10017-0.0-0.5	SO	SA	0-0.5	X				
SB25-34	25RI10018-0.0-0.5	SO	SA	0-0.5	X				
SB25-35	25RI10019-0.0-0.5	SO	SA	0-0.5	X				
SB25-36	25RI10020-0.0-0.5	SO	SA	0-0.5	X				
SB25-37	25RI10021-0.0-0.5	SO	SA	0-0.5	X				
SB25-38	25RI10022-0.0-0.5	SO	SA	0-0.5	X				
SB25-39	25RI10023-0.0-0.5	SO	SA	0-0.5	X				
SB25-40	25RI10024-0.0-0.5	SO	SA	0-0.5	X				
SB25-41	25RI10025-0.0-0.5	SO	SA	0-0.5	X				
SB25-42	25RI10026-0.0-0.5	SO	SA	0-0.5	X				
SB25-43	25RI10027-0.0-0.5	SO	SA	0-0.5	X				
SB25-44	25RI10028-0.0-0.5	SO	SA	0-0.5	X				
SB25-45	25RI10029-0.0-0.5	SO	SA	0-0.5	X				
SB25-46	25RI10030-0.0-0.5	SO	SA	0-0.5	X				
TBD	25RI10031-0.0-0.5	SO	DU	0-0.5	X				
TBD	25RI10032-0.0-0.5	SO	DU	0-0.5	X				
TBD	25RI10033-0.0-0.5	SO	DU	0-0.5	X				
TBD	25RI100##-MS 25RI100##-MSD	SO	MS/MSD	0-0.5	X				
TBD	25RI100##-MS 25RI100##-MSD	SO	MS/MSD	0-0.5	X				

TABLE 4

SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Subsurface Soil Samples									
TBD	25RI10034-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	25RI10035-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	25RI10036-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	25RI10037-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	25RI10038-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	25RI10039-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	25RI10040-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	25RI10041-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	25RI10042-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	25RI10043-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	25RI10044-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	25RI100##-2.0-4.0-MS 25RI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				
QC Blank Format									
n/a	25RI000##	AQ	EB	n/a	X				
TBD	25RI010##-X.X-X.X	AQ	FB	TBD	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Soil samples from multiple depths have a Top and Bottom depth value incorporated in the sample ID, such as 25RI10001-0.0-0.5 and 25RI10001-2.0-4.0. These would represent two soil boring samples collected at location 25RI10001; one sample at a depth of 0.0-0.5 ft bgs, and the other sample at a depth of 2.0-4.0 ft bgs. If shallower depths are being sampled, inches may be used such as 25RI10001-0-06 and 25RI10001-18-24.

4) Samples selected for additional analyses will target suspected source areas.

AQ = aqueous
DU = duplicate
EB = equipment blank
FB = field blank sample
ft bgs = feet below ground surface
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SO = soil sample
TBD = to be determined

TABLE 5
SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED SURFACE WATER AND SEDIMENT SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]
Proposed Surface Water Samples					
SWSD25-00	25RI30001	SW	SA	1	X
SWSD25-01	25RI30002	SW	SA	1	X
SWSD25-02	25RI30003	SW	SA	1	X
SWSD25-04	25RI30004	SW	SA	1	X
SWSD25-05	25RI30005	SW	SA	1	X
SWSD25-06	25RI30006	SW	SA	1	X
SWSD25-07	25RI30007	SW	SA	1	X
SWSD25-08	25RI30008	SW	SA	1	X
SWSD25-09	25RI30009	SW	SA	1	X
SWSD25-10	25RI30010	SW	SA	1	X
SWSD25-11	25RI30011	SW	SA	1	X
SWSD25-12	25RI30012	SW	SA	1	X
TBD	25RI30013	SW	DU	1	X
TBD	25RI30014	SW	DU	1	X
TBD	25RI300##-MS 25RI300##-MSD	SW	MS/MSD	1	X
SWSD25-00	25RI30015	SW	SA	2	X
SWSD25-01	25RI30016	SW	SA	2	X
SWSD25-02	25RI30017	SW	SA	2	X
SWSD25-04	25RI30018	SW	SA	2	X
SWSD25-05	25RI30019	SW	SA	2	X
SWSD25-06	25RI30020	SW	SA	2	X
SWSD25-07	25RI30021	SW	SA	2	X
SWSD25-08	25RI30022	SW	SA	2	X
SWSD25-09	25RI30023	SW	SA	2	X
SWSD25-10	25RI30024	SW	SA	2	X
SWSD25-11	25RI30025	SW	SA	2	X
SWSD25-12	25RI30026	SW	SA	2	X
TBD	25RI30027	SW	DU	2	X
TBD	25RI30028	SW	DU	2	X
TBD	25RI300##-MS 25RI300##-MSD	SW	MS/MSD	2	X
SWSD25-07	25RI30029	SW	SA	3	X
SWSD25-08	25RI30030	SW	SA	3	X
SWSD25-09	25RI30031	SW	SA	3	X
SWSD25-07	25RI300XX	SW	SA	4	X
SWSD25-08	25RI300XX	SW	SA	4	X
SWSD25-09	25RI300XX	SW	SA	4	X

TABLE 5
SEAD-25 (FIRE TRAINING AND DEMONSTRATION PAD) PROPOSED SURFACE WATER AND SEDIMENT SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]
Proposed Sediment Sampling Locations					
SWSD25-00	25RI40001	SD	SA	1	X
SWSD25-01	25RI40002	SD	SA	1	X
SWSD25-02	25RI40003	SD	SA	1	X
SWSD25-04	25RI40005	SD	SA	1	X
SWSD25-05	25RI40006	SD	SA	1	X
SWSD25-06	25RI40007	SD	SA	1	X
SWSD25-07	25RI40008	SD	SA	1	X
SWSD25-08	25RI40009	SD	SA	1	X
SWSD25-09	25RI40010	SD	SA	1	X
SWSD25-10	25RI40011	SD	SA	1	X
SWSD25-11	25RI40012	SD	SA	1	X
SWSD25-12	25RI40013	SD	SA	1	X
TBD	25RI40014	SD	DU	1	X
TBD	25RI40015	SD	DU	1	X
TBD	25RI400##-MS 25RI400##-MSD	SD	MS/MSD	1	X
SD25-00	25RI40018	SD	SA	2	X
SWSD25-01	25RI40019	SD	SA	2	X
SWSD25-02	25RI40020	SD	SA	2	X
SWSD25-04	25RI40022	SD	SA	2	X
SWSD25-05	25RI40023	SD	SA	2	X
SWSD25-06	25RI40024	SD	SA	2	X
SWSD25-07	25RI40025	SD	SA	2	X
SWSD25-08	25RI40026	SD	SA	2	X
SWSD25-09	25RI40027	SD	SA	2	X
SWSD25-10	25RI40028	SD	SA	2	X
SWSD25-11	25RI40029	SD	SA	2	X
SWSD25-12	25RI40030	SD	SA	2	X
TBD	25RI40031	SD	DU	2	X
TBD	25RI40032	SD	DU	2	X
TBD	25RI400##-MS 25RI400##-MSD	SD	MS/MSD	2	X
QC Blank Format					
n/a	25RI000##	AQ	EB	n/a	X
TBD	25RI010##	AQ	FB	n/a	X

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.
2) Location SWSD25-03 will be sampled as part of the SEDA Background Study.
3) For sampling rounds where the number of samples is less than the QC ratio (e.g., DU 1:10), sample duplicates may be shared between sites sampled during the same time period.

AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SD = sediment
SW = surface water
TBD = to be determined

TABLE 6

SEAD-26 (FIRE TRAINING PIT) PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
MW26-12	26RI20001	GW	SA	1	X				
MW26-13	26RI20002	GW	SA	1	X				
MW26-15	26RI20003	GW	SA	1	X				
MW26-16	26RI20004	GW	SA	1	X	X	X	X	X
MW26-18	26RI20005	GW	SA	1	X				
MW26-19	26RI20006	GW	SA	1	X				
MW26-20	26RI20007	GW	SA	1	X				
MW26-23	26RI20008	GW	SA	1	X	X	X	X	X
MW26-23D	26RI20009	GW	SA	1	X				
MW26-24	26RI20010	GW	SA	1	X				
MW26-25	26RI20011	GW	SA	1	X				
MW26-26	26RI20012	GW	SA	1	X	X	X	X	X
MW26-27	26RI20013	GW	SA	1	X				
MW26-28	26RI20014	GW	SA	1	X	X	X	X	X
MW26-28D	26RI20015	GW	SA	1	X				X
MW26-29	26RI20016	GW	SA	1	X				X
MW26-30	26RI20017	GW	SA	1	X	X	X	X	
MW26-31	26RI20018	GW	SA	1	X				
MW26-32D	26RI20019	GW	SA	1	X				
MW26-33	26RI20020	GW	SA	1	X				
MW26-34	26RI20021	GW	SA	1	X				
TBD	26RI20022	GW	DU	1	X				
TBD	26RI200##-MS 26RI200##-MSD	GW	MS/MSD	1	X				
MW26-33	26RI20023	GW	SA	2	X				
MW26-34	26RI20024	GW	SA	2	X				
TBD	26RI20025	GW	DU	2	X				
TBD	26RI200##-MS 26RI200##-MSD	GW	MS/MSD	2	X				
QC Blank Format									
n/a	26RI000##	AQ	EB	n/a	X				
TBD	26RI010##	AQ	FB	n/a	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Field and equipment blanks will be collected daily as specified in the UFP-QAPP (HGL, 2023).

4) Existing wells *italicized* . New wells **bold**.

AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
GW = groundwater
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
TBD = to be determined

TABLE 7
SEAD-26 (FIRE TRAINING PIT) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Surface Soil Samples									
SB26-13	26RI10001-0.0-0.5	SO	SA	0-0.5	X				
SB26-14	26RI10002-0.0-0.5	SO	SA	0-0.5	X				
SB26-15	26RI10003-0.0-0.5	SO	SA	0-0.5	X				
SB26-16	26RI10004-0.0-0.5	SO	SA	0-0.5	X				
SB26-17	26RI10005-0.0-0.5	SO	SA	0-0.5	X				
SB26-18	26RI10006-0.0-0.5	SO	SA	0-0.5	X				
SB26-19	26RI10007-0.0-0.5	SO	SA	0-0.5	X				
SB26-20	26RI10008-0.0-0.5	SO	SA	0-0.5	X				
SB26-21	26RI10009-0.0-0.5	SO	SA	0-0.5	X				
SB26-22	26RI10010-0.0-0.5	SO	SA	0-0.5	X				
SB26-23	26RI10011-0.0-0.5	SO	SA	0-0.5	X				
SB26-24	26RI10012-0.0-0.5	SO	SA	0-0.5	X				
SB26-25	26RI10013-0.0-0.5	SO	SA	0-0.5	X				
SB26-26	26RI10014-0.0-0.5	SO	SA	0-0.5	X				
SB26-27	26RI10015-0.0-0.5	SO	SA	0-0.5	X				
SB26-28	26RI10016-0.0-0.5	SO	SA	0-0.5	X				
SB26-29	26RI10017-0.0-0.5	SO	SA	0-0.5	X				
SB26-30	26RI10018-0.0-0.5	SO	SA	0-0.5	X				
SB26-31	26RI10019-0.0-0.5	SO	SA	0-0.5	X				
SB26-32	26RI10020-0.0-0.5	SO	SA	0-0.5	X				
SB26-33	26RI10021-0.0-0.5	SO	SA	0-0.5	X				
SB26-34	26RI10022-0.0-0.5	SO	SA	0-0.5	X				
SB26-35	26RI10023-0.0-0.5	SO	SA	0-0.5	X				
SB26-36	26RI10024-0.0-0.5	SO	SA	0-0.5	X				
SB26-37	26RI10025-0.0-0.5	SO	SA	0-0.5	X				
SB26-38	26RI10026-0.0-0.5	SO	SA	0-0.5	X				
SB26-39	26RI10027-0.0-0.5	SO	SA	0-0.5	X				
SB26-40	26RI10028-0.0-0.5	SO	SA	0-0.5	X				
SB26-41	26RI10029-0.0-0.5	SO	SA	0-0.5	X				
SB26-42	26RI10030-0.0-0.5	SO	SA	0-0.5	X				
TBD	26RI10031-0.0-0.5	SO	DU	0-0.5	X				
TBD	26RI10032-0.0-0.5	SO	DU	0-0.5	X				
TBD	26RI10032-0.0-0.5	SO	DU	0-0.5	X				
TBD	26RI100##-MS 26RI100##-MSD	SO	MS/MSD	0-0.5	X				
TBD	26RI100##-MS 26RI100##-MSD	SO	MS/MSD	0-0.5	X				

TABLE 7
SEAD-26 (FIRE TRAINING PIT) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity (SW9081)	Metals/Cations (SW6010)[2]
Subsurface Soil Samples									
TBD	26RI10034-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10035-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10036-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10037-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10038-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10039-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	26RI10040-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10041-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10042-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10043-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10044-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10045-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	26RI10046-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	26RI100##-2.0-4.0-MS 26RI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				
QC Blank Format									
n/a	26RI000##	AQ	EB	n/a	X				
TBD	26RI010##-X.X-X.X	AQ	FB	TBD	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Soil samples from multiple depths have a Top and Bottom depth value incorporated in the sample ID, such as FHRI10001-0.0-0.5 and FHRI10001-2.0-4.0. These would represent two soil boring samples collected at location FHRI10001; one sample at a depth of 0.0-0.5 ft bgs, and the other sample at a depth of 2.0-4.0 ft bgs. If shallower depths are being sampled, inches may be used such as FHRI10001-0-06 and FHRI10001-18-24.

4) Samples selected for additional analyses will target suspected source areas.

AQ = aqueous
DU = duplicate
EB = equipment blank
FB = field blank sample
ft bgs = feet below ground surface
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SO = soil sample
TBD = to be determined

TABLE 8
SEAD-26 (FIRE TRAINING PIT) PROPOSED SURFACE WATER AND SEDIMENT
SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)
Proposed Surface Water Samples					
SWSD26-04	26RI30001	SW	SA	1	X
SWSD26-05	26RI30002	SW	SA	1	X
SWSD26-06	26RI30003	SW	SA	1	X
SWSD26-07	26RI30004	SW	SA	1	X
SWSD26-08	26RI30005	SW	SA	1	X
SWSD26-09	26RI30006	SW	SA	1	X
SWSD26-10	26RI30007	SW	SA	1	X
SWSD26-11	26RI30008	SW	SA	1	X
SWSD26-12	26RI30009	SW	SA	1	X
SWSD26-13	26RI30010	SW	SA	1	X
TBD	26RI30011	SW	DU	1	X
TBD	26RI300##-MS 26RI300##-MSD	SW	MS/MSD	1	X
SWSD26-04	26RI30012	SW	SA	2	X
SWSD26-05	26RI30013	SW	SA	2	X
SWSD26-06	26RI30014	SW	SA	2	X
SWSD26-07	26RI30015	SW	SA	2	X
SWSD26-08	26RI30016	SW	SA	2	X
SWSD26-09	26RI30017	SW	SA	2	X
SWSD26-10	26RI30018	SW	SA	2	X
SWSD26-11	26RI30019	SW	SA	2	X
SWSD26-12	26RI30020	SW	SA	2	X
SWSD26-13	26RI30021	SW	SA	2	X
TBD	26RI30022	SW	DU	2	X
TBD	26RI300##-MS 26RI300##-MSD	SW	MS/MSD	2	X
SWSD26-07	26RI30023	SW	SA	3	X
SWSD26-08	26RI30024	SW	SA	3	X
SWSD26-07	26RI30025	SW	SA	4	X
SWSD26-08	26RI30026	SW	SA	4	X

TABLE 8

SEAD-26 (FIRE TRAINING PIT) PROPOSED SURFACE WATER AND SEDIMENT SAMPLING IDENTIFICATION AND ANALYTES

PFAS REMEDIAL INVESTIGATION

SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)
Proposed Sediment Samples					
SWSD26-04	26RI40001	SD	SA	1	X
SWSD26-05	26RI40002	SD	SA	1	X
SWSD26-06	26RI40003	SD	SA	1	X
SWSD26-07	26RI40004	SD	SA	1	X
SWSD26-08	26RI40005	SD	SA	1	X
SWSD26-09	26RI40006	SD	SA	1	X
SWSD26-10	26RI40007	SD	SA	1	X
SWSD26-11	26RI40008	SD	SA	1	X
SWSD26-12	26RI40009	SD	SA	1	X
SWSD26-13	26RI40010	SD	SA	1	X
TBD	26RI40011	SD	DU	1	X
TBD	26RI400##-MS 26RI400##-MSD	SD	MS/MSD	1	X
SWSD26-04	26RI40012	SD	SA	2	X
SWSD26-05	26RI40013	SD	SA	2	X
SWSD26-06	26RI40014	SD	SA	2	X
SWSD26-07	26RI40015	SD	SA	2	X
SWSD26-08	26RI40016	SD	SA	2	X
SWSD26-09	26RI40017	SD	SA	2	X
SWSD26-10	26RI40018	SD	SA	2	X
SWSD26-11	26RI40019	SD	SA	2	X
SWSD26-12	26RI40020	SD	SA	2	X
SWSD26-13	26RI40021	SD	SA	2	X
TBD	26RI40022	SD	DU	2	X
TBD	26RI400##-MS 26RI400##-MSD	SD	MS/MSD	2	X
Proposed Pore Water Samples					
PW26-01	26RI60001	AQ	SA	1	X
PW26-02	26RI60002	AQ	SA	1	X
TBD	26RI60003	AQ	DU	1	X
TBD	26RI600##-MS 26RI600##-MSD	AQ	MS/MSD	1	X
QC Blank Format					
n/a	26RI000##	AQ	EB	n/a	X
TBD	26RI010##	AQ	FB	n/a	X

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SD = sediment
SW = surface water
TBD = to be determined

TABLE 9
SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
MW122E-04	122ERI20001	GW	SA	1	X	X	X	X	X
MW122E-05	122ERI20002	GW	SA	1	X				
MW122E-06	122ERI20003	GW	SA	1	X	X	X	X	X
MW122E-07	122ERI20004	GW	SA	1	X	X	X	X	X
MW122E-08	122ERI20005	GW	SA	1	X				
MW122E-09	122ERI20006	GW	SA	1	X				
MW122E-10	122ERI20007	GW	SA	1	X	X	X	X	X
MW122E-11	122ERI20008	GW	SA	1	X				
MW122E-12	122ERI20009	GW	SA	1	X				
MW122E-13	122ERI20010	GW	SA	1	X	X	X	X	X
MW122D-01	122DRI20001	GW	SA	1	X				X
MW122D-02	122DRI20002	GW	SA	1	X	X	X	X	
MW122D-03	122DRI20003	GW	SA	1	X				
MW122D-04	122DRI20004	GW	SA	1	X				X
TBD	122DRI20005	GW	DU	1	X				
TBD	122ERI20011	GW	DU	1	X				
TBD	122RI200##-MS 122RI200##-MSD	GW	MS/MSD	1	X				
Bedrock 1 TBD	TBD	GW	SA	1A	X				X
Bedrock 2 TBD	TBD	GW	SA	1A	X				
Bedrock 3 TBD	TBD	GW	SA	1A	X				X
Bedrock 4 TBD	TBD	GW	SA	1A	X				
MW122E-04	122ERI20012	GW	SA	2	X				
MW122E-05	122ERI20013	GW	SA	2	X				
MW122E-06	122ERI20014	GW	SA	2	X				
MW122E-07	122ERI20015	GW	SA	2	X				
MW122E-08	122ERI20016	GW	SA	2	X				
MW122E-09	122ERI20017	GW	SA	2	X				
MW122E-10	122ERI20018	GW	SA	2	X				
MW122E-11	122ERI20019	GW	SA	2	X				
MW122E-12	122ERI20020	GW	SA	2	X				
MW122E-13	122ERI20021	GW	SA	2	X				
MW122D-01	122DRI20006	GW	SA	2	X				
MW122D-02	122DRI20007	GW	SA	2	X				
MW122D-03	122DRI20008	GW	SA	2	X				
MW122D-04	122DRI20009	GW	SA	2	X				
TBD	122DRI20010	GW	DU	2	X				
TBD	122ERI20022	GW	DU	2	X				
TBD	122RI200##-MS 122RI200##-MSD	GW	MS/MSD	2	X				
Bedrock 1 TBD	TBD	GW	SA	2	X				
Bedrock 2 TBD	TBD	GW	SA	2	X				
Bedrock 3 TBD	TBD	GW	SA	2	X				
Bedrock 4 TBD	TBD	GW	SA	2	X				

TABLE 9

SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED GROUNDWATER SAMPLING IDENTIFICATION AND ANALYTES

PFAS REMEDIAL INVESTIGATION

SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]	Total Dissolved Solids	Total Organic Carbon (SW9060)	Metals/Cations (SW6010)[2]	Slug Test
QC Blank Format									
n/a	122RI000##	AQ	EB	n/a	X				
TBD	122RI010##	AQ	FB	n/a	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Field and equipment blanks will be collected daily as specified in the UFP-QAPP (HGL, 2023).

4) The first round (1A) of bedrock well sampling will be after groundwater results from round 1 shallow wells are received.

AQ = aqueous

DU = field duplicate sample

EB = equipment blank

FB = field blank sample

GW = groundwater

MS = matrix spike sample

MSD = matrix spike duplicate sample

PFAS = per- and polyfluoroalkyl substances

SA = sample

TBD = to be determined

TABLE 10
SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity	Metals/Cations (SW6010)[2]
Surface Soil Samples									
SB122D-01	122DRI10001-0.0-0.5	SO	SA	0-0.5	X				
SB122D-02	122DRI10002-0.0-0.5	SO	SA	0-0.5	X				
SB122D-03	122DRI10003-0.0-0.5	SO	SA	0-0.5	X				
SB122D-04	122DRI10004-0.0-0.5	SO	SA	0-0.5	X				
SB122D-05	122DRI10005-0.0-0.5	SO	SA	0-0.5	X				
SB122E-01	122ERI10001-0.0-0.5	SO	SA	0-0.5	X				
SB122E-02	122ERI10002-0.0-0.5	SO	SA	0-0.5	X				
SB122E-03	122ERI10003-0.0-0.5	SO	SA	0-0.5	X				
SB122E-04	122ERI10004-0.0-0.5	SO	SA	0-0.5	X				
SB122E-05	122ERI10005-0.0-0.5	SO	SA	0-0.5	X				
SB122E-06	122ERI10006-0.0-0.5	SO	SA	0-0.5	X				
SB122E-07	122ERI10007-0.0-0.5	SO	SA	0-0.5	X				
SB122E-08	122ERI10008-0.0-0.5	SO	SA	0-0.5	X				
SB122E-09	122ERI10009-0.0-0.5	SO	SA	0-0.5	X				
SB122E-10	122ERI10010-0.0-0.5	SO	SA	0-0.5	X				
SB122E-11	122ERI10011-0.0-0.5	SO	SA	0-0.5	X				
SB122E-12	122ERI10012-0.0-0.5	SO	SA	0-0.5	X				
SB122E-13	122ERI10013-0.0-0.5	SO	SA	0-0.5	X				
SB122E-14	122ERI10014-0.0-0.5	SO	SA	0-0.5	X				
SB122E-15	122ERI10015-0.0-0.5	SO	SA	0-0.5	X				
SB122E-16	122ERI10016-0.0-0.5	SO	SA	0-0.5	X				
SB122E-17	122ERI10017-0.0-0.5	SO	SA	0-0.5	X				
SB122E-18	122ERI10018-0.0-0.5	SO	SA	0-0.5	X				
SB122E-19	122ERI10019-0.0-0.5	SO	SA	0-0.5	X				
SB122E-20	122ERI10020-0.0-0.5	SO	SA	0-0.5	X				
SB122E-21	122ERI10021-0.0-0.5	SO	SA	0-0.5	X				
SB122E-22	122ERI10022-0.0-0.5	SO	SA	0-0.5	X				
SB122E-23	122ERI10023-0.0-0.5	SO	SA	0-0.5	X				
SB122E-24	122ERI10024-0.0-0.5	SO	SA	0-0.5	X				
SB122E-25	122ERI10025-0.0-0.5	SO	SA	0-0.5	X				
TBD	122ERI10026-0.0-0.5	SO	DU	0-0.5	X				
TBD	122ERI10027-0.0-0.5	SO	DU	0-0.5	X				
TBD	122ERI10028-0.0-0.5	SO	DU	0-0.5	X				
TBD	XXXXRI100##-0.0-0.5-MS XXXXRI100##-0.0-0.5-MSD	SO	MS/MSD	0-0.5	X				
TBD	XXXXRI100##-0.0-0.5-MS XXXXRI100##-0.0-0.5-MSD	SO	MS/MSD	0-0.5	X				
Subsurface Soil Samples									
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	SA	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	XXXXRI100##-2.0-4.0-MS XXXXRI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				

TABLE 10
SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED SOIL SAMPLING IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sample Depth (ft bgs)	PFAS (Draft Method 1633)[1]	pH (SW9045)	Total Organic Carbon (SW9060)	Anion Exchange Capacity	Metals/Cations (SW6010)[2]
Soil Samples Collected from new Monitoring Well Locations									
SB122D-06/MW122D-01	122DRI10006-0.0-0.5	SO	SA	0-0.5	X				
SB122D-06/MW122D-01	122DRI10006-2.0-4.0	SO	SA	2.0-4.0	X				
SB122D-07/MW122D-02	122DRI10007-0.0-0.5	SO	SA	0-0.5	X				
SB122D-07/MW122D-02	122DRI10007-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
SB122D-08/MW122D-03	122DRI10008-0.0-0.5	SO	SA	0-0.5	X				
SB122D-08/MW122D-03	122DRI10008-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
SB122D-09/MW122D-04	122DRI10009-0.0-0.5	SO	SA	0-0.5	X				
SB122D-09/MW122D-04	122DRI10009-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-26/MW122E-04	122ERI10026-0.0-0.5	SO	SA	0-0.5	X				
SB122E-26/MW122E-04	122ERI10026-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
SB122E-27/MW122E-05	122ERI10027-0.0-0.5	SO	SA	0-0.5	X				
SB122E-27/MW122E-05	122ERI10027-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-28/MW122E-06	122ERI10028-0.0-0.5	SO	SA	0-0.5	X				
SB122E-28/MW122E-06	122ERI10028-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
SB122E-29/MW122E-07	122ERI10029-0.0-0.5	SO	SA	0-0.5	X				
SB122E-29/MW122E-07	122ERI10029-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-30/MW122E-08	122ERI10030-0.0-0.5	SO	SA	0-0.5	X				
SB122E-30/MW122E-08	122ERI10030-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-31/MW122E-09	122ERI10031-0.0-0.5	SO	SA	0-0.5	X				
SB122E-31/MW122E-09	122ERI10031-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-32/MW122E-10	122ERI10032-0.0-0.5	SO	SA	0-0.5	X				
SB122E-32/MW122E-10	122ERI10032-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-33/MW122E-11	122ERI10033-0.0-0.5	SO	SA	0-0.5	X				
SB122E-33/MW122E-11	122ERI10033-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-34/MW122E-12	122ERI10034-0.0-0.5	SO	SA	0-0.5	X				
SB122E-34/MW122E-12	122ERI10034-2.0-4.0	SO	SA	2.0-4.0	X				
SB122E-35/MW122E-13	122ERI10035-0.0-0.5	SO	SA	0-0.5	X				
SB122E-35/MW122E-13	122ERI10035-2.0-4.0	SO	SA	2.0-4.0	X	X	X	X	X
TBD	XXXXRI100XX-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	XXXXRI100XX-2.0-4.0	SO	DU	2.0-4.0	X				
TBD	XXXXRI100##-0.0-0.5-MS XXXXRI100##-0.0-0.5-MSD	SO	MS/MSD	0-0.5	X				
TBD	XXXXRI100##-2.0-4.0-MS XXXXRI100##-2.0-4.0-MSD	SO	MS/MSD	2.0-4.0	X				
QC Blank Format									
n/a	122RI000##	AQ	EB	n/a	X				
TBD	122RI010##-X.X-X.X	AQ	FB	TBD	X				

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) Metals/cations include aluminum, calcium, iron, magnesium, manganese, sodium and potassium.

3) Soil samples from multiple depths have a Top and Bottom depth value incorporated in the sample ID, such as FHRI10001-0.0-0.5 and FHRI10001-2.0-4.0. These would represent two soil boring samples collected at location FHRI10001; one sample at a depth of 0.0-0.5 ft bgs, and the other sample at a depth of 2.0-4.0 ft bgs. If shallower depths are being sampled, inches may be used such as FHRI10001-0-06 and FHRI10001-18-24.

4) Samples selected for additional analyses will target suspected source areas.

AQ = aqueous
DU = duplicate
EB = equipment blank
FB = field blank sample
ft bgs = feet below ground surface
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
SO = soil sample
TBD = to be determined

TABLE 11

SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED SURFACE WATER AND SEDIMENT SAMPLING IDENTIFICATION AND ANALYTES

PFAS REMEDIAL INVESTIGATION

SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]
SEAD 122D					
Proposed Surface Water Samples					
SWSD122D-01	122DRI30001	SW	SA	1	X
SWSD122D-02	122DRI30002	SW	SA	1	X
TBD	122DRI30003	SW	DU	1	X
SWSD122D-01	122DRI30006	SW	SA	2	X
SWSD122D-02	122DRI30007	SW	SA	2	X
TBD	122DRI30008	SW	DU	2	X
Proposed Sediment Samples					
SWSD122D-01	122DRI40001	SD	SA	1	X
SWSD122D-02	122DRI40002	SD	SA	1	X
TBD	122DRI40003	SD	DU	1	X
SWSD122D-01	122DRI40006	SD	SA	2	X
SWSD122D-02	122DRI40007	SD	SA	2	X
TBD	122DRI40008	SD	DU	2	X
SEAD 122E					
Proposed Surface Water Samples					
SWSD122E-01	122ERI30001	SW	SA	1	X
SWSD122E-02	122ERI30002	SW	SA	1	X
SWSD122E-03	122ERI30003	SW	SA	1	X
SWSD122E-04	122ERI30004	SW	SA	1	X
SWSD122E-05	122ERI30005	SW	SA	1	X
SWSD122E-06	122ERI30006	SW	SA	1	X
TBD	122ERI30007	SW	DU	1	X
SWSD122E-01	122ERI30010	SW	SA	2	X
SWSD122E-02	122ERI30011	SW	SA	2	X
SWSD122E-03	122ERI30012	SW	SA	2	X
SWSD122E-04	122ERI30013	SW	SA	2	X
SWSD122E-05	122ERI30014	SW	SA	2	X
SWSD122E-06	122ERI30015	SW	SA	2	X
TBD	122ERI30016	SW	DU	2	X

TABLE 11

SEAD-122D and SEAD-122E (AIRFIELD) PROPOSED SURFACE WATER AND SEDIMENT SAMPLING IDENTIFICATION AND ANALYTES

PFAS REMEDIAL INVESTIGATION

SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)[1]
Proposed Sediment Samples					
SWSD122E-01	122ERI40001	SD	SA	1	X
SWSD122E-02	122ERI40002	SD	SA	1	X
SWSD122E-03	122ERI40003	SD	SA	1	X
SWSD122E-04	122ERI40004	SD	SA	1	X
SWSD122E-05	122ERI40005	SD	SA	1	X
SWSD122E-06	122ERI40006	SD	SA	1	X
TBD	122ERI40007	SD	DU	1	X
SWSD122E-01	122ERI40010	SD	SA	2	X
SWSD122E-02	122ERI40011	SD	SA	2	X
SWSD122E-03	122ERI40012	SD	SA	2	X
SWSD122E-04	122ERI40013	SD	SA	2	X
SWSD122E-05	122ERI40014	SD	SA	2	X
SWSD122E-06	122ERI40015	SD	SA	2	X
TBD	122ERI40016	SD	DU	2	X
QC Blank Format					
n/a	122ERI40017	AQ	EB	n/a	X
TBD	122ERI40018	AQ	FB	n/a	X

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.

2) For sampling rounds where the number of samples is less than the QC ratio (e.g., DU 1:10), sample duplicates may be shared between sites sampled during the same time period.

AQ = aqueous

DU = field duplicate sample

EB = equipment blank

FB = field blank sample

MS = matrix spike sample

MSD = matrix spike duplicate sample

PFAS = per- and polyfluoroalkyl substances

SA = sample

SD = sediment

SW = surface water

TBD = to be determined

TABLE 12
PROPOSED BIOTA SAMPLE IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)
Muscle tissue samples					
DEERMUSC-01	SARI50001	MUSC	SA	1	X
DEERMUSC-02	SARI50002	MUSC	SA	1	X
DEERMUSC-03	SARI50003	MUSC	SA	1	X
DEERMUSC-04	SARI50004	MUSC	SA	1	X
DEERMUSC-05	SARI50005	MUSC	SA	1	X
DEERMUSC-06	SARI50006	MUSC	SA	1	X
DEERMUSC-07	SARI50007	MUSC	SA	1	X
DEERMUSC-08	SARI50008	MUSC	SA	1	X
DEERMUSC-09	SARI50009	MUSC	SA	1	X
DEERMUSC-10	SARI50010	MUSC	SA	1	X
DEERMUSC-11	SARI50011	MUSC	SA	1	X
DEERMUSC-12	SARI50012	MUSC	SA	1	X
DEERMUSC-13	SARI50013	MUSC	SA	1	X
DEERMUSC-14	SARI50014	MUSC	SA	1	X
DEERMUSC-15	SARI50015	MUSC	SA	1	X
DEERMUSC-16	SARI50016	MUSC	DU	1	X
DEERMUSC-17	SARI50017	MUSC	DU	1	X
TBD	SARI500##-MS SARI500##-MSD	MUSC	MS/MSD	1	X
Liver tissue samples					
DEERLIV-01	SARI50018	LIV	SA	1	X
DEERLIV-02	SARI50019	LIV	SA	1	X
DEERLIV-03	SARI50020	LIV	SA	1	X
DEERLIV-04	SARI50021	LIV	SA	1	X
DEERLIV-05	SARI50022	LIV	SA	1	X
DEERLIV-06	SARI50023	LIV	SA	1	X
DEERLIV-07	SARI50024	LIV	SA	1	X
DEERLIV-08	SARI50025	LIV	SA	1	X
DEERLIV-09	SARI50026	LIV	SA	1	X
DEERLIV-10	SARI50027	LIV	SA	1	X
DEERLIV-11	SARI50028	LIV	SA	1	X
DEERLIV-12	SARI50029	LIV	SA	1	X
DEERLIV-13	SARI50030	LIV	SA	1	X
DEERLIV-14	SARI50031	LIV	SA	1	X
DEERLIV-15	SARI50032	LIV	SA	1	X
DEERLIV-16	SARI50033	LIV	DU	1	X
DEERLIV-17	SARI50034	LIV	DU	1	X
TBD	SARI500##-MS SARI500##-MSD	LIV	MS/MSD	1	X

TABLE 12
PROPOSED BIOTA SAMPLE IDENTIFICATION AND ANALYTES
PFAS REMEDIAL INVESTIGATION
SENECA ARMY DEPOT ACTIVITY, NY

Sampling Location	Field Sample ID	Media	Sample Type	Sampling Round	PFAS (Draft Method 1633)
QC Blank Format					
n/a	SARI000##	AQ	EB	n/a	
TBD	SARI010##	AQ	FB	n/a	

Notes:

1) PFAS analysis will be EPA Draft Method 1633 by Eurofins Lancaster compliant with the requirements in the Department of Defense (DoD) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4 (Oct 2021), Table B-24.
AQ = aqueous
DU = field duplicate sample
EB = equipment blank
FB = field blank sample
MS = matrix spike sample
MSD = matrix spike duplicate sample
PFAS = per- and polyfluoroalkyl substances
SA = sample
MUSC = muscle tissue
LIV = liver tissue
TBD = to be determined

APPENDIX A: RISK ASSESSMENT WORK PLAN

RISK ASSESSMENT WORK PLAN

REMEDIAL INVESTIGATION
SEAD-25, SEAD-26, SEAD-122D/122E, AND FIRE HOUSE BUILDING 103
FORMER SENECA ARMY DEPOT
ROMULUS, SENECA COUNTY, NEW YORK

Contract W912DY-20-D-0017
Delivery Order: W912DY21F0310

Prepared for:

U.S. Army Engineering and Support Center, Huntsville

Prepared by:

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Northway 10 Executive Park
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Ballston Lake, NY 12019

August 2023

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ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AFFF	aqueous film-forming foam
bgs	below ground surface
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
DoD	Department of Defense
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESI	Expanded Site Investigation
ft	foot/feet
HGL	HydroGeoLogic, Inc.
HHRA	human health risk assessment
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
kg	kilogram
L	liter
L/m^3	liter per cubic meter
µg/L	microgram per liter
mg/m^3	milligram per cubic meter
mg/kg	milligram per kilogram
mg/L	milligram per liter
NOAEL	no observed adverse effects level
NYSDEC	New York State Department of Environmental Conservation
OSWER	Office of Solid Waste and Emergency Response
PEF	particulate emissions factor
%	percent
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
RAGS	Risk Assessment Guidance for Superfund

RI	Remedial Investigation
RSL	regional screening level
SEDA	Seneca Army Depot Activity
SI	Site Investigation
SLERA	screening level ecological risk assessment
SPLP	synthetic precipitation leaching procedure
TR	target risk
UCL	upper confidence limit
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers

RISK ASSESSMENT WORK PLAN
REMEDIAL INVESTIGATION
SEAD-25, SEAD-26, SEAD-122D/122E,
AND FIRE HOUSE BUILDING 103
FORMER SENECA ARMY DEPOT
ROMULUS, SENECA COUNTY, NEW YORK

1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) prepared this work plan to document the planned human health and ecological risk assessment approach for the Remedial Investigation (RI) at four sites with known per- and polyfluoroalkyl substances (PFAS) contamination within the Seneca Army Depot Activity (SEDA). These four sites are SEAD-25, SEAD-26, SEAD-122D/122E, and Fire House Building 103. This work is being conducted for the U.S. Army Corps of Engineers (USACE) – Huntsville District under Contract No. W912DY-20-D-0017, Delivery Order No. W912DY21F0310.

The RI and associated baseline risk assessment will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The U.S. Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) are the regulatory authorities for PFAS characterization at SEDA (Parsons, 2022). The human health and ecological risk assessments will be conducted in accordance with Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989; EPA, 2004; EPA, 2009); Office of Solid Waste and Emergency Response (OSWER) directives; and Ecological RAGS (EPA, 1997).

The figures cited in this Risk Assessment Work Plan are provided in the RI Work Plan, of which this Risk Assessment Work Plan is an appendix.

2.0 SITE DESCRIPTION

A brief description of the four known PFAS contamination sites at the former SEDA is presented below. An installation-wide conceptual site model (CSM) is presented in Worksheet #10 of the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) (HGL, 2021). This CSM lists 34 suspected PFAS sites, which did not include the four known PFAS contamination sites that are the focus of this work plan. The installation-wide CSM discusses historical remedial actions at SEAD-25, SEAD-26, and SEAD-122D/122E. Under the future use plan, SEAD-25, SEAD-26, and Fire House Building 103 are all in an area designated as a Planned Industrial Development/Warehousing Area. Future use of the former airfield in the southwest corner of SEDA, an area that includes SEAD-122D/122E, is expected to maintain its current status as a training area (e.g., law enforcement driver training; county fire training, state police firearms training). Some areas of the airfield, which are adjacent to the areas of concern, are used for growing corn. The corn is not for human consumption but is provided to the deer within the base. SEDA is a 10,587-acre former military facility located approximately 40 miles south of Lake Ontario in Seneca County, New York (Figure 1 of the RI Work Plan). The facility is located

between Seneca Lake and Cayuga Lake and is bordered by New York State Highway 96 to the east, New York State Highway 96A to the west, and sparsely populated farmland to the north and south. The facility was wholly owned by the U.S. Government and was operated by the Department of the Army between 1941 and 2000 with the primary mission to receive, store, maintain, and supply military items. In 1995, SEDA was designated for closure under the Department of Defense's (DoD) Base Realignment and Closure process.

A PFAS Site Investigation (SI) Report identified SEAD-25 and SEAD-26 as locations where PFAS release occurred and recommended these sites proceed to an RI (Parsons, 2018). This SI Report also recommended No Further Action at SEAD-122E because the sum of detections for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) did not exceed the EPA health advisory level of 70 nanograms per liter (parts per trillion) (EPA, 2022). The detections, however, are greater than the state of New York maximum contaminant level of 10 nanograms per liter. Based on comparison to the state maximum contaminant level, SEAD-122E proceeded to the RI stage. SEAD-122D was to be addressed separately in the Preliminary Assessment/SI; however, because the site is located within the extent of the area being investigated as part of the RI for SEAD-122E, the two sites are being addressed together as SEAD-122D/122E. A PFAS Expanded Site Investigation (ESI) identified elevated PFAS concentrations at Fire House Building 103 and this site was recommended to proceed to the RI stage (Parsons, 2022). The PFAS sites encompassed by this work plan are:

- Fire House Building 103,
- SEAD-25 (Fire Training and Demonstration Pad),
- SEAD-26 (Fire Training Pit and Area), and
- SEAD-122D and SEAD-122E (Airfield).

Fire House Building 103 is located along the east side of SEDA (Figure 1 of the RI Work Plan). The Fire House Building 103 site includes Building 103, the adjacent paved areas, and surrounding mowed lawn. Building 103 is a former fire department. The building is in a developed area of the installation, on a block of land that is approximately 3 acres. Figure 2 of the RI Work Plan shows the site layout. There is limited background information available describing historical activities at Fire House Building 103, but it is likely PFAS-containing aqueous film-forming foams (AFFF) were used at some point in its history. Shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 25 feet below ground surface (ft bgs), and there are two deep wells screened at 42 to 62 ft bgs (MWFH-09D) and 37.5 to 57.5 ft bgs (MWFH-10D) (Parsons, 2022). Building 103 is currently owned by Seneca County but is unoccupied and not in use. The surrounding area includes maintained grass. There are subsurface stormwater features parallel to the north-south roads adjacent to the Firehouse. The stormwater is channeled south, then west, and eventually outfalls into an open drainage ditch northwest of SEAD-25.

SEAD-25 is in the east-central portion of SEDA (Figure 1 of the RI Work Plan). The site is approximately 7 acres and comprises mostly undeveloped land with a centrally located crushed shale pad (Parsons, 2022). The site is bounded to the east by Administration Avenue, beyond which is undeveloped land covered by deciduous trees and a wetland area; to the south by Ordnance

Drive, beyond which is an open grassy field and a stand of coniferous trees; to the west by a drainage ditch running from the northeast to the southwest with grassland, brush, and conifers between the site and the ditch; and, to the north by grassland and brush. Figure 4 of the RI Work Plan shows the layout of SEAD-25.

SEAD-25 was in use from the late 1960s to the late 1980s. The former pad was used for fire control training. During the 1980s, the pad was used twice for fire-fighting demonstrations, including one demonstration in 1982 or 1983, and one in 1987. Shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 20 ft bgs, and there are three deep wells screened at 39 to 49 ft bgs (MW25-22D), 41 to 81 ft bgs (MW25-31D), and 44 to 54 ft bgs (MW25-34D) (Parsons, 2022). Ongoing activities at this site are limited, except for some periodic maintenance of the grassland around the pad and monitoring wells.

SEAD-26, located in the southeastern portion of SEDA (Figure 1 of the RI Work Plan), was used for firefighting training during which various flammable materials were floated on water, ignited, and extinguished. Prior to 1977, the fire training area also may have been used for firefighting demonstrations. The site is characterized by an elevated, approximately 6-acre rectangular, grass-covered pad that contains a former fire training tower, an area that at one time held a storage trailer, a circular burning pit, and a former drum storage area, based on figures from the ESI (see Figure 6 of the RI Work Plan for the site layout). The centrally located circular burning pit has a diameter of approximately 75 feet and is surrounded by a 2-3-foot-high soil berm. Approximately 50 feet south of the former burning pit, former site features included two large, empty cylindrical steel tanks and the burned-out fuselage of a helicopter. A former drum storage area is located at the far southern end of the site. Except for the former fire tower, other former site features have been removed. None of the samples collected from northern third of the site during the ESI had exceedances of PFAS screening values; however, total PFAS concentrations were elevated within and downstream of a nearby pond, which indicates groundwater is upwelling and discharging in this area, impacting surface water approximately 2,000 feet downgradient of the source area (Parsons, 2022). Shallow wells at the site are screened in the overburden till and weathered bedrock between 5 and 21.5 ft bgs, and there are three deep wells screened at 42 to 57 ft bgs (MW26-23D), 50 to 100 ft bgs (MW26-28D), and 39 to 79 ft bgs (MW26-32D) (Parsons, 2022). There are no ongoing maintenance activities at the site.

SEAD-122D and SEAD-122E are in the southwest corner of SEDA and include a former aircraft refueling area and three deicing areas at the former SEDA Airfield (Figure 1 of the RI Work Plan). Three of the four historical deicing/refueling pads that comprise SEAD-122E are located along the western side of the northwest-southeast runway, and the fourth fuel pad (SEAD-122D) is located to the east near the middle portion of the runway. Two of the deicing/refueling pads are located near either end of the runway, a third is located at the end of a short taxiway to the west of the middle portion of the runway, and a fourth pad is located on the east side of the runway near the southeastern end. Figure 8 of the RI Work Plan presents the site layout for SEAD-122D/122E.

Based on data from temporary wells sampled during the SI, an AFFF source exists within SEAD-122E. No permanent surface water bodies are present around SEAD-122D/122E; however, stormwater drainage features are present on the site. The temporary shallow wells from the SI were screened in the overburden till and weathered bedrock between 1 and 15.5 ft bgs. There are no

deep wells at either SEAD-122D or SEAD-122E (Parsons, 2018). The airfield is no longer operational, and the current use is as a training area (e.g., law enforcement driver training; county fire training, state police firearms training). Some areas of the airfield adjacent to RI areas of concern are used for growing corn. The corn is not for human consumption but is provided to the deer within the base.

3.0 CONCEPTUAL SITE MODEL

The CSM for the installation is presented in detail in Worksheet #10 of the UFP-QAPP (HGL, 2021). To support the exposure assessment, a preliminary CSM was developed for the four sites with known PFAS contamination.

Based on the information presented in the SI and ESI reports, contaminated media at the four PFAS contamination sites include surface soil, surface water, and groundwater. Neither subsurface soil nor sediment was sampled during the SI and ESI. Contamination in surface soil could have leached to subsurface soil or eroded to become sediment in nearby drainage ditches. PFAS contamination in groundwater that discharges to surface water could partition onto sediment. The planned RI will characterize the PFAS contamination in surface soil (0 – 0.5 ft bgs), subsurface soil (1.5 - 2 ft bgs), sediment, surface water, and groundwater.

Past sampling indicates that PFAS is present in surface water in the drainage ditches southwest of SEAD-25 and in the drainages and pond west of SEAD-26. These results indicate a transport pathway exists between the SEAD-25 and the drainage ditches southwest of SEAD-25 via groundwater discharge. In addition, stormwater runoff from the Administration Area (Fire House Building 103) could affect these drainage ditches. The analytical results also indicate a transport pathway is present between SEAD-26 and the drainage ditches, pond, and wetland area west of SEAD-26 (Parsons, 2018; 2022).

PFAS is known to bioaccumulate. PFAS in soil can accumulate into plants, soil invertebrates, and animals, such as deer, that forage at the sites. Deer harvesting is conducted routinely to manage the deer population at SEAD, and harvested deer will be sampled and analyzed for PFAS. PFAS in surface water and sediment can accumulate into fish and benthic invertebrates. The surface water bodies at SEDA are too small to support sport fish. Small fish, however, could be consumed by birds and mammals. Benthic invertebrates also could be consumed by wildlife.

Of the PFASs listed in the November 2022 regional screening level (RSL) table, only one, hexafluoropropylene oxide dimer acid, is identified as a volatile compound. Currently, there are no inhalation toxicity values available for evaluating potential risks from inhalation exposure routes. As there is more research into PFASs, other PFASs may be identified as volatile and inhalation toxicity values may become available. To accommodate these possibilities, this Risk Assessment Work Plan identifies inhalation of volatile PFASs during potable water use and from vapor intrusion as potentially complete exposure routes that may warrant either qualitative or quantitative evaluation, depending on the state of the science, at the time of the risk assessment.

4.0 DATA TO BE USED IN THE RISK ASSESSMENT

4.1 HISTORICAL PFAS DATA

There are historical PFAS data available, including:

- Groundwater samples collected for PFAS analysis from shallow monitoring wells during the SI. Deep groundwater was not sampled as part of the SI. There were no surface water, sediment, or soil samples collected during the SI (Parsons, 2018).
- Samples of surface water, shallow groundwater, and deep groundwater analyzed for PFAS as part of the ESI. There were no sediment samples collected during the ESI. Soil samples were analyzed using the synthetic precipitation leaching procedure (SPLP) (Parsons, 2022). The SPLP leachate results will be evaluated in the RI report to assess the soil-to-groundwater migration pathway but will not be considered in the baseline risk assessment.

As part of the SI, groundwater samples were submitted to Test America-Sacramento, a DoD-approved and New York State-certified laboratory, for analysis of 14 PFASs using EPA Test Method 537 (Parsons, 2018). The ESI samples were submitted to Eurofins-Test America, West Sacramento, California; a DoD-approved and New York State-certified laboratory. The ESI surface water and groundwater samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022). As noted above, the baseline risk assessment will not include the soil SPLP data. Instead, the SPLP results will be evaluated in the contaminant transport section of the RI report.

The following subsections describe the groundwater and surface water samples collected during the historical investigations.

4.1.1 Fire House Building 103

Fire House Building 103 was not sampled during the SI. During the ESI, 10 shallow, permanent groundwater monitoring wells and 2 deep, permanent groundwater monitoring wells were each sampled on two occasions between May 2019 and March 2021. The groundwater samples were analyzed for 21 PFASs using Method 537.1 Modified (Parsons, 2022).

There are no surface water bodies near Building 103; however, surface water samples were collected from three locations in catchment basins downgradient of the site after a precipitation event, as part of the ESI. These three locations were sampled on two occasions, once in August 2020 and once in March 2021. The surface water samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022).

All groundwater and surface water data associated with Fire House Building 103 from the ESI were validated and are considered usable for the baseline risk assessment.

4.1.2 SEAD-25

During the SI, groundwater samples were collected from 12 shallow, permanent monitoring wells associated with SEAD-25 and analyzed for 14 PFASs using EPA Method 537 (Parsons, 2018).

During the ESI, the 12 shallow monitoring wells previously sampled as part of the SI were resampled and an additional 15 shallow, permanent monitoring wells were each sampled on two occasions between May 2019 and March 2021. A permanent, deep monitoring well (MW25-22D) was sampled once in March 2021. Two permanent, deep monitoring wells (MW25-31D and MW25-34D) were each sampled on two occasions, once in the summer of 2020 and once in March 2021. Groundwater samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022).

As part of the ESI, six locations around SEAD-25 were sampled for surface water. One location (25SW-01) was sampled three times. One location (25SW-03) was dry during the August 2020 sampling event and only sampled once in March 2021. The remaining four locations were sampled on two occasions, once in August 2020 and once in March 2021. All surface water samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022).

All groundwater and surface water data associated with SEAD-25 from the SI and ESI were validated and are considered usable for the baseline risk assessment.

4.1.3 SEAD-26

During the SI, shallow groundwater samples were collected from eight temporary monitoring wells associated with SEAD-26. The samples were analyzed for 14 PFASs using EPA Method 537 (Parsons, 2018).

During the ESI, groundwater samples were collected from 20 permanent, shallow monitoring wells. Each shallow well was sampled on two occasions between May 2019 and March 2021. Groundwater samples were collected from three permanent, deep monitoring wells on two occasions, once in the summer of 2020 and once in March 2021. Groundwater samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022).

As part of the ESI, six locations within or downgradient of SEAD-26 were sampled for surface water. Two locations were dry during the August 2020 sampling event and only sampled once during March 2021. The remaining four locations were each sampled on two occasions, once in August 2020 and once in March 2021. All surface water samples were analyzed for 21 PFASs using EPA Method 537.1 Modified (Parsons, 2022).

All groundwater and surface water data associated with SEAD-25 from the ESI were validated and are considered usable for the RI risk assessment. Because the SI groundwater samples were obtained from temporary monitoring wells, the SI results are not considered to be usable for risk assessment. The baseline risk assessment will consider only the ESI data.

4.1.4 SEAD-122D/122E

During the SI, groundwater samples were collected from 26 temporary, shallow monitoring wells associated with SEAD-122E and analyzed for 14 PFASs using EPA Method 537. No other environmental media at SEAD-122D/122E were sampled during the SI (Parsons, 2018).

SEAD-122D/122E was not investigated during the ESI (Parsons, 2022).

The temporary monitoring well data from the SI are not usable for risk assessment. Therefore, the baseline risk assessment will not include any historical data for SEAD-122D/122E.

4.2 PLANNED RI DATA

The planned field investigation includes the collection of surface soil (0 – 0.5 ft bgs), subsurface soil (1.5 – 2 ft bgs), surface water, sediment, groundwater, and deer tissue samples, and completion of a background study. The following subsections summarize the planned sampling program for the RI. Modification No. 1 of the proposed technical approach for the RI describes the PFAS sampling program in detail (HGL, 2022). The proposed plan includes PFAS analysis using the new EPA Method 1633 for all samples. EPA Method 1633 includes the PFAS constituents that are analyzed for using EPA Method 537 and EPA Method 537.1 Modified.

4.2.1 Groundwater Sampling

The planned RI includes installation of monitoring wells and sampling the new wells along with existing wells from the SI/ESI. All groundwater samples will be analyzed for PFAS. The planned groundwater samples are listed below by site.

- Fire House Building 103
    - Installation of five shallow monitoring wells and two deep monitoring wells
    - One round of sampling for the eight existing wells and seven new wells
    - One additional round of sampling for the seven new wells
- SEAD-25
    - Installation of five shallow monitoring wells and one piezometer
    - One round of sampling for the 18 existing wells and five new wells and new piezometer
    - One additional round of sampling for the five new wells and new piezometer
- SEAD-26
    - Installation of two shallow monitoring wells
    - One round of sampling for the 19 existing wells and two new wells
    - One additional round of sampling for the two new wells
- SEAD-122D/122E
    - Installation of 12 shallow monitoring wells and four bedrock monitoring wells

- Two rounds of sampling for the 12 new shallow monitoring wells and the four new bedrock monitoring wells

4.2.2 Soil Sampling

- Fire House Building 103
  - 20 surface soil samples (0 to 0.5 ft bgs) from in and around the site boundaries
  - 8 subsurface soil samples (2.0 to 4.0 ft bgs) will be collected based on the results for the surface soil samples
  - Surface soil samples (0 to 0.5 ft bgs) and subsurface soil samples (2.0 to 4.0 ft bgs) to be collected from each of the five new shallow monitoring well locations
- SEAD-25
  - 30 surface soil (0 to 0.5 ft bgs) samples from in and around the site boundaries
  - 10 subsurface soil samples (2.0to 4.0 ft bgs) will be collected based on the surface soil data
- SEAD-26
  - 30 surface soil (0 to 0.5 ft bgs) samples from within the site boundaries
  - 12 subsurface soil samples (2.0 to 4.0 ft bgs) will be collected based on the results for the surface soil samples
- SEAD-122D/122E
  - 30 surface soil (0 to 0.5 ft bgs) samples split between the four areas of concern within SEAD-122D/122E and other areas within the airfield
  - 10 subsurface soil samples (2.0 to 4.0 ft bgs) will be collected based on the surface soil data
  - Surface soil samples (0 to 0.5 ft bgs) and subsurface soil samples (2.0 to 4.0 ft bgs) will be collected from each of the 12 new shallow monitoring well locations

4.2.3 Surface Water and Sediment Sampling

There are limited surface water, wetland, and drainage basin features within the boundaries of the four known PFAS contamination sites. However, the SI/ESI identified surface water bodies that could be affected by discharge of shallow groundwater or stormwater runoff. The technical approach in Modification No. 1 proposes two to four rounds of samples at locations that are generally downgradient of the following sites (see Table 1 of the modified technical approach [HGL, 2022]):

- SEAD-25
  - 12 surface water and 13 sediment sampling locations
  - A total of 30 surface water and 27 sediment samples
- SEAD-26
  - 10 surface water and 10 sediment sampling locations

  - A total of 24 surface water and 20 sediment samples
  - 6 sediment pore water samples

- Airfield
  - 8 surface water and 6 sediment sampling locations
  - A total of 16 surface water and 12 sediment samples

No surface water or sediment samples are planned for the vicinity of Fire House Building 103.

4.2.4 Tissue Samples

Tissue and liver samples will be collected from the installation deer population. Both tissue and liver samples will be analyzed for PFAS using EPA Method 1633.

4.3 BASELINE RISK ASSESSMENT DATASET

Only data determined to be usable will be included in the baseline risk assessment. Rejected data and screening level data (i.e., analytical results for samples from temporary wells) will be excluded. As described in Section 4.1, the SI and ESI groundwater data from permanent monitoring wells and surface water data were validated and determined to be usable for the baseline risk assessment. The historical temporary monitoring well data will not be considered in the baseline risk assessment.

The planned RI samples will be validated. All RI results determined to be usable through the data validation process will be included in the baseline risk assessment dataset.

Only one result will be used for parent sample and field duplicate pairs. If an analyte was detected in both the parent sample and field duplicate, the maximum detection will be used for that location. If an analyte was positively detected in only one sample, the detection will be used. If an analyte was not detected in either sample, the lower of the two limits of detection will be used. Analyte detections with a "U" or "UJ" qualifier applied in the validation process (due to suspected artifacts) will be considered non-detect results. As noted above, rejected data will be excluded from the risk assessment dataset.

5.0 HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment (HHRA) approach is described in the subsections below.

5.1 POTENTIAL RECEPTORS AND EXPOSURE ROUTES

Based on current land use of the four known PFAS contamination sites, current receptors include outdoor workers (adult), site visitors/trespassers (adult and adolescent), hunters (adult), recreational users (adult and adolescent), and wild game/deer consumers (adult and child). Indoor workers (adult) also are present at Fire House Building 103. The four sites are not currently used for residential purposes and no construction projects are ongoing.

There are no plans to change the current site uses, and the near future land use is to maintain the general area for livestock grazing and wildlife; however, the HHRA also will consider unrestricted future land use to support risk management decision making. Assuming an unrestricted future land use, potential future receptors include hypothetical residents (adult and child) and construction workers (adult) in addition to the current receptors listed above. Farming already occurs on parts of SEDA. It is possible that SEAD-25 could be used for farming. The other sites are in industrial areas that are unlikely to be re-purposed for farming. Based on current farming practices at SEDA, any future farming at SEAD-25 is likely to consist of hay or livestock farming. Because this type of farming does not include tilling, it is expected that potential risks to farmers would be equal to or less than those for the outdoor worker. For this reason, the HHRA will not estimate potential risks to future farmers.

The indoor worker is a receptor only for Fire House Building 103. Because an indoor worker will experience less contact with site soil than an outdoor worker, potential risks for the indoor worker will be less than those estimated for an outdoor worker. For this reason, the HHRA will not estimate potential risks for the indoor worker associated with direct contact exposure (i.e., ingestion, dermal contact, or inhalation of fugitive dusts) to site soil. Although many of the PFAS compounds are not volatile (e.g., PFOS), there are thousands of PFAS compounds and some (e.g., 8:2 FTOH) may be volatile enough to result in a potentially complete vapor intrusion exposure pathway. Accordingly, indoor workers are assumed to have a potentially complete inhalation exposure route via vapor intrusion.

Hunters, recreational users, and site visitors/trespassers represent individuals that infrequently contact site media over an extended period. These receptors have similar degrees of exposure in terms of frequency and duration. To streamline the risk calculations, recreational users and site visitors/trespassers will be merged into a single receptor for the HHRA. Because the hunter also could consume wild game or deer, this receptor will be evaluated separately.

As described in Section 3, PFAS can bioaccumulate in fish. SEDA is used for recreational purposes. The surface water bodies at SEDA, however, are too small to support the presence of sport fish that could be caught for human consumption. Therefore, the exposure route for fish consumption is identified as incomplete for human receptors.

Currently, groundwater at each of the sites is not used for any purpose. There are no known public or private water supply wells within 1 mile of the Fire House, SEAD-25, or SEAD-26 sites, nor are there known private groundwater wells within the former SEDA boundary. A water distribution building/reservoir (formerly Building 334R), located 1,700 ft south of SEAD-25, is now used by the Seneca County Water Department. This structure is partially below grade and was formerly uncovered. This building is outside the expected extent of the SEAD-25 PFAS plume, bound to the north of Building 334R by non-detect data at wells MW25-23 and MW25-26, and does not provide water from within the SEDA. The nearest residences are at the Spring Meadows Apartments located east of the Fire House Building 103. These apartments are connected to the Seneca County Water District and do not use the local groundwater for potable water supply. The nearest known downgradient drinking water wells are located along Route 96A, approximately 2.5 miles west of the four known contamination sites (Parsons, 1994). There are currently groundwater use restrictions in the vicinity of SEAD-25 and former Fire House Building

103 (Parsons, 2021). Although future use of site groundwater as a potable water supply is unlikely, this scenario will be evaluated in the HHRA.

Potentially contaminated media, receptors, and exposure routes to be evaluated in the HHRA are listed below and summarized in RAGS Part D Table 1 (Attachment 1).

- **Soil (surface [0 – 0.5 ft bgs] and subsurface [2.0 – 4.0 ft bgs]):**
  - Current/future outdoor worker: this individual could be exposed to soil contaminants during routine maintenance work such as mowing. Exposure routes are incidental ingestion, dermal contact, and inhalation of fugitive dust. Consistent with prior HHRAs for SEDA, the results for the top 2 ft of soil will be pooled to represent soil to which an outdoor worker could be exposed under both current and potential future site conditions.
  - Current/future recreator/site visitor/trespasser and current/future hunter: these individuals could contact site soil while traversing the sites. Exposure routes are incidental ingestion, dermal contact, and inhalation of fugitive dust. Like the outdoor worker, it is assumed that the hunter and recreator/site visitor/trespasser will be exposed to contaminants in the top 2 ft of soil.
  - Future construction worker: if future site activities include excavation or utility work, construction workers could be exposed to surface soil and subsurface soil through incidental ingestion, dermal contact, and inhalation of fugitive dusts.
  - Future resident: a hypothetical future resident could be exposed to site soil through incidental ingestion, dermal contact, and inhalation of fugitive dusts. For this receptor, exposure to surface soil (0 – 0.5 ft bgs) and pooled surface soil/subsurface soil (2 – 4 ft bgs) will be evaluated separately.
- **Surface Water and Sediment:**
  - Current/future outdoor worker: this individual could contact surface water and sediment during maintenance work in drainage ditches and ponds. The exposure routes for both media are incidental ingestion and dermal contact.
  - Current/future hunter and current/future recreator/site visitor/trespasser: these people could contact surface water and sediment while wading, playing, and traversing SEDA. The exposure routes for both media are incidental ingestion and dermal contact.
  - Future construction worker: because it is unlikely that construction projects would occur in a surface water body, there are no complete exposure routes to surface water and sediment for this receptor.
  - Future resident: a hypothetical future resident could play and wade in surface water bodies. The exposure routes for both media are incidental ingestion and dermal contact.
- **Groundwater:** Because groundwater is not currently used for any purpose, only future receptors could be exposed to this medium.

  - Future outdoor worker: if a potable water supply well is installed at a PFAS site, the outdoor worker could use the water for drinking and washing. Exposure routes are ingestion and dermal contact.
  - Future hunter and future recreator/site visitor/trespasser: it is expected that these receptors would consume minimal quantities of groundwater if a potable water supply well were installed. The HHRA will not estimate exposure of these receptors to groundwater because any exposure would be less than that for the outdoor worker and resident.
  - Future construction worker: if a potable water supply well were installed, it is unlikely that a construction worker would consume much groundwater. If an excavation were to intersect groundwater, minimal exposure to a construction worker is expected due to dewatering. For these reasons, the HHRA will not estimate potential exposure of the construction worker to groundwater.
  - Future resident: it is assumed that a future resident will use site groundwater as a potable water supply. The exposure routes are ingestion and dermal contact. In addition, exposure via inhalation will be evaluated if detected PFASs are determined to be volatile.

- **Wild game/deer:** The current/future wild game/deer consumer is someone who could eat deer meat caught at SEDA. It is assumed that the wild game/deer consumer is exposed only to wild game/deer and not to other site media. The current/future hunter also could consume wild game/deer. The exposure route is ingestion.
- **Indoor air:** The current/future indoor worker and future hypothetical resident could be exposed to volatile PFASs in indoor air via the vapor intrusion exposure route. The exposure route is inhalation.

5.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Identification of the chemicals of potential concern (COPC) will be a two-step process. The first step will consist of comparing the PFAS results for each site to the SEDA background data. The RI will include a background study that will develop background concentrations of PFAS in soil, surface water, sediment, and groundwater. The background data will be used to perform a statistical analysis that will compare site PFAS concentrations to background data to determine if they are consistent with preexisting anthropogenic conditions within SEDA, as opposed to being associated with site-related activities. Parsons (2023; in progress) describes the planned background sample locations and how the site data will be compared to the background data. In accordance with the US Department of Defense Manual: Defense Environmental Restoration Program (DERP) Management, the HHRA will not quantify exposure to naturally occurring substances present at concentrations unaffected by current or past site activities (DoD, 2012). If a site-related contaminant is present at concentrations greater than the risk-based screening value, it will be identified as a site-related COPC and will be quantitatively evaluated in the HHRA. If a background constituent (non-site-related constituent) is present at concentrations greater than the risk-based screening value, it will be identified as a non-site-related COPC and will be considered qualitatively and separate from site-related COPCs in the risk characterization. Analytes with

maximum detections less than or equal to the risk-based screening values will not be identified as COPCs.

- **Soil and Sediment:** EPA RSL for residential soil (target risk [TR] = 1E-06, target hazard quotient [HQ] = 0.1);
- **Groundwater:** EPA tap water RSL (TR = 1E-06, HQ = 0.1); if none available, the lower of the Federal or New York maximum contaminant level; and
- **Surface Water:** New York surface water quality standards or, if none available, the EPA tap water RSL (TR = 1E-06, HQ = 0.1).

The EPA RSLs are updated semi-annually. The most current version of the RSL table will be used for COPC identification.

Vapor intrusion screening values (VISLs) are not currently available for PFAS. If VISLs become available for PFASs, these values will be used to identify COPCs for exposure via the vapor intrusion migration pathway. If values are not available, inhalation via vapor intrusion will be evaluated qualitatively in the HHRA.

5.3 EXPOSURE ASSESSMENT

5.3.1 Exposure Assumptions

The HHRA will estimate exposure of current/future outdoor workers, current/future hunters/recreators/visitors/trespassers, current/future wild game/deer consumers, future construction workers, indoor workers, and future residents to site contaminants. The outdoor worker, resident, indoor worker, and construction worker are standard receptors for which default exposure assumptions are available from EPA guidance. The HHRA will use EPA default exposure assumptions for these receptors.

The hunter/recreator/visitor/trespasser is a site-specific receptor. Some of the planned exposure assumptions for this individual, such as body weight of an adult, are default values from EPA guidance. Other exposure assumptions, such as exposure frequency, are site-specific values. Exposure assumptions and associated rationale for all receptors are provided in RAGS Part D Tables 4.1 through 4.7 (Attachment 1). These tables also present the equations for the dose calculations.

5.3.2 Exposure Area

The HHRA will evaluate each PFAS site as a separate exposure area. The dataset for each exposure area (i.e., each site) will consist of:

- Soil samples collected within and adjacent to the site boundary;
- Groundwater samples from monitoring wells within and adjacent to the site boundary.

- Surface water and sediment samples collected downgradient of the site. There will be no surface water or sediment samples associated with Fire House Building 103 site.

5.3.3 Exposure Point Concentration

As described in Section 4.1, there are no historical PFAS data for soil or sediment. Accordingly, the soil and sediment exposure point concentrations (EPC) will be calculated from the planned RI data. Separate EPCs will be calculated for soil and sediment at each PFAS site. If a soil or sediment COPC has more than five detections, the EPC will be the 95 percent (%) upper confidence limit (UCL) of the mean concentration. If the dataset has five or fewer detections or if the 95% UCL is greater than the maximum detection, then the maximum detection will be the EPC. The 95% UCL calculations will be performed using the current version of EPA's ProUCL statistical software.

Historical data are available for groundwater and surface water. Both media, however, are transient. For this reason, the groundwater and surface water EPCs will be calculated from the RI data, not the historical data. The uncertainty section of the HHRA will compare the historical data to the RI data to assess whether concentrations have changed and, if so, whether these changes contribute to the HHRA's uncertainty.

For groundwater, EPCs will be calculated in accordance with EPA (2014). This guidance recommends that the EPC be the 95% UCL of the mean concentration for monitoring wells located within the plume core. To comply with this guidance, the analytical results for COPCs with more than five detections will be evaluated to determine if there is a plume core. If there is no plume core (for example, if the detections are normally distributed), then the EPC will be the 95% UCL of the site's entire groundwater dataset. If there is a plume core, the EPC will be the 95% UCL of the mean concentration for only those wells that comprise the plume core. In all cases, if there are five or fewer detections, the EPC will be the maximum detection.

For each exposure area, the EPC for surface water will be the 95% UCL of the mean concentration for COPCs with more than five detections and the maximum detection for COPCs with five or fewer detections.

Inhalation of fugitive dust emissions is a potential exposure route. A particulate emissions factor (PEF) will be applied to the soil EPC to calculate the ambient air EPC. For the outdoor worker, hunter/recreator/visitor/trespasser, the PEF will be the default value of 1.36×10^9 cubic meter per kilogram. For the construction worker, a site-specific PEF will be calculated in accordance with Appendix E of EPA (2002). The equation for estimating the ambient air concentration is below.

Ambient air concentration (milligram per cubic meter [mg/m^3]) = EPC_{soil} (milligram per kilogram [mg/kg]) x 1/PEF (cubic meter per kilogram)

If detected PFAS are determined to be volatile, a volatilization factor will be calculated in accordance with EPA (2002) and included in the equation for estimating ambient air concentrations. In addition, indoor air concentrations due to vapor intrusion will be estimated using groundwater concentrations and the equation listed below, which is from EPA's *Vapor Intrusion Screening Levels User's Guide* (EPA, 2015).

Indoor air concentration (mg/m^3) = $EPC_{groundwater}$ (micrograms per liter [µg/L]) x groundwater attenuation factor (0.001 [unitless]) x 1000 liters per cubic meter [L/m^3] x Dimensionless Henry's Law Constant

In addition, for groundwater COPCs that are determined to be volatile, indoor air concentrations due to potable water use will be estimated by multiplying the groundwater EPC by a volatilization factor of 0.5 L/m^3.

5.4 TOXICITY ASSESSMENT

Toxicity values will be obtained from the hierarchy of sources outlined in OSWER Directive 9285.7-53 (EPA, 2003). Dermal reference doses and dermal cancer slope factors will be estimated from oral values in accordance with EPA (2004). Where available, subchronic reference doses and reference concentrations will be used for the construction worker who is exposed to site contaminants for a duration of 1 year.

5.5 RISK CHARACTERIZATION

For each receptor, cancer risks will be calculated for each site-related COPC within each exposure medium and summed across each exposure medium. The equations for calculating cancer risk are:

(ingestion or dermal contact) ILCR = intake (milligrams per kilogram per day [mg/kg-day]) x CSF $(mg/kg\text{-}day)^{-1}$

Where: ILCR = incremental lifetime cancer risk
CSF = cancer slope factor

(inhalation) ILCR = C_a (mg/m^3) x IUR $(mg/m^3)^{-1}$

Where: C_a = concentration in air adjusted for exposure time
IUR = inhalation unit risk

The HQ will be calculated for each site-related COPC and summed across each exposure medium to provide a hazard index (HI) for each receptor. For HIs greater than 1, a target organ analysis will be performed to account for differences in toxic mechanisms among the site-related COPCs. The equations for calculating the HQs are:

(ingestion and dermal contact) HQ = intake (mg/kg/day) / RfD (mg/kg/day)

Where: RfD = reference dose

(inhalation) HQ = C_a (mg/m^3) / RfC (mg/m^3)

Where: RfC = reference concentration

Potential risks posed by non-site-related COPCs will be evaluated qualitatively through comparison of detections to the risk-based screening values. In addition, potential risks posed by non-site-related COPCs will be considered separately from the risks posed by site-related COPCs.

5.6 UNCERTAINTY ASSESSMENT

The HHRA will include a discussion of the uncertainties associated with the risk assessment process, including uncertainties resulting from chemical analysis, exposure assessment, and toxicity assessment. The chemical analysis evaluation will include comparison of limits of detection for nondetected analytes to the health-based screening values to ascertain whether the analytical method was sufficiently sensitive to identify all COPCs. As noted above, this section will evaluate the uncertainty associated with using only the RI data to estimate surface water and groundwater EPCs. Given the emerging status of PFASs as contaminants, it is likely that there will not be any toxicity values for some of the detected analytes. For this reason, the uncertainty section also will discuss the potential lack of toxicity values for detected analytes.

6.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The assessment of potential ecological risks will be performed in accordance with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments,* Interim Final (EPA, 1997) and current EPA guidance documents.

6.1 STEP 1 - PROBLEM FORMULATION

The initial step in the screening level ecological risk assessment (SLERA) process is to formulate the problem. This step develops the CSM for the SLERA and defines the assessment and measurement endpoints.

6.1.1 Installation Description

SEDA is a 10,587-acre former military facility located approximately 40 miles south of Lake Ontario in Seneca County, New York. The major vegetation communities in the vicinity of the four known PFAS sites are three upland cover types: the old field type vegetation (successional old field), shrub vegetation (successional shrubland), and inter-spaced deciduous forests. Old fields and shrub vegetation are comprised of a mixture of herbaceous and shrub plant species with some small trees. Deciduous forests are a secondary cover type that occurs as woodlots and tree rows near the four known PFAS contamination sites. A brief description of predominant plant cover types is presented below.

Successional Old Field. Large areas within SEDA, including those areas adjacent to the four known PFAS contamination sites, are covered with successional old field. This habitat type occurs in areas in which the vegetation and/or soil have been altered by clear-cutting, grading, draining, mowing, or other activities commonly associated with land management practices. The vegetative cover in these areas is limited to herbaceous species common to recently or routinely disturbed areas and includes numerous nuisance exotic and opportunistic species. Most of the opportunistic species compete with the introduced turf and native grass species. Typical species present include goldenrod, chickweed, New England aster, Queen Anne's lace, ragweed, wild strawberry, and dandelion. Some areas are succeeding into shrublands, as indicated by the presence of red-osier, sumac, eastern red cedar sapling, multiflora rose, and serviceberry. This vegetation provides habitat for the white-tailed deer. Other species common to this habitat include eastern cottontail rabbit, numerous songbirds, red fox, and raccoon.

Successional Shrub. This vegetation classification is characterized by a dominance of shrub species and less than 50% cover of canopy trees. This vegetation type is present in some areas near the four known PFAS contamination sites. The species in this community may include red-osier dogwood, staghorn sumac, wild plum, European buckthorn, red raspberry, black cherry, wild rose, and saplings of early successional trees such as black locust and red maple. The groundcover in the successional shrub community is usually dominated by various graminoid species, interspersed with opportunistic forb species. This vegetation community is a suitable habitat for songbirds, especially migrating species. Typical species include cedar waxwing, American robin, brown thrasher, blue jay, mockingbird, European starling, gray catbird, and rufous-sided towhee. Also likely common in this habitat are the white-tailed deer, raccoon, and eastern cottontail rabbit.

Deciduous Forest/Tree Rows. These plant communities develop on formerly wooded sites that have been cleared, graded, logged, or otherwise disturbed, which include some areas near the four known PFAS contamination sites. The canopy is usually composed of fast-growing species that require a significant amount of light. Shade-tolerant trees become established when the canopy becomes dense. This vegetation community is characterized by early and mid-successional native and introduced tree species such as gray birch, black locust, silver maple, and eastern cottonwood. The wildlife species likely associated with this habitat include common white-tailed deer, black-capped chickadee, tufted titmouse, northern cardinal, northern flicker, downy woodpecker, raccoon, opossum, and eastern gray squirrel.

Several surface water bodies throughout SEDA provide aquatic habitat. Some of these surface water bodies are located downgradient of a known PFAS site and will be sampled as part of the RI. Some of the perennial creeks and ponds support populations of small fish (e.g., members of the minnow family) but none of the surface water bodies can support larger fish. Benthic invertebrates can live in the surface water bodies, along with frogs and turtles. The storm drainage system consists of both open and closed systems that discharge into the four watersheds of Indian Creek, Kendaia Creek, Kendig Creek, and Reeder Creek. A system of extensive channels has been excavated, and drains have been built to facilitate surface drainage of most of the depot lands. Specifically, SEAD-25 drainages traverse the SEDA to the west and eventually drain into Kendaia Creek; SEAD-26 drainages traverse into Indian Creek; and SEAD-122D/122E drainage mostly disperses into the surrounding area or infiltrates into the ground.

6.1.2 Site Descriptions

Fire House Building 103 is in a developed area of the installation to the northeast of SEAD-25. The site consists of a building, parking lot, and a maintained lawn. The area surrounding this site is a mixture of maintained grass and pavement. The drainage features near this site contain water intermittently. There is no aquatic habitat associated with this site, and thus no surface water or sediment samples will be collected for the Fire House Building 103 site. Due to the developed nature of this site, the terrestrial habitat is of poor quality. Although birds and small mammals could traverse the site, it is unlikely that site conditions can support viable terrestrial populations due to the developed conditions. For this reason, the ecological evaluation for the Fire House Building 103 site will not proceed beyond the problem formulation of Step 1.

SEAD-25 is in an industrial area of the installation with medium density roadway and building coverage. There are nearby forested and grassland areas, with some minor wetlands and surface drainage features. The site is generally grass-covered with pockets of tree/canopy coverage. The RI will include collection of surface water and sediment samples downgradient of this site. For this reason, SEAD-25 encompasses aquatic habitat for the purposes of the baseline risk assessment.

SEAD-26 is in an industrial area of the installation to the south of SEAD-25. The surrounding areas are mostly grassland, shrub-covered, or lightly forested, with some minor wetlands and surface drainage features. The site is generally grass-covered with a small pond and remnants of historical site structures. Surface water bodies near SEAD-26 provide some aquatic habitat. The small pond; the wetland area surrounding and to the west of the pond; and several nearby drainages will be sampled as part of the risk assessment.

SEAD-122D/122E is located on an old airfield in the southwest corner of the SEDA. The surrounding areas are generally grassland covered with some light shrubbery and forested areas nearby. Indian Creek runs through the airfield, adjacent to some minor wetlands and surface drainage features. The site is generally grass-covered with a concrete runway. The creek and nearby drainage ditches provide aquatic habitat. Indian Creek will not be sampled as part of the risk assessment, but stormwater and ditch soil samples are planned for the drainage systems near the SEAD-122D/122E.

6.1.3 Sensitive Environments

According to the U.S. Fish and Wildlife Service planning tool (U.S. Fish and Wildlife Service, 2022), the monarch butterfly is a candidate for listing as a threatened species and this species is the only potential species of concern known to be in the vicinity of SEDA. However, there are several species that are threatened or endangered within Seneca County, New York, and are potentially present at SEDA. These include the following:

- Mammals
    - Indiana bat (Myotis sodalis) – Endangered
    - Northern long-eared bat (Myotis septentrionalis) – Threatened
- Reptiles
    - Bog turtle (Glyptemys muhlenbergii) – Threatened
- Insects
    - Monarch butterfly (Danaus plexippus) – Candidate
- Flowering Plants
    - Leedy’s roseroot (Rhodiola intergrifolia ssp. leedyi) – Threatened
- Ferns and Allies
    - American hart’s-tongue fern (Asplenium scolopendrium var. americanum) – Threatened

6.1.4 Preliminary Assessment and Measurement Endpoints

Terrestrial plants, invertebrates, and animals could be exposed directly to PFAS in soil within the ecologically active zone (approximately 0 to 2 ft bgs). Terrestrial animals could be exposed indirectly to PFAS in soil via bioaccumulation into the tissues of dietary items (plants, invertebrates, and mammals) and consumption of these items.

The aquatic community (plants, invertebrates, small fish) and amphibians can be exposed directly to PFAS in surface water. In addition, PFAS can bioaccumulate into small fish and amphibians which, in turn, can be consumed by birds, mammals, reptiles, and other amphibians. Similarly, benthic invertebrates can be exposed directly to PFAS in sediment and can bioaccumulate these compounds. Birds, mammals, reptiles, and amphibians can eat the contaminated invertebrates. Due to the lack of toxicity reference values, potential effects to reptiles and amphibians will not be assessed quantitatively. The uncertainty section will include a qualitative evaluation of these organisms.

As described in Section 3, the historical data suggest that PFAS contamination in groundwater is discharging to surface water. The transition zone community is exposed directly to PFAS where contaminated groundwater discharges to surface water. The transition zone community comprises those organisms that live in the sediment beneath a surface water body where the groundwater and surface water meet and mix.

The ecological preliminary assessment and measurement endpoints are summarized in Table 6.1. The following species are selected as surrogates for the bird and mammal populations that could be exposed to PFAS contamination:

- Birds
    - American robin (Turdus migratorius), avian omnivore
    - Song sparrow (Melospiza melodia), avian insectivore
    - Red-tailed hawk (Buteo jamaicensis), avian carnivore
    - Belted kingfisher (Megaceryle alcyon), avian piscivore
- Mammals
    - Deer mouse (Peromyscus maniculatusi), mammalian omnivore
    - Short-tailed shrew (Blarina brevicauda), mammalian insectivore
    - White-tailed deer (Odocoileus virginianus), large mammalian herbivore
    - Red fox (Vulpes vulpes), mammalian carnivore
    - Mink (Neovison vison), mammalian piscivore
    - Raccoon (Procyon lotor), aquatic mammalian omnivore

6.2 STEP 2 - INITIAL SCREENING

The initial screening, also known as Step 2, is a conservative comparison of maximum detections to conservative screening values and, for birds and mammals, comparison of average daily doses calculated through food web modeling to no observed adverse effects levels (NOAEL). If there

are food-web-based screening values, these will be used in place of food web modeling during Step 2.

Each site and associated surface water body will be evaluated as a separate exposure area. As described for the HHRA, the SLERA will use the RI data to evaluate potential risks posed by surface water and groundwater contaminants and will evaluate the uncertainty associated with not pooling the RI and historical data.

Maximum detections will be compared to screening values protective of the different communities that are exposed via direct contact. In addition, maximum detections will be used to estimate exposure of birds and mammals via the food web. The resulting doses will be compared to NOAELs. In accordance with the US Department of Defense Manual: Defense Environmental Restoration Program (DERP) Management, the SLERA will not quantify exposure to naturally occurring substances present at concentrations unaffected by current or past site activities. If a site-related contaminant is present at concentrations greater than the ecological screening value or results in a food web dose greater than the NOAEL, it will be identified as a site-related chemical of potential ecological concern (COPEC) and will be quantitatively evaluated in the SLERA. If a background constituent (non-site-related constituent) is present at concentrations greater than the ecological screening value or results in a food web dose greater than the NOAEL, it will be identified as a non-site-related COPEC and will be considered qualitatively and separate from site-related COPECs in Step 3A of the SLERA. Analytes with maximum detections less than or equal to screening values or daily doses less than or equal to NOAELs will not be identified as COPECs.

The subsections below describe the sources of ecological screening values and how the food web modeling will be completed.

6.2.1 Ecological Benchmarks

There are a limited number of ecological screening values available for PFAS. The primary source of benchmarks will be *Derivation of PFAS Ecological Screening Values* (Grippo, et al, 2021). This document presents screening values for exposure of terrestrial plants, soil invertebrates, terrestrial birds, terrestrial mammals, the aquatic community, aquatic birds, and aquatic mammals to eight PFASs. Not all eight PFASs have screening values for each type of receptor. The aquatic community ecological screening values will be used to evaluate the potential effects of contaminated groundwater on the transition zone community.

NYSDEC developed a chronic surface water quality standard of 160 parts per billion for exposure of freshwater aquatic life to perfluorooctane sulfonate. Because this screening value is greater than that listed in Grippo, et al (2021), the latter screening value will be used in the SLERA.

Grippo, et al (2021) does not include screening values for sediment nor does it include screening values for all PFASs on the analyte list. For the draft SLERA, HGL will conduct a literature search to identify other sources of PFAS screening values (e.g., Texas Commission on Environmental Quality ecological screening values).

6.2.2 Food Web Modeling

As noted above, Grippo, et al (2021) contains some screening values for birds and mammals. As appropriate, these screening values will be used in place of food web modeling for the applicable compounds. For aquatic birds and mammals that are exposed to both surface water (via fish consumption) and sediment (via benthic invertebrate consumption), the food web screening values listed in Grippo, et al (2021) will not be used. Instead, food web modeling will be performed to account for contributions to the average daily dose from both surface water and sediment. In addition, food web modeling will be conducted for PFASs that lack food web-based screening values.

Although wildlife receptors may be exposed to chemicals via dermal contact and inhalation, there is minimal exposure and toxicity information available for these exposure routes. Therefore, the estimation of chemical intake will consider only the ingestion route. The ingestion route includes direct ingestion of the contaminated medium (i.e., incidental consumption of sediment or soil; ingestion of surface water) and the ingestion of chemicals accumulated in the tissue of the wildlife receptor's diet (plants, soil invertebrates, small mammals, benthic invertebrates, and/or fish). Table 6.2 identifies the exposure assumptions (food ingestion rate, dietary components, etc.) that will be used to estimate the average daily dose for each surrogate species. For this initial food web analysis, no area use factor will be applied, all chemicals will be assumed to be 100% bioavailable, and maximum ingestion rates will be used. The equation used to estimate chemical intake is presented below.

$$E_j = \left[\sum_{i=1}^{N} B_{ij} \times P_i \times FIR \right] + S_{IR} \text{ x FIR x Cs} + W_{IR} \text{ x Cw}$$

Where:

	E_j	=	daily dose (mg/kg-body weight/day)
	FIR	=	species-specific food ingestion rate (kilogram [kg]-dry weight food/kg body weight/day)
	B_{ij}	=	concentration of chemical (j) in biota type (i) (mg/kg-dry weight food)
	P_i	=	proportion of biota type (i) in diet
	S_{IR}	=	soil or sediment ingestion rate as a fraction of the food ingestion rate
	W_{IR}	=	water ingestion rate (liters/kg-body weight/day)
	Cs	=	concentration in soil or sediment (mg/kg)
	Cw	=	concentration in surface water (milligram per liter)

The planned RI does not include collecting plant, soil invertebrate, benthic invertebrate, small mammals, or fish samples for PFAS analysis. For this reason, it will be necessary to estimate the tissue concentrations of the various dietary items. HGL will conduct a literature search to identify appropriate biota transfer factors for estimating tissue concentrations. Similarly, HGL will conduct a literature search to identify NOAELs. To the extent available, HGL will obtain biota transfer factors and toxicity reference values from Grippo, et al (2021).

6.3 STEP 3A - REFINED ECOLOGICAL RISK ASSESSMENT

Because of the conservatism inherent in the initial screening against benchmark values, further evaluation of the site-related will be conducted as described below. The intent of this additional evaluation is to provide a more realistic evaluation of potential risks. The analytical data will be evaluated to assess the spatial extent to which the dataset exceeds the benchmarks and the potential magnitude of impacts to the overall community. All non-site-related COPECs will be evaluated qualitatively and separately from the site-related COPECs.

For site-related terrestrial plant, soil invertebrate, aquatic community, and benthic invertebrate community COPECs that have more than five detections, the 95% UCL of the mean concentration will be compared to the screening values. Regardless of the number of detections, the spatial distribution of the site-related COPECs will be evaluated to assess the distribution of screening value exceedances throughout the site.

For wildlife receptors, daily doses of site-related COPECs will be estimated using 95% UCLs, mean ingestion rates, and area use factors. In addition, daily doses of site-related COPECs will be compared to lowest observed adverse effects levels in addition to NOAELs. The results of these analyses will be evaluated to assess whether a particular site-related chemical presents a risk to the overall target community.

6.4 UNCERTAINTY ASSESSMENT

To be consistent with the HHRA, the SLERA will include a discussion of the uncertainties associated with the risk assessment process, including uncertainties resulting from chemical analysis and the associated analytical suite. The SLERA will evaluate the uncertainty associated with sampling only the top 6 inches of soil and not collecting data for the 0.5 to 1 ft bgs interval, and the lack of toxicity reference values and biota transfer factors for PFASs. In addition, the SLERA will assess the uncertainty associated with evaluating only the most recent surface water and groundwater data instead of pooling the historical data with the RI data.

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TABLES

Table 6.1
Ecological Preliminary Assessment and Measurement Endpoints
SEAD-25, SEAD-26, SEAD-122D/122E, and Fire House Bldg. 103
Seneca Army Depot Activity, Seneca County, New York

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Terrestrial Receptors			
Growth, survival, and reproduction of soil invertebrate communities.	Soil invertebrates promote development of a well-conditioned soil to support plant growth. Invertebrates are also an important food source for upper trophic level receptors.	Comparison of maximum detected concentrations in the top 2 feet of soil to benchmarks. For chemicals with concentrations greater than benchmarks, evaluation of chemical distribution and comparison of 95 percent upper confidence limits (UCLs) to benchmarks.	Soil Invertebrates (earthworms)
Growth, survival, and reproduction of terrestrial plant communities.	Plants provide food and habitat for a multitude of wildlife receptors.	Comparison of maximum detected concentrations in the top 2 feet of soil to benchmarks. For chemicals with concentrations greater than benchmarks, evaluation of chemical distribution and comparison of 95 percent UCLs to benchmarks.	Terrestrial plants
Growth, survival, and reproduction of terrestrial omnivores (avian and mammalian).	Terrestrial omnivores consume plant matter and invertebrates, and serve as prey species for upper trophic level receptors.	Calculation of maximum chemical intakes and comparison to no observed adverse effects levels (NOAELs). For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and lowest observed adverse effects levels (LOAELs).	American robin (bird) Deer mouse (mammal)
Growth, survival, and reproduction of terrestrial insectivores (avian and mammalian).	Terrestrial insectivores forage on invertebrates and serve as prey species for upper trophic level receptors. They often have the greatest exposure to bioaccumulative chemicals.	Calculation of maximum chemical intakes and comparison to NOAELs. For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and LOAELs.	Song sparrow (bird) Short-tailed shrew (mammal)
Growth, survival, and reproduction of terrestrial carnivores (avian and mammalian).	Terrestrial carnivores consume small birds and small mammals, thereby ensuring balance in the ecosystem. These receptors may be particularly vulnerable to compounds that bioaccumulate.	Calculation of maximum chemical intakes and comparison to NOAELs. For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and LOAELs.	Red-tailed hawk (bird) Red fox (mammal)
Growth, survival, and reproduction of large mammalian herbivores.	Large mammalian herbivores feed on plants and serve as prey species for large carnivores.	Calculation of maximum chemical intakes and comparison to NOAELs. For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and LOAELs.	White-tailed deer
Aquatic Receptors			
Growth, survival, and reproduction of benthic invertebrate community.	Benthic invertebrates recycle nutrients and condition the sediment. They are also important prey species for upper trophic level receptors.	Comparison of maximum detected concentrations of sediment in each surface water body to benchmarks. For chemicals with concentrations greater than benchmarks, evaluation of chemical distribution and comparison of 95 percent UCLs to benchmarks.	Benthic invertebrate Community
Growth, survival, and reproduction of transition zone community.	The transition zone is where potentially contaminated groundwater mixes with surface water. Areas of groundwater discharge can support spawning, feeding, and nursing habitats. Benthic and epibenthic organisms can live in these zones, and fish can find refuge in groundwater discharge areas.	Comparison of maximum detected concentrations in groundwater to aquatic benchmarks. For chemicals with concentrations greater than benchmarks, evaluation of chemical distribution and comparison of 95 percent UCLs to benchmarks.	Transition zone community
Growth, survival, and reproduction of aquatic community.	The aquatic community includes aquatic plants, aquatic invertebrates, and fish. These organisms provide food for upper trophic level receptors.	Comparison of maximum detected concentrations in each surface water body to aquatic benchmarks. For chemicals with concentrations greater than benchmarks, evaluation of chemical distribution and comparison of 95 percent UCLs to benchmarks.	Aquatic community
Growth, survival, and reproduction of aquatic omnivores (mammalian).	Aquatic omnivores consume a mixture of fish, benthic invertebrates, plants, small mammals, and terrestrial invertebrates. These animals provide balance in the aquatic ecosystem and are consumed by larger predators.	Calculation of maximum chemical intakes and comparison to NOAELs. For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and LOAELs.	Raccoon
Growth, survival, and reproduction of piscivores (avian and mammalian).	Piscivores consume fish and some types of benthic invertebrates, thereby providing balance for the aquatic ecosystem. These receptors may be particularly vulnerable to bioaccumulative chemicals.	Calculation of maximum chemical intakes and comparison to NOAELs. For chemicals with NOAEL hazard quotient greater than 1, calculation of central tendency intakes and comparison to NOAELs and LOAELs.	Belted kingfisher (bird) Mink (mammal)

Table 6.2
Exposure Parameters for Upper Trophic Level Ecological Receptors
Four Known PFAS Contamination Sites, Seneca Army Depot Activity
Seneca County, New York

Receptor	Food Ingestion Rate (g/g-day) (wet weight or dry weight specified below)		Soil/Sediment Ingestion Rate (as Fraction of Food Ingestion Rate)		Water Ingestion Rate (g/g-day)		Dietary Composition (percent)						Foraging Area	
	Value	Comment	Value	Comment	Value	Comment	Terrestrial Plants	Soil Invertebrates	Small Mammals	Benthic Invertebrates	Fish	Comment	Value	Comment
Birds														
American robin	1.96 (maximum) 1.52 (mean)	Wet weight; maximum and mean values for free-living birds in Kansas (Hazelton, et al, 1984 as cited in EPA, 1993)	10.4%	No value in EPA (1993); proposed value based on that for the American woodcock in Table 4-4 of EPA (1993).	0.14	Estimated mean value provided in EPA (1993).	63	37	0	0	0	Average seasonal percentage, adult, eastern United States (Wheelwright, 1986, as cited in EPA, 1993).	0.81 hectares	Adults in summer feeding fledglings (Weatherhead and McRae, 1990, as cited in EPA, 1993).
Song sparrow	0.25	Dry weight; calculated from average weight of 21.3 grams (Bent, 1968) and using equation 3-4 in EPA (1993).	6.1%	Soil ingestion rate: 6.1%, assumed equal to 50th percentile for ground gleaning bird (dove) (EPA 2007, Attachment 4-1, Table 3).	0.21	Calculated from average body weight of 21.3 grams (Bent, 1968) using equation 3-15 in EPA (1993).	25	75	0	0	0	Per California Wildlife Habitat Relationships System, insects comprise approximately 50% of the song sparrow diet during nesting season. A higher percentage is assumed here because the song sparrow represents insectivores and to match prior ecological risk assessments for SEDA.	0.6 hectares	Winter home range in New York (California Wildlife Habitat Relationships System).
Red-tailed Hawk	0.0353 (maximum) 0.026 (mean)	Dry weight; maximum value is that used in calculation of ecological soil screening levels; mean value is the average of the mean ingestion rates listed in Table 1, Attachment 4-1, EPA, 2007	2.6%	Mean soil ingestion rate, Table 3, Attachment 4-1, EPA (2007)	0.057	Average of estimated values in EPA (1993).	0	0	100	0	0	Represents carnivorous bird.	60 hectares	Low end of mean range (Fitch, et al, 1946, as cited in EPA, 1993).
Belted kingfisher	0.5	Wet weight; adults, Alexander, 1977 as cited in EPA (1993).	2.0%	Low end of values listed in Table 4-4, EPA, 1993	0.11	Estimated value provided in EPA (1993).	0	0	0	41	59	Michigan trout stream study by Salyer and Lagler (1946) as cited in EPA (1993).	1.03 kilometers of shoreline	Middle of the range of mean values listed in EPA (1993).
Mammals														
Deer mouse	0.45 (maximum) 0.22 (mean)	Wet weight; maximum is lactating adult female (Millar, 1979) and mean is adult male (Cronin and Bradley, 1988) as cited in EPA (1993).	2.0%	Value for white-footed mouse, Table 4-4, EPA (1993).	0.19	Adult males and females, Ross (1930) and Dice (1922), as cited in EPA (1993).	50	50	0	0	0	Species reported as an opportunistic omnivore with substantial regional and seasonal variation in its diet (EPA 1997).	0.061 hectares	Breeding female, mixed deciduous forest in Virginia (Wolff, 1985, as cited in EPA, 1993).
Short-tailed shrew	0.209 (maximum) 0.17 (mean)	Dry weight; maximum value is that used in calculation of ecological soil screening levels; mean value is the average of the mean ingestion rates listed in Table 1, Attachment 4-1, EPA, 2007	3.0%	90th percentile, Table 3, Attachment 4-1, EPA (2007).	0.223	Chew (1951) as cited in EPA (1993).	0	100	0	0	0	Represents insectivorous mammal.	0.39 hectares	Mean value identified in EPA 1993
White-tailed deer	0.031	Wet weight; food consumption rate of 1.74 kg/day divided by mean body weight of 56.5 kg, Sample and Suter (1994).	2.0%	Sample and Suter (1994)	0.006549	3.7 liters per day normalized to body weight using mean of 56.5 kilograms (Sample and Suter, 1994)	100	0	0	0	0	Represents herbivores.	59 hectares	Low end of range listed in Sample and Suter (1994).
Red fox	0.16	Wet weight; mean ingestion rate, juvenile, 5-8 weeks old, North Dakota, Sargeant, 1978, as cited in EPA (1993)	2.8%	Table 4-4, EPA, 1993	0.086	Estimated value, EPA, 1993	5	4	91	0	0	Average seasonal percentages, Missouri (Korschgen, 1959, as cited in EPA, 1993).	96 hectares	Adult female, all year, diverse habitat in Wisconsin (Ables, 1959, as cited in EPA, 1993).
Raccoon	0.17	Dry weight, calculated with equation 3-7 in EPA, 1993 and body weight of 6.7 kilograms (average adult weight, Sanderson, 1984 as cited in EPA, 1993).	9.4%	Table 4-4, EPA, 1993	0.083	Estimated value, EPA, 1993	0	40	7	42	9	Spring, Maryland/forested bottomland, Llewellyn and Uhler, 1952, as cited in EPA, 1993.	108 hectares	Adult female, May - December, Michigan/riparian, Stuewer, 1943, as cited in EPA, 1993.
Mink	0.22	Wet weight; estimated year-round rate for adult male, EPA (1993).	2.0%	Recommended value listed in USCHPPM (2004).	0.099	Estimated value for adult male, EPA (1993).	0	0	6	7	85	Michigan, river, year-round, Alexander (1977) as cited in EPA (1993).	1.23 kilometers shoreline	Juvenile male, Gerell, 1970 as cited in EPA, 1993.

Notes:

To convert wet weight to dry weight, assumed water contents of terrestrial diet components are: 85% plants, 84% earthworms, and 68% small mammals (Attachment 4-1, USEPA, 2003).

To convert wet weight to dry weight, assumed water contents of aquatic diet components are 75% fish and 78% benthic invertebrates. Table 4-1 of EPA (1993).

EPA = United States Environmental Protection Agency.

g/g-day = grams per gram a day.

% = percent.

USCHPPM = U.S. Army Center for Health Promotion and Preventative Medicine

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ATTACHMENT 1

RAGS PART D TABLES

Table 1
Selection of Exposure Pathways
SEAD-25, SEAD-26, SEAD-122D/122E, and Fire House Building 103
Seneca Army Depot Activity, Seneca County, New York

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Soil	Soil	Direct contact with surface soil at the individual sites	Outdoor Worker	Adult	Ingestion and Dermal Contact	Quant.	An outdoor worker could be exposed to surface soil under current and future site conditions.
				Hunter, Recreator, and Site Visitor/Trespasser	Adult and Adolescent	Ingestion and Dermal Contact	Quant.	Hunters, recreators, and site visitors/trespassers could be exposed to site surface soil under current and future site conditions.
				Indoor Worker (Building 103 only)	Adult	Ingestion and Dermal Contact	None	Indoor workers experience minimal exposure to soil in comparison to the outdoor worker. Thus, potential risks posed by Site-related PFAS contamination to the indoor worker will be less than those estimated for the outdoor worker.
		Wild Game/Deer	Hunting on SEDA	Wild Game/Deer Consumer	Adult and Child	Ingestion	Quant.	Deer are harvested annually to manage the deer population on SEDA. Deer could have foraged in areas of PFAS-contaminated soil. Exposure will be estimated through deer tissue data.
		Outdoor Air	Fugitive dust emissions from surface soil at the individual sites	Outdoor Worker	Adult	Inhalation	Quant.	Outdoor workers could inhale fugitive dust emissions during routine maintenance work at each site.
				Hunter, Recreator, and Site Visitor/Trespasser	Adult and Adolescent	Inhalation	Quant.	Hunters, recreators, and site visitors/trespassers could be exposed to fugitive dust emissions under current and future site conditions.
				Indoor Worker (Building 103 only)	Adult	Inhalation	None	Indoor workers experience minimal exposure to fugitive dust emissions as compared to the outdoor worker. Thus, potential risks posed by Site-related PFAS contamination to the indoor worker will be less than those estimated for the outdoor worker.
	Surface Water/ Sediment	Surface Water/ Sediment	Direct contact with surface water and sediment	Outdoor Worker	Adult	Ingestion and Dermal Contact	Quant.	An outdoor worker could be exposed to site surface water or sediment during maintenance activities in the surface water bodies.
				Hunter, Recreator, and Site Visitor/Trespasser	Adult and Adolescent	Ingestion and Dermal Contact	Quant.	Hunters, recreators, and site visitors/trespassers could be exposed to surface water and sediment while traversing the installation. Each surface water body will be evaluated as a separate exposure area.
				Indoor Worker (Building 103 only)	Adult	Ingestion and Dermal Contact	None	It is unlikely that an indoor worker would be exposed to surface water bodies.
		Fish	Fishing on SEDA	Fish consumer	Adult and Child	Ingestion	None	The surface water bodies on SEDA are small and do not support sport fish. For this reason, potential fish consumption is an incomplete exposure route.
		Wild Game/Deer	Hunting on SEDA	Wild Game/Deer Consumer	Adult and Child	Ingestion	Quant.	Deer are harvested annually to manage the deer population on SEDA. Deer could obtain water from PFAS-contaminated streams. Exposure will be estimated through deer tissue data.
		Outdoor Air	Fugitive dust emissions from sediment	All Receptors	All	Inhalation	None	Sediment is typically too saturated to generate fugitive dust.

Table 1
Selection of Exposure Pathways
SEAD-25, SEAD-26, SEAD-122D/122E, and Fire House Building 103
Seneca Army Depot Activity, Seneca County, New York

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Groundwater	Groundwater	Use of site groundwater as potable water	Outdoor Worker	Adult	Ingestion and Dermal Contact	Quant. (future only)	Currently, SEDA groundwater is not used for any purpose. If a supply well is installed in the future, the outdoor worker could use the water for ingestion and washing.
				Hunter, Recreator, and Site Visitor/Trespasser	Adult and Adolescent	Ingestion and Dermal Contact	None	Currently, there is no complete exposure route to SEDA groundwater. If a supply well is installed in the future, it is expected that a hunter, recreator, and site visitor/trespasser would consume minimal groundwater and thus experience negligible exposure.
				Indoor Worker (Building 103 only)	Adult	Ingestion and Dermal Contact	None	Similar to the outdoor worker, the indoor worker could use a future supply well for drinking water and washing. Because the indoor worker would have similar exposure to groundwater as the outdoor worker, the potential risks to the indoor worker will not be separately estimated.
		Air	Indoor air (vapor intrusion)	Indoor Worker (Building 103 only)	Adult	Inhalation	Quant. or Qual	The indoor worker could be exposed to volatile PFAS compounds in indoor air via the vapor intrusion exposure pathway. If information is available to support a quantitative evaluation, potential risks will be quantified. Otherwise, this exposure pathway will be evaluated qualitatively.
Future	Soil	Soil	Direct contact with soil at the individual sites (surface soil for the resident and farmer; surface soil and subsurface soil for the construction worker)	Resident	Adult and Child	Ingestion and Dermal Contact	Quant.	Potential risks to a hypothetical resident will be estimated to assess unrestricted use/unlimited exposure scenarios. A future resident could contact site soil.
				Farmer	Adult	Ingestion and Dermal Contact	None	None of the PFAS-contaminated sites are currently used for farming. SEAD-25 is the only site that may be used for farming in the future; however, this scenario is for hay/pasture farming to support local livestock and would not include tilling activities. Therefore, the exposure route is determined to be negligible.
				Construction Worker	Adult	Ingestion and Dermal Contact	Quant.	A construction worker could be exposed to site soil as part of a future construction project.
		Outdoor Air	Fugitive dust emissions from soil (surface soil for resident and farmer; surface soil and subsurface soil for construction worker)	Resident	Adult and Child	Inhalation	Quant.	Potential risks to a hypothetical resident will be estimated to assess unrestricted use/unlimited exposure scenarios.
				Farmer	Adult	Inhalation	None	None of the PFAS-contaminated sites is currently used for farming. SEAD-25 is the only site that may be used for farming in the future; however, this scenario is for hay/pasture farming to support local livestock and would not include tilling activities. Therefore, the exposure route is determined to be negligible.
				Construction Worker	Adult	Inhalation	Quant.	A construction worker could be exposed to fugitive dust from soil as part of a future construction project.

Table 1
Selection of Exposure Pathways
SEAD-25, SEAD-26, SEAD-122D/122E, and Fire House Building 103
Seneca Army Depot Activity, Seneca County, New York

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (continued)	Surface Water/ Sediment	Surface Water/ Sediment	Direct contact with surface water and sediment	Resident	Adult and Child (2 to 6 years)	Ingestion and Dermal Contact	Quant.	Given the distance between the sites and nearest surface water body, it is unlikely that a resident would spend much time contacting surface water or sediment. However, the cumulative exposure of the future resident to soil, sediment, and surface water will be evaluated.
				Farmer	Adult	Ingestion and Dermal Contact	None	It is unlikely that a farmer would contact site surface water and sediment during potential future haying or livestock management activities.
				Construction Worker	Adult	Ingestion and Dermal Contact	None	It is unlikely that a construction project would occur in a surface water body.
	Groundwater	Groundwater	Use of site groundwater as potable water	Resident	Child and Lifetime	Ingestion and Dermal Contact	Quant.	A hypothetical resident could use groundwater as a potable water source.
				Farmer	Adult	Ingestion and Dermal Contact	None	It is unlikely that a farmer would consume substantial amounts of groundwater if a supply well were installed.
				Construction Worker	Adult	Ingestion and Dermal Contact	None	It is unlikely that a construction worker would consume substantial amounts of groundwater if a supply well were installed. At some sites, the groundwater is shallow enough to intersect a future excavation. The construction area is assumed to be dewatered, which would ensure the ingestion and dermal exposure pathway of the construction worker is negligible.
		Air	Inhalation of volatiles from potable water use	Resident	Child and Lifetime	Inhalation	Quant. or Qual	The resident could be exposed to volatile PFAS compounds during potable water use. If information is available to support a quantitative evaluation, potential risks will be quantified. Otherwise, this exposure pathway will be evaluated qualitatively.
			Indoor air (vapor intrusion)	Resident	Child and Lifetime	Inhalation	Quant. or Qual	The resident could be exposed to volatile PFAS compounds in indoor air via the vapor intrusion exposure pathway. If information is available to support a quantitative evaluation, potential risks will be quantified. Otherwise, this exposure pathway will be evaluated qualitatively.

Notes:

- For the outdoor worker, hunter, site visitor/trespasser, and recreator, surface soil concentrations will be represented by data for samples collected from 2 feet below ground surface.

- For the resident, two soil scenarios will be evaluated. For the first, data for samples from 0 to 0.5 feet bgs will be used to represent surface soil conditions. For the second, data for samples collected from 0.5 to 2 ft bgs will be used to represent subsurface soil conditions.

- The construction worker is assumed to be exposed to soil ranging in depth from 0 to 2 ft bgs.

Table 4.1
Values Used for Daily Intake Calculations, Soil via Ingestion/Dermal Contact
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child (0-6 years)	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		Average daily dose (ADD_{ing}) or lifetime ADD_{ing} ($LADD_{ing}$) (mg/kg-day) = $\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{soil}	Soil ingestion rate	200	mg/day	EPA (2014)	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	6	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				BW	Body weight	15	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
		Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{soil}	Soil ingestion rate	100	mg/day	EPA (2014)	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	20	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight	80	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
	Outdoor Worker	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{soil}	Soil ingestion rate	100	mg/day	EPA (2014)	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	225	days/year	EPA (2014)	
				ED	Exposure duration	25	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	

Table 4.1
Values Used for Daily Intake Calculations, Soil via Ingestion/Dermal Contact
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Outdoor Worker	Adult	Site soil	AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Construction Worker	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				IR_{soil}	Soil ingestion rate	330	mg/day	EPA (2002)	ADD_{ing} or $LADD_{ing}$ (mg/kg-day) =
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	$\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				EF	Exposure frequency	250	days/year	EPA (1991)	
				ED	Exposure duration	1	years	EPA (2002)	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	365	days	EPA (2002)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				IR_{soil}	Soil ingestion rate	100	mg/day	EPA (2014)	ADD_{ing} or $LADD_{ing}$ (mg/kg-day) =
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	$\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	9	years	[2]	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight	54.5	kg	[3]	
				AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				IR_{soil}	Soil ingestion rate	100	mg/day	EPA (2014)	ADD_{ing} or $LADD_{ing}$ (mg/kg-day) =
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	$\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	[4]	
				CF	Conversion factor	1E-06	kg/mg	--	

Table 4.1
Values Used for Daily Intake Calculations, Soil via Ingestion/Dermal Contact
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreator/ Trespasser/ Visitor/Hunter	Adult	Site soil	BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
Dermal	Resident	Child (0-6 years)	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		Dermally absorbed dose (DAD) or lifetime DAD (LDAD) (mg/kg-day) = $\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				CF	Conversion factor	1E-06	kg/mg	--	
				AF	Adherence factor	0.2	mg/cm^2	EPA (2014)	
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	6	years	EPA (2014)	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				SA	Skin surface area	2,373	cm^2/day	EPA (2014)	
				BW	Body weight	15	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
		Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		DAD or LDAD (mg/kg-day) = $\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				CF	Conversion factor	1E-06	kg/mg	--	
				AF	Adherence factor (child)	0.07	mg/cm^2	EPA (2014)	
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	20	years	EPA (2014)	
				SA	Skin surface area	6,032	cm^2/day	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	

Table 4.1
Values Used for Daily Intake Calculations, Soil via Ingestion/Dermal Contact
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Outdoor Worker	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD or LDAD (mg/kg-day) =
				AF	Adherence factor	0.12	mg/cm^2	EPA (2014)	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	225	days/year	EPA (2014)	
				ED	Exposure duration	25	years	EPA (2014)	
				SA	Skin surface area	3,527	cm^2/day	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Construction Worker	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD or LDAD (mg/kg-day) =
				AF	Adherence factor	0.3	mg/cm^2	EPA (2002)	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	250	days/year	EPA (1991)	
				ED	Exposure duration	1	year	EPA (2002)	
				SA	Skin surface area	3,527	cm^2/day	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	365	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Site soil	EPC_{soil}	Chemical concentration in surface soil	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD or LDAD (mg/kg-day) =
				AF	Adherence factor	0.04	mg/cm^2	EPA (2011)	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	9	years	[2]	
				SA	Skin surface area	10,200	cm^2/day	[5]	
				BW	Body weight	54.5	kg	[3]	

Table 4.1
Values Used for Daily Intake Calculations, Soil via Ingestion/Dermal Contact
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Site soil	AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Site soil	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD or LDAD (mg/kg-day) =
				AF	Adherence factor	0.07	mg/cm^2	[6]	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				ABS_d	Dermal absorption factor	chem. specific	--	--	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	[4]	
				SA	Skin surface area	6,032	cm^2/day	[6]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Notes:

[1] Twice per month throughout the year.

[2] Adolescent assumed to be 9-18 years.

[3] Weighted average body weight for children aged 9-18 years, Table 8-1, EPA 2008.

[4] Resident exposure duration; receptor assumed to be a nearby, offsite resident.

[5] Average of head, hands, arms, legs, and feet; age 9-18 years. Table 7-2, EPA, 2008.

[6] Same adherence factor and skin surface area as for adult resident.

Sources:

EPA (1989). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002, December.

EPA (2002). Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Emergency and Remedial Response. Washington, DC. OSWER 9355.4-24. December 2002.

EPA (2008). Child-Specific Exposure Factors Handbook (Final Report).

EPA (2011). Exposure Factors Handbook: 2011 Edition. Office of Research and Development. Washington, DC. EPA/600/R-090/052F. September 2011.

EPA (2014). Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Response. Washington, DC. OSWER 9200.1-12

Table 4.2
Values Used for Daily Intake Calculations, Soil via Inhalation
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child (0-6 years)	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		Exposure concentration (EC) or lifetime exposure concentration (EC_{life}) (mg/m^3) = $\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$ Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				PEF	Particulate emission factor	1.36E+09	m^3/kg	EPA (2002)	
				ET	Exposure time	24	hours/day	EPA (2014)	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	6	years	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	613,200	hours	EPA (2009)	
				AT-n	Averaging time (noncancer endpoint)	52,560	hours	EPA (2009)	
		Adult	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		EC or EC_{life} (mg/m^3) = $\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$
				PEF	Particulate emission factor	1.36E+09	m^3/kg	EPA (2002)	
				ET	Exposure time	24	hours/day	EPA (2014)	
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	20	years	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	613,200	hours	EPA (2009)	
				AT-n	Averaging time (noncancer endpoint)	175,200	hours	EPA (2009)	
	Outdoor Worker	Adult	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in surface soil	TBD	mg/kg		EC or EC_{life} (mg/m^3) = $\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$
				PEF	Particulate emission factor	1.36E+09	m^3/kg	EPA (2002)	
				ET	Exposure time	8	hours/day	EPA (2014)	
				EF	Exposure frequency	225	days/year	EPA (2014)	
				ED	Exposure duration	25	years	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	219,000	hours	EPA (2009)	
				AT-c	Averaging time (cancer endpoint)	613,200	hours	EPA (2009)	
	Construction Worker	Adult	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		EC or EC_{life} (mg/m^3) = $\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$
				PEF	Particulate emission factor	Site-specific	m^3/kg	To be calculated per EPA (2002)	
				ET	Exposure time	8	hours/day	EPA (2014)	

Table 4.2
Values Used for Daily Intake Calculations, Soil via Inhalation
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: Current/future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Particulates/ Fugative Dust	EF	Exposure frequency	250	days/year	EPA (2014)	AT
				ED	Exposure duration	1	years	EPA (2002)	
				AT-n	Averaging time (noncancer endpoint)	8,760	days	EPA (2009)	
				AT-c	Averaging time (cancer endpoint)	613,200	days	EPA (2009)	
	Recreator/ Trespasser/Visitor	Adolescent (9-18 years)	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				PEF	Particulate emission factor	1.36E+09	m^3/kg	EPA (2002)	EC or EC_{life} (mg/m^3) =
				ET	Exposure time	4	hours/day	[1]	$\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	9	years	[3]	
				AT-n	Averaging time (noncancer endpoint)	78,840	days	EPA (2009)	
				AT-c	Averaging time (cancer endpoint)	613,200	days	EPA (2009)	
	Recreator/ Trespasser/Visitor/Hunter	Adult	Particulates/ Fugative Dust	EPC_{soil}	Chemical concentration in soil	TBD	mg/kg		
				PEF	Particulate emission factor	1.36E+09	m^3/kg	EPA (2002)	EC or EC_{life} (mg/m^3) =
				ET	Exposure time	4	hours/day	[1]	$\frac{EPC_{soil} \times (1/PEF) \times ET \times EF \times ED}{AT}$
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	20	years	[4]	
				AT-n	Averaging time (noncancer endpoint)	175,200	days	EPA (2009)	
				AT-c	Averaging time (cancer endpoint)	613,200	days	EPA (2009)	

Notes:
[1] Professional judgement, receptor assumed to spend 4 hours at the site per visit.
[2] Twice per month throughout the year.
[3] Receptor assumed to be 9-18 years.
[4] Resident exposure duration; receptor assumed to be a nearby, offsite resident.
Sources:
EPA (2002). Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Emergency and Remedial Response. Washington, DC. OSWER 9355.4-24. December 2002.
EPA (2009), Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). EPA-540-R-070-002, OSWER 9285.7-82, January.
EPA (2014). Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Response. Washington, DC. OSWER 9200.1-120. February 6, 2014.

Table 4.3
Values Used for Daily Intake Calculations, Groundwater
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: future
Medium: groundwater
Exposure Medium: potable water supply

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child (0-6 years)	Tapwater	EPC_{gw}	Chemical concentration in groundwater	TBD	mg/L		Average daily dose (ADD_{ing}) or lifetime ADD_{ing} ($LADD_{ing}$) (mg/kg-day) =
				IR_{water}	Water ingestion rate	0.78	L/day	EPA (2014)	$\frac{EPC_{gw} \times IR_{water} \times EF \times ED}{BW \times AT}$
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	6	years	EPA (2014)	
				BW	Body weight	15	kg	EPA (2014)	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
		Adult	Tapwater	EPC_{gw}	Chemical concentration in groundwater	TBD	mg/L		ADD_{ing} or $LADD_{ing}$ =
				IR_{water}	Water ingestion rate	2.5	L/day	EPA (2014)	$\frac{EPC_{gw} \times IR_{water} \times EF \times ED}{BW \times AT}$
				EF	Exposure frequency	350	days/year	EPA (2014)	
				ED	Exposure duration	20	years	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
	Outdoor Worker	Adult	Tapwater	EPC_{gw}	Chemical concentration in groundwater	TBD	µg/L		
				IR_{water}	Water ingestion rate	1.25	L/day	[1]	ADD_{ing} or $LADD_{ing}$ =
				EF	Exposure frequency	225	days/year	EPA (2014)	$\frac{EPC_{gw} \times IR_{water} \times EF \times ED}{BW \times AT}$
				ED	Exposure duration	25	years	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	
Dermal Uptake	Resident	Child (0-6 years)	Potable water	Cw	Chemical Concentration in Water	TBD	mg/L		
				CF	Conversion Factor	0.001	L/cm^3		ADD_{derm} or $LADD_{derm}$ =
				SA	Skin Surface Area	6,365	cm^2/event	EPA (2014)	Devent x SA x ED x EF/(BW x AT)
				Devent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	EPA (2004)	
				tevent	Exposure time	0.54	hours/event	EPA (2014)	If tevent < or = t*, then
				EF	Exposure Frequency	350	events/year	EPA (2014)	$Devent = 2 \times FA \times Kp \times Cw \times CF \times (6 \times tau_{event} \times tevent \times 1/pi)^{1/2}$
				ED	Exposure Duration	6	years	EPA (2014)	
				FA	Fraction absorbed	chemical specific	unitless	[2]	
				Kp	Permeability Coefficient	chemical specific	cm/hr	[2]	If tevent > t*, then

Table 4.3
Values Used for Daily Intake Calculations, Groundwater
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: future
Medium: groundwater
Exposure Medium: potable water supply

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal Uptake	Resident	Child (0-6 years)	Potable water	tau_{event}	Lag time per event	chemical specific	hr/event	[2]	Devent = FA x Kp x CF x Cw x {tevent/(1+B) + 2 x tau_{event} x $[1+3B+3B^2/(1+B)^2]$}
				B	Dimensionless constant	chemical specific	unitless	[2]	
				t*	Time to reach steady-state	chemical specific	hrs	[2]	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				BW	Body Weight	80	kg	EPA (2014)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-N	Averaging Time (Non-cancer)	2,190	days	EPA (1989)	
		Adult	Potable water	Cw	Chemical Concentration in Water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical specific parameters
				CF	Conversion Factor (CF)	0.001	L/cm^3		
				SA	Skin Surface Area	19,652	cm^2/event	EPA (2014)	
				tevent	Exposure time	0.71	hours/event	EPA (2014)	
				EF	Exposure Frequency	350	events/year	EPA (2014)	
				ED	Exposure Duration	20	years	EPA (2014)	
				BW	Body Weight	80	kg	EPA (2014)	
				AT-C	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-N	Averaging Time (Non-cancer)	7,300	days	EPA (1989)	
	Outdoor Worker	Adult	Potable water	Cw	Chemical Concentration in Water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical specific parameters. Because of the intermittent nature of washing exposure, the non-steady state equation (tevent < t*) will be used regardless of the value for t*.
				CF	Conversion Factor (CF)	0.001	L/cm^3		
				SA	Skin Surface Area	4,985	cm^2/event	[3]	
				tevent	Exposure time	1	hours/event	[4]	
				EF	Exposure Frequency	225	events/year	EPA (2014)	
				ED	Exposure Duration	25	years	EPA (2014)	
				BW	Body Weight	80	kg	EPA (2014)	
				AT-C	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
				AT-N	Averaging Time (Non-cancer)	9,125	days	EPA (1989)	

Table 4.3
Values Used for Daily Intake Calculations, Groundwater
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: future
Medium: groundwater
Exposure Medium: potable water supply

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation of volatiles from potable water use	Resident	Child (0-6 years)	Air	CA	Chemical Concentration in Air	Cw * VF	mg/m^3		Adjusted air concentration (mg/m^3) =
				Cw	Chemical Concentration in Water	TBD	mg/L		
				VF	Volatilization Factor	0.5	L/m^3	EPA, 1991	CA x ET x EF x ED x 1/AT
				ET	Exposure time	24	hours/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				EDc	Exposure Duration	6	years	EPA, 2014	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 2009	
				AT-Nc	Averaging Time (Non-cancer)	52,560	hours	EPA, 2009	
		Adult	Air	CA	Chemical Concentration in Air	Cw * VF	mg/m^3		Adjusted air concentration (mg/m^3) =
				Cw	Chemical Concentration in Water	TBD	mg/L		
				VF	Volatilization Factor	0.5	L/m^3	EPA, 1991	CA x ET x EF x ED x 1/AT
				ET	Exposure time	24	hours/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				EDc	Exposure Duration	20	years	EPA, 2014	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 2009	
				AT-Nc	Averaging Time (Non-cancer)	175,200	hours	EPA, 2009	

Notes:
[1] Assumed worker consumes one-half the daily adult ingestion rate on site.
[2] Chemical-specific parameters will be obtained from the most current version of the chemical parameter table at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
[3] Average of male and female 50th percentile areas for head, arms, and hands listed in Tables 7-12 and 7-13 of EPA, 2011.
[4] Assumed that the outdoor worker is exposed a maximum of 1 hour per day cumulatively.

Sources:
EPA (1989). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002, December.
EPA (2004). Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. OSWER 9285.7-02EP.
EPA (2011). Exposure Factors Handbook: 2011 Edition. Office of Research and Development. Washington, DC. EPA/600/R-090/052F. September 2011.
EPA (2014). Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Response. Washington, DC. OSWER 9200.1-120. February 6, 2014.

Table 4.4
Values Used for Daily Intake Calculations, Surface Water
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: surface water
Exposure Medium: surface water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child (0-6 years)	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		Average daily dose (ADD_{ing}) or lifetime ADD_{ing} ($LADD_{ing}$) (mg/kg-day) = $\frac{EPC_{sw} \times IR_{water} \times ET \times EV \times EF \times ED}{BW \times AT}$
				IR_{sw}	Surface water intake rate	0.05	L/hr	EPA (1989)	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	6	years	EPA (2014)	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				BW	Body weight	15	kg	EPA (2014)	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
		Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{sw} \times IR_{water} \times ET \times EV \times EF \times ED}{BW \times AT}$
				IR_{sw}	Surface water intake rate	0.05	L/hr	EPA (1989)	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	EPA (2014)	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{sw} \times IR_{sw} \times EF \times ED \times EV \times ET}{BW \times AT}$
				IR_{sw}	Surface water intake rate	0.05	L/hr	EPA (1989)	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	9	years	[3]	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				BW	Body weight	54.5	kg	[4]	
				AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{sw} \times IR_{sw} \times EF \times ED \times EV \times ET}{BW \times AT}$
				IR_{sw}	Surface water intake rate	0.05	L/hr	EPA (1989)	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	[5]	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Table 4.4
Values Used for Daily Intake Calculations, Surface Water
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: surface water
Exposure Medium: surface water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Outdoor Worker	Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) =
				IR_{sw}	Surface water intake rate	0.1	L/hr	[6]	$\frac{EPC_{sw} \times IR_{sw} \times EF \times ED \times EV \times ET}{BW \times AT}$
				EF	Exposure frequency	12	days/year	[7]	
				EV	Events per day	1	events/day	[8]	
				ET	Exposure time per event	4	hr/event	[8]	
				ED	Exposure duration	25	years	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	9,125	years	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
Dermal	Resident	Child (0-6 years)	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		
				EF	Exposure frequency	24	days/year	[1]	ADD_{derm} or $LADD_{derm}$ =
				ED	Exposure duration	6	years	EPA (2014)	Devent x SA x ED x EF/(BW x AT)
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	If tevent < or = t*, then
				SA_{sw}	Skin surface area exposed to surface water	2,373	cm^2	[9]	Devent = 2 x FA x Kp x Cw x CF x $(6 \times tau_{event} \times tevent \times 1/pi)^{1/2}$
				BW	Body weight	15	kg	EPA (2014)	
				FA	Fraction absorbed	Chemical-specific	unitless	[10]	
				K_p	Dermal permeability	Chemical-specific	cm/hr	[10]	If tevent > t*, then
				τ_{event}	Lag time per event	Chemical-specific	hr/event	[10]	Devent = FA x Kp x CF x Cw x {tevent/(1+B) + 2 x tau_{event} x $[1+3B+3B^2/(1+B)^2]$}
				t*	Time to reach steady-state	Chemical-specific	hr	[10]	
				B	Ratio of permeability through stratum corneum to permeability across viable epidermis	Chemical-specific	unitless	[10]	
				CF	Conversion factor	1E-03	L/cm^3	--	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
		Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical-specific parameters
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	EPA (2014)	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				SA_{sw}	Skin surface area exposed to surface water	6,032	cm^2	[9]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Table 4.4
Values Used for Daily Intake Calculations, Surface Water
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: surface water
Exposure Medium: surface water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical-specific parameters
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	9	years	[3]	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				SA_{sw}	Skin surface area exposed to surface water	10,200	cm^2	[9]	
				BW	Body weight	54.5	kg	[4]	
				CF	Conversion factor	1E-03	L/cm^3	--	
				AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical-specific parameters
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	[5]	
				EV	Events per day	1	events/day	[2]	
				ET	Exposure time per event	2	hr/event	[2]	
				SA_{sw}	Skin surface area exposed to surface water	6,032	cm^2	[9]	
				BW	Body weight	80	kg	EPA (2014)	
				CF	Conversion factor	1E-03	L/cm^3	--	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Outdoor Worker	Adult	Surface Water	EPC_{sw}	Chemical concentration in surface water	TBD	mg/L		See child resident for dermal uptake equations and associated chemical-specific parameters
				EF	Exposure frequency	12	days	[7]	
				EV	Events per day	1	events/day	[8]	
				ET	Exposure time per event	4	hr/event	[8]	
				ED	Exposure duration	25	years	EPA (2014)	
				SA_{sw}	Skin surface area exposed to surface water	3,527	cm^2	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				CF	Conversion factor	1E-03	L/cm^3	--	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Notes:
[1] Twice per month throughout the year.
[2] Professional judgment.
[3] Adolescent assumed to be 9-18 years.
[4] Weighted average body weight for children aged 9-18 years. Table 8-1, EPA 2008.
[5] Resident exposure duration; receptor assumed to be a nearby, offsite resident.
[6] Greater ingestion rate than for recreator/resident due to greater potential to splash water while working in a ditch or pond.
[7] Twice per month between May and October.
[8] Outdoor worker assumed to spend half of the work day in direct contact with surface water.
[9] Ponds and creeks too shallow for swimming. Assumed same surface area as for soil.
[10] Chemical-specific parameters will be obtained from the most current version of the chemical parameter table at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Sources:
EPA (1989). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002, December.
EPA (2004). Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. OSWER 9285.7-02EP.
EPA (2008). Child-Specific Exposure Factors Handbook (Final Report).
EPA (2014). Region 4 Human Health Risk Assessment Supplemental Guidance. Technical Services Section. Superfund Division. EPA Region 4. January 2014 Draft Final.

Table 4.5
Values Used for Daily Intake Calculations, Sediment
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: sediment
Exposure Medium: sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child (0-6 years)	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		Average daily dose (ADD_{ing}) or lifetime ADD_{ing} ($LADD_{ing}$) (mg/kg-day) = $\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{sed}	Sediment ingestion rate	200	mg/day	[1]	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	6	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				BW	Body weight	15	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
		Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{soil} \times IR_{soil} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{sed}	Sediment ingestion rate	100	mg/day	[1]	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	20	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) = $\frac{EPC_{sed} \times IR_{sed} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				IR_{sed}	Sediment ingestion rate (adolescent)	100	mg/day	[1]	
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	9	years	[3]	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight (adolescent)	54.5	kg	[4]	
				AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	

Table 4.5
Values Used for Daily Intake Calculations, Sediment
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: sediment
Exposure Medium: sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreator/ Trespasser/Visitor	Adolescent (9-18 years)	Sediment	AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		ADD_{ing} or $LADD_{ing}$ (mg/kg-day) =
				IR_{sed}	Sediment ingestion rate (adolescent)	100	mg/day	[1]	$\frac{EPC_{sed} \times IR_{sed} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	20	years	[5]	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight (adolescent)	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Outdoor Worker	Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		
				IR_{sed}	Sediment ingestion rate (adolescent)	100	mg/day	[1]	ADD_{sed} or $LADD_{sed}$ (mg/kg-day) =
				RBA	Relative bioavailability factor	1	unitless	Assumed completely bioavailable	$\frac{EPC_{sed} \times IR_{sed} \times RBA \times EF \times ED \times CF}{BW \times AT}$
				EF	Exposure frequency	12	days	[6]	
				ED	Exposure duration	25	years	EPA (2014)	
				CF	Conversion factor	1E-06	kg/mg	--	
				BW	Body weight (adolescent)	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
Dermal	Resident	Child (0-6 years)	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		Dermally absorbed dose (DAD) or lifetime DAD (LDAD) (mg/kg-day) =
				CF	Conversion factor	1E-06	kg/mg	--	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				AF_{sed}	Adherence factor for sediment	0.3	mg/cm^2	[7]	
				ABS_d	Dermal absorption factor	Chemical specific	--	Chemical specific	
				EF	Exposure frequency	24	days/year	[2]	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				ED	Exposure duration	6	years	EPA (2014)	
				SA_{sed}	Skin surface area exposed to sediment	2,373	cm^2/day	[8]	
				BW	Body weight	15	kg	EPA (2014)	

Table 4.5
Values Used for Daily Intake Calculations, Sediment
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: sediment
Exposure Medium: sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child (0 -6 years)	Sediment	AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
		Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		DAD or LDAD (mg/kg-day) =
				CF	Conversion factor	1E-06	kg/mg	--	$\frac{EPC_{soil} \times CF \times AF \times ABS_d \times EF \times ED \times SA}{BW \times AT}$
				AF_{sed}	Adherence factor for sediment	0.3	mg/cm^2	[7]	
				ABS_d	Dermal absorption factor	Chemical specific	--	Chemical specific	
				EF	Exposure frequency	24	days/year	[2]	
				ED	Exposure duration	20	years	EPA (2014)	
				SA_{sed}	Skin surface area exposed to sediment	6,032	cm^2/day	[8]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor	Adolescent (9-18 years)	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD_{sed} or $LDAD_{sed}$ (mg/kg-day) =
				AF_{sed}	Adherence factor for sediment	0.3	mg/cm^2	[7]	$\frac{EPC_{sed} \times CF \times AF_{sed} \times ABS_d \times EF \times ED \times SA_{sed}}{BW \times AT}$
				ABS_d	Dermal absorption factor	Chemical specific	--	Chemical specific	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	9	years	[3]	
				SA_{sed}	Skin surface area exposed to sediment	10,200	cm^2/day	[8]	
				BW	Body weight	54.5	kg	[4]	
				AT-n	Averaging time (noncancer endpoint)	3,285	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Recreator/ Trespasser/ Visitor/Hunter	Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		DAD_{sed} or $LDAD_{sed}$ (mg/kg-day) =
				CF	Conversion factor	1E-06	kg/mg	--	$\frac{EPC_{sed} \times CF \times AF_{sed} \times ABS_d \times EF \times ED \times SA_{sed}}{BW \times AT}$
				AF_{sed}	Adherence factor for sediment	0.3	mg/cm^2	[7]	

Table 4.5
Values Used for Daily Intake Calculations, Sediment
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: sediment
Exposure Medium: sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreator/ Trespasser/ Visitor/Hunter	Adult	Sediment	ABS_d	Dermal absorption factor	Chemical specific	--	Chemical specific	
				EF	Exposure frequency	24	days/year	[1]	
				ED	Exposure duration	20	years	[5]	
				SA_{sed}	Skin surface area exposed to sediment	6,032	cm^2/day	[8]	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
	Outdoor Worker	Adult	Sediment	EPC_{sed}	Chemical concentration in sediment	TBD	mg/kg		
				CF	Conversion factor	1E-06	kg/mg	--	DAD_{sed} or $LDAD_{sed}$ (mg/kg-day) =
				AF_{sed}	Adherence factor for sediment	0.3	mg/cm^2	[7]	$\frac{EPC_{sed} \times CF \times AF_{sed} \times ABS_d \times EF \times ED \times SA_{sed}}{BW \times AT}$
				ABS_d	Dermal absorption factor	Chemical specific	--	Chemical specific	
				EF	Exposure frequency	12	days	[6]	
				ED	Exposure duration	25	years	EPA (2014)	
				SA_{sed}	Skin surface area exposed to sediment	3,527	cm^2/day	EPA (2014)	
				BW	Body weight	80	kg	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	9,125	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Notes:
[1] Assumed to be the same as the ingestion rates for soil (from EPA, 2014).
[2] Twice per month throughout the year.
[3] Adolescent assumed to be 9-18 years.
[4] Weighted average body weight for children aged 9-18 years, Table 8-1, EPA 2008.
[5] Resident exposure duration; receptor assumed to be a nearby, offsite resident.
[6] Twice per month between May and October.
[7] Geometric mean adherence factor for reed gatherers (EPA, 2004).
[8] Used same surface area as for soil.

Sources:
EPA (1989). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002, December.
EPA (2008). Child-Specific Exposure Factors Handbook (Final Report).
EPA (2014). Region 4 Human Health Risk Assessment Supplemental Guidance. Technical Services Section. Superfund Division. EPA Region 4. January 2014 Draft Final.

Table 4.6
Values Used for Daily Intake Calculations, Wild Game/Deer Meat
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: curent/future
Medium: soil
Exposure Medium: wild game/deer meat

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Wild game/deer meat consumer	Child (0-6 years)	Wild game/deer meat	EPC_{tissue}	Chemical concentration in deer tissue	TBD	mg/kg		Average daily dose (ADD_{ing}) or lifetime ADD_{ing} ($LADD_{ing}$) (mg/kg-day) = EPC_{tissue} x IR-M x CF x FV x EF x ED x 1/AT
				IR-M	Ingestion rate of total meat (uncooked)	1.05	g/kg-day	[1]	
				FV	fraction of total meat caught onsite	0.33	unitless	[2]	
				CF	Conversion Factor	0.001	kg/g		
				EF	Exposure Frequency	350	days/year	[2]	Note: wild game/deer meat consumer cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for an offsite resident
				ED	Exposure Duration	6	years	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	2,190	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	
		Adult	Wild game/deer meat	EPC_{tissue}	Chemical concentration in deer tissue	TBD	mg/kg		Same equation as listed above for the child
				IR-M	Ingestion rate of total meat (uncooked)	0.529	g/kg-day	[3]	
				FV	fraction of total meat caught onsite	0.33	unitless	[2]	
				CF	Conversion Factor	0.001	kg/g		
				EF	Exposure Frequency	350	days/year	[2]	
				ED	Exposure Duration	20	years	EPA (2014)	
				AT-n	Averaging time (noncancer endpoint)	7,300	days	EPA (1989)	
				AT-c	Averaging time (cancer endpoint)	25,550	days	EPA (1989)	

Notes:

[1] Mean per capita intake of total meat, uncooked, consumers only, years 0 - < 6 (EPA, 2018) (Table 11-1).Wet weight ingestion rate (3.6 ww g/kg day) converted to a dry weight basis using dry solids content of 0.294 kg dry wt/kg wet weight obtained from the moisture content of raw, lean beef (EPA, 2018) (Table 11-42).

[2] It is assumed that the child and adult consume wild game/deer meat year round, and replace one-third of total meat consumption with deer caught on site. The listed ingestion rate is a per day ingestion rate based on total ingestion averaged over a year.

[3] Mean per capita intake of total meat (consumers only), uncooked, years 21 - < 50 (EPA, 2018) (Table 11-1). Wet weight ingestion rate (1.8 ww g/kg day) converted to dry weight basis using dry solids content of 0.294 kg dry wt/kg wet weight obtained from the moisture content of raw, lean beef (EPA, 2018) (Table 11-42).

Sources:

EPA (1989). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002, December.
EPA (2014). Region 4 Human Health Risk Assessment Supplemental Guidance. Technical Services Section. Superfund Division. EPA Region 4. January 2014 Draft Final.
EPA (2018). Update for Chapter 11 of the Exposure Factors Handbook, Intake of Meats, Dairy Products, and Fats. EPA/600/R-17/485F. April.

Table 4.7
Values Used for Daily Intake Calculations, Indoor Air
Seneca Army Depot Activity
Seneca County, New York

Scenario Timeframe: current/future
Medium: groundwater
Exposure Medium: indoor air (vapor intrusion)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child (0-6 years)	Indoor air	CA	Chemical Concentration in Air	Cw * AF * HLC * CF1	µg/m^3		Adjusted air concentration (mg/m^3) = CA x CF2 x ET x EF x ED x 1/AT
				Cw	Chemical Concentration in Water	TBD	mg/L		
				AF	Groundwater Attenuation Factor	0.001	unitless	EPA, 2015	
				HLC	Henry's Law Constant	chemical-specific	unitless		
				CF1	Conversion Factor	1000	L/m^3		
				CF2	Conversion Factor	0.001	mg/µg		
				ET	Exposure Time	24	hours/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	
				ED	Exposure Duration	6	years	EPA, 2014	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 2009	
				AT-N	Averaging Time (Non-cancer)	52,560	hours	EPA, 2009	
		Adult	Indoor air	CA	Chemical Concentration in Air	Cw * AF * HLC * CF1	µg/m^3		Adjusted air concentration (mg/m^3) = CA x CF2 x ET x EF x ED x 1/AT
				Cw	Chemical Concentration in Water	TBD	mg/L		
				AF	Groundwater Attenuation Factor	0.001	unitless	EPA, 2015	
				HLC	Henry's Law Constant	chemical-specific	unitless		
				CF1	Conversion Factor	1000	L/m^3		
				CF2	Conversion Factor	0.001	mg/µg		
				ET	Exposure Time	24	hours/day	EPA, 2014	
				EF	Exposure Frequency	350	days/year	EPA, 2014	Note: resident cancer risk will be calculated separately for child and adult and then summed to account for exposure across the 26-year total exposure duration for the resident
				ED	Exposure Duration	20	years	EPA, 2014	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 2009	
				AT-N	Averaging Time (Non-cancer)	175,200	hours	EPA, 2009	
	Indoor worker	Adult	Indoor air	CA	Chemical Concentration in Air	Cw * AF * HLC * CF1	µg/m^3		Adjusted air concentration (mg/m^3) = CA x CF2 x ET x EF x ED x 1/AT
				Cw	Chemical Concentration in Water	TBD	mg/L		
				AF	Groundwater Attenuation Factor	0.001	unitless	EPA, 2015	
				HLC	Henry's Law Constant	chemical-specific	unitless		
				CF1	Conversion Factor	1000	L/m^3		
				CF2	Conversion Factor	0.001	mg/µg		
				ET	Exposure Time	8	hours/day	EPA, 2014	
				EF	Exposure Frequency	250	days/year	EPA, 2014	
				ED	Exposure Duration	25	years	EPA, 2014	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 2009	
				AT-N	Averaging Time (Non-cancer)	219,000	hours	EPA, 2009	

Sources:
EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final.
EPA, 2014: Update of Standard Default Exposure Factors, Human Health Evaluation Manual, Supplemental Guidance. OSWER Directive 9200.1-120.
EPA, 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. OSWER Publication 9200.2-154. June.

APPENDIX B: BIOTA STANDARD OPERATING PROCEDURES (SOPS)

Procedure # SOP-ENV-01	Title: DEER TISSUE SAMPLING	Revision # 00
Effective Date: 06/01/2022	Approved By: Todd Belanger	Last Revised: n/a

1. PURPOSE

The purpose of this SOP is to describe the general methods to be employed when collecting deer tissue samples for analysis during environmental investigations where PFAS compounds are part of the subject of investigation. The **SOP PFAS ENV-01 PFAS Sampling Guidance** provides an in-depth discussion of prohibited and approved materials and should be used in conjunction with this SOP.

2. RESPONSIBILITIES

Role	SOP-specific Responsibilities
Project Biologist	Specifies the types and quantities of samples to be collected. Monitors sample collection through communication with project team and field document review to confirm required samples are collected. Coordinates with analytical laboratory during sampling.
Sampling Team Leader	Responsible for implementing the sampling activities outlined in the work plan/QAPP. Ensures required QC and QA samples are collected. Records sample collection on field documents.
Sampling Team Assistant	Assists the Sampling Team Leader with sample collection and other sampling activities.

3. RELEVANT DEFINITIONS

Term	Definition
PFAS	Per- and poly-fluoroalkyl substances

4. REQUIRED EQUIPMENT

Equipment	Brief Description of Function and Purpose
Sampling tools	Disposable stainless steel scalpels, stainless steel bowls, PFAS-free gloves, PFAS-free water.
Sample containers	Sample bags (verified PFAS-free) provided by the analytical laboratory. Coolers for sample shipment.
Logbook	Paper or electronic field forms for documenting field activities. No weatherproof field books.
Chain-of-custody (CoC) forms	For tracking sample details and chain-of-custody, and for providing instruction on sample analysis to analytical laboratory.

Procedure # SOP-ENV-01	Title: DEER TISSUE SAMPLING	Revision # 00
Effective Date: 06/01/2022	Approved By: Todd Belanger	Last Revised: n/a

5. PROCEDURE

5.1. Health and Safety

All elements of this procedure will be conducted in accordance with the approved site safety and health plan, including but not limited to specified requirements for training, personal protective equipment (PPE), exposure monitoring and air sampling, etc. The designated safety representative will review the relevant site-specific activity hazard analyses (AHAs) prior to implementing this SOP. Any health and safety products will follow the guidance provided in **SOP PFAS ENV-01 PFAS Sampling Guidance**. Additional PPE may be required for sampling personnel such as waders and personal floatation devices. Ensure that these materials that will come in contact with the sampling media do not consist of water-resistant coatings or other PFAS containing materials or substances.

5.2. General Requirements for all Sample Methods

5.2.1. Documentation

5.2.1.1. The Sampling Team Leader or designee shall record the description of sample locations, sample type, and any other relevant or notable details on the Field Sampling forms and/or on project-specific sampling forms. Whenever possible, the Sampling Team Leader or designee shall also record the sample locations based on the deer harvest areas provided (**Exhibit 1**) on the Field Sampling form (**Exhibit 2**). The Sampling Team Leader or designee shall record other information as specified in the approved work plan, including completion of daily field notes.

5.2.2. Sample Handling and Shipment

The Sampling Team Leader is responsible for ensuring samples are packaged and shipped to the analytical laboratories in accordance with the approved work plan, QAPP and **SOP PFAS ENV-01 PFAS Sampling Guidance**. The Sampling Team Leader or designee shall document sample details on the CoC form. The completed CoC form will be included with the shipped sample(s).

5.2.3. Sample Analysis and Quality Control Samples

Collected samples shall be analyzed in the field and/or at the analytical laboratory as described in the approved work plan/QAPP. The Sampling Team Leader or designee shall collect the quantities and types of Quality Assurance (QA)/QC samples specified in the approved work plan/QAPP to ensure proper QC review of each sampling event.

5.3. Sampling Methods for Deer Tissue Sampling

Deer tissue sampling includes all types of deer tissue used in analytical biological sampling including, but not limited to, muscle and liver tissue.

Deer tissue samples may be collected using several methods depending on the timing and type of harvest. Direct coordination with state agents or local hunters may be utilized to harvest deer so the level of cooperation may vary sample to sample. This SOP will outline methodology for obtaining sufficient deer tissue without accidental PFAS contamination after the deer has been harvested.

5.3.1. Preparation for Deer Tissue Sampling

The following steps shall be completed when preparing for collection of tissue samples:

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Effective Date: 06/01/2022	Approved By: Todd Belanger	Last Revised: n/a

1. The Sampling Team Leader shall provide notifications to local hunters through coordination with State and local agencies and the hunt manager. This notification will request cooperation with sampling efforts. Instruction will be provided to hunters on where to bring harvested deer so that samples can be collected. Hunters will specifically be instructed to retain the liver for sampling, rather than discarding it when field dressing deer.
2. The Sampling Team Leader shall review the applicable section(s) of the work plan/QAPP to confirm the sample location, quantities, required sample containers, and other relevant information.
3. Once notified of a harvest to be sampled the Sampling Team Leader shall determine the optimal sampling procedure and equipment required to collect the sample, unless already specified in the work plan.
4. The Sampling Team will navigate to the sample location, make initial observations, and complete the required documentation (see Section 5.2.1).
5. The Sampling Team shall review Figure 1 – PFAS Sampling Checklist provided in **SOP PFAS ENV-01 PFAS Sampling Guidance** and document any deviations from the SOP and their solutions.
6. The Sampling Team shall don clean, powder free nitrile gloves before each sampling event.
7. The Sampling Team shall assemble the necessary sampling equipment and supplies, sample containers, decontamination materials, etc. in the sampling area. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the sample location. All equipment utilized shall be decontaminated prior to use.

5.3.2. Collection of Deer Tissue Samples

5.3.2.1. Local hunters will be notified in advance of the survey and participating hunters will be instructed to contact the Sample Team Leader. Level of participation may vary case by case and the Sample Team Leader will need to coordinate with the hunters to sample harvested deer in a safe, secure location, either where the deer was harvested or a secondary location.

5.3.2.2. Following the preparatory actions (Section 5.3.1), the Sampling Team shall complete the following steps to collect samples from deer harvested:

1. Record all applicable observations about the harvest including: time, date, location, position of projectile entry hole, sex, approximate age, height and weight, or anything else specified by the Work Plan.
2. Using a new disposable scalpel for each animal, expose muscle tissue in rump area to be sampled. Using scalpel, remove 100-200 grams (approximately fist-sized) of tissue to sample.
    a. Use stainless steel knives only, preferably disposable scalpels, and PFAS-free gloves
    b. Do not include skin in tissue sample. Try to make sure that hair/feathers are not included with the tissue sample.
    c. Do not collect sample from area that may have been contaminated with lead from the bullet used to kill the animal. Make sure that the sample area is away from the path of the bullet.
3. Rinse sample with PFAS-free water prior to packaging to remove any excess hair, blood, dirt, etc.
4. Repeat steps 1 and 2 removing 100-200g of liver tissue.
5. Samples will be transferred directly into laboratory provided containers once the tissue is removed and washed.
6. When sample containers are filled, secure the containers and place on ice as soon as possible. Samples must be protected by from light and stored at a temperature between 0 – 6 °C (32 – 43 °F) before and during transport.
7. Perform post-sampling activities (Section 5.3.3)

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5.3.3. Post Sampling Activities for Tissue Sampling

The following steps shall be completed once tissue sample collection is complete:

1. The Sampling Team Leader or designee shall label each sample container with the Sample ID, date, time, analysis, and other information required on the sample label.
2. The Sampling Team Leader or designee will confirm the required samples were collected, including necessary QC samples as specified in the approved work plan/QAPP.
3. The Sampling Team Leader or designee shall ensure the samples are properly stored until they can be shipped for analysis.
4. The Sampling Team will decontaminate reusable sampling equipment as described in Section 5.4.2 or as specified in the approved work plan/QAPP.
5. The Sampling Team Leader or designee shall complete the CoC and other required documentation (see Section 5.2.1) and prepare the sample for shipment (see Section 5.2.2).

5.4. Sampling Equipment Decontamination

Depending on the equipment used there may be no need for Decontamination. If the Sample Team chooses to use disposable stainless-steel scalpels and disposable PFAS-free gloves then equipment is single use and must be properly disposed of after each sample is received. If reusable sample equipment is used the decontamination process outlined in Section 5.4.2. must be followed after each sample is collected.

5.4.1. PFAS-free Water

5.4.1.1. The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2022). Note: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

5.4.1.2. One important consideration for each project site is to identify a PFAS-free water source to use for decontamination of sampling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

5.4.2. Decontamination Procedures

5.4.2.1. Sampling equipment should be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the site-specific QAPP. Field sampling equipment, including knives, bowls, and other nondedicated equipment used at each sample location, requires cleaning between uses.

5.4.2.2. Decontamination of reusable sampling equipment:

1. Upon donning a new pair of nitrile gloves, equipment will be:
2. Rinsed and scrubbed in a bucket with a mix of Alconox® (or similar) cleaning solution and potable water;
3. Rinsed in a bucket of clean potable PFAS-free water;
4. Second rinse using reagent-grade methanol;
5. Rinse using deionized water;
6. Final rinse with laboratory-provided, "PFAS-free" water, as appropriate;

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7. All rinsate should be collected in a sealed pail for disposal.

5.4.2.3. If required by the Waste Management Plan in the approved work plan, sampling equipment decontamination water shall be containerized for subsequent chemical analysis and for proper disposal of decontamination water. Equipment blanks shall be collected as specified in the approved work plan.

6. REFERENCES

Reference Title (Author)	Brief summary of relevance to this procedure
ITRC PFAS Fact Sheets, Interstate Technology Regulatory Council.	PFAS guidance on sampling and avoiding cross contamination.
New York State Department of Environmental Conservation (NYSDEC), 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. June 2021.	Project state PFAS guidance.

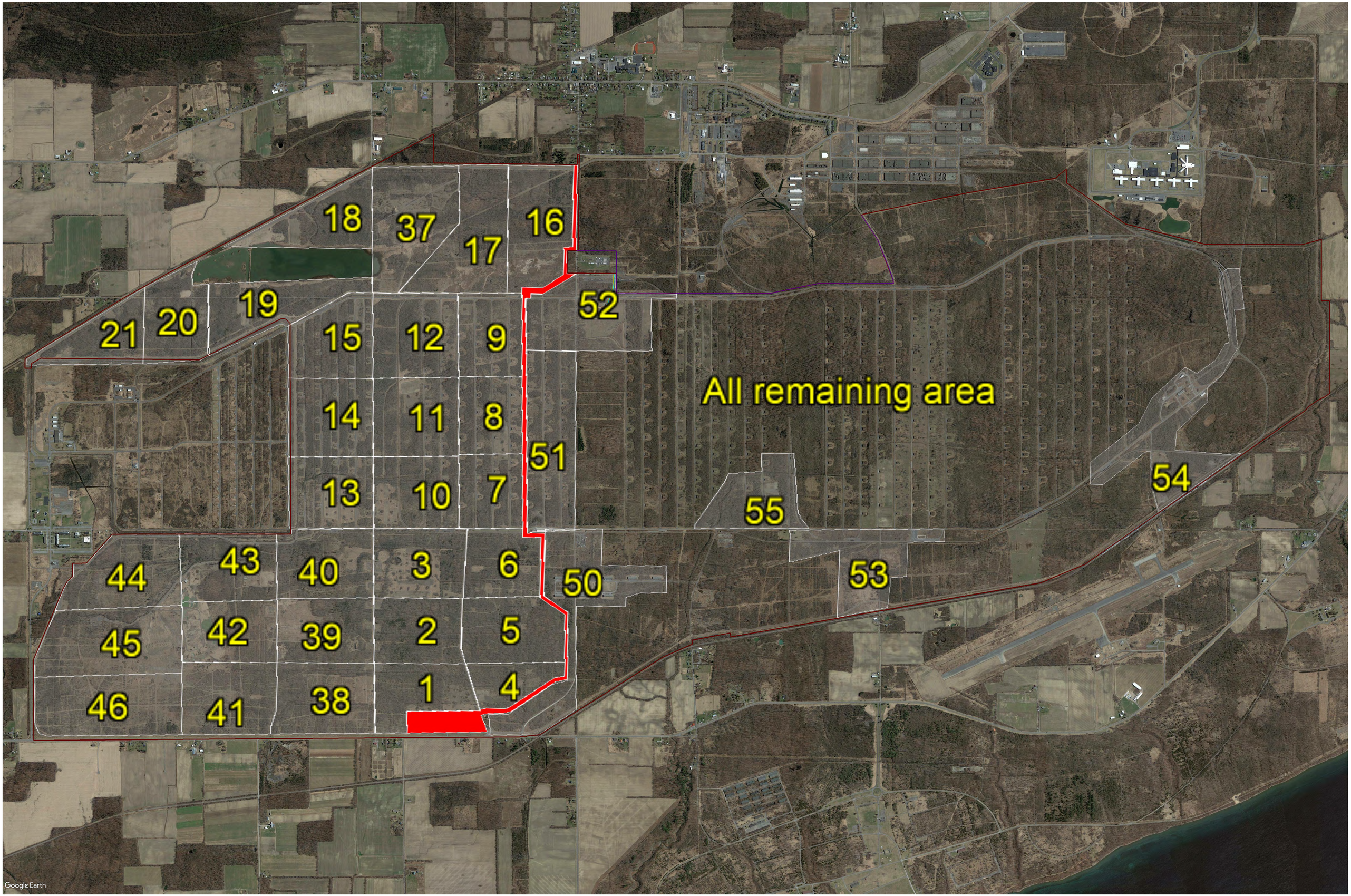
7. EXHIBITS

Exhibit 1: Deer Harvest Areas Map

Exhibit 2: Deer Tissue Sampling Form

8. REVISION HISTORY

Rev.	Date	Summary of Changes	Reason for Revision
00	06/10/2022	Initial Release	n/a


18
37
17
16
19
21
20
15
12
9
52
All remaining area
14
11
8
51
13
10
7
54
55
44
43
40
3
6
50
53
45
42
39
2
5
46
41
38
1
4
Google Earth

Biota Sampling Form
Parsons

SITE NAME: Seneca Army Depot, Romulus, NY
PROJECT NUMBER:
SAMPLE DATE
SAMPLER(S):

DESCRIPTION OF ANIMAL SAMPLED

SPECIES:
SEX:
DATE & TIME HARVESTED:
APPROXIMATE WEIGHT:
APPROXIMATE LOCATION HARVESTED:
PROJECTILE TYPE USED IN HARVEST:
ENTRY/EXIT WOUND LOCATION:

SAMPLE 1

SAMPLE ID: **SAMPLE TIME:**

MEDIA SAMPLED: MUSCLE LIVER OTHER:

QA/QC SAMPLES

DUPLICATE SAMPLE COLLECTED: YES NO

DUPLICATE SAMPLE ID: **SAMPLE TIME:**

MS/MSD SAMPLE COLLECTED YES NO

MS SAMPLE ID: **SAMPLE TIME:**

MSD SAMPLE ID: **SAMPLE TIME:**

COMMENTS:

SAMPLE 2

SAMPLE ID: **SAMPLE TIME:**

MEDIA SAMPLED: MUSCLE LIVER OTHER:

QA/QC SAMPLES

DUPLICATE SAMPLE COLLECTED: YES NO

DUPLICATE SAMPLE ID: **SAMPLE TIME:**

MS/MSD SAMPLE COLLECTED YES NO

MS SAMPLE ID: **SAMPLE TIME:**

MSD SAMPLE ID: **SAMPLE TIME:**

COMMENTS:

APPENDIX C: PORE WATER SOPS AND LAB SHEETS

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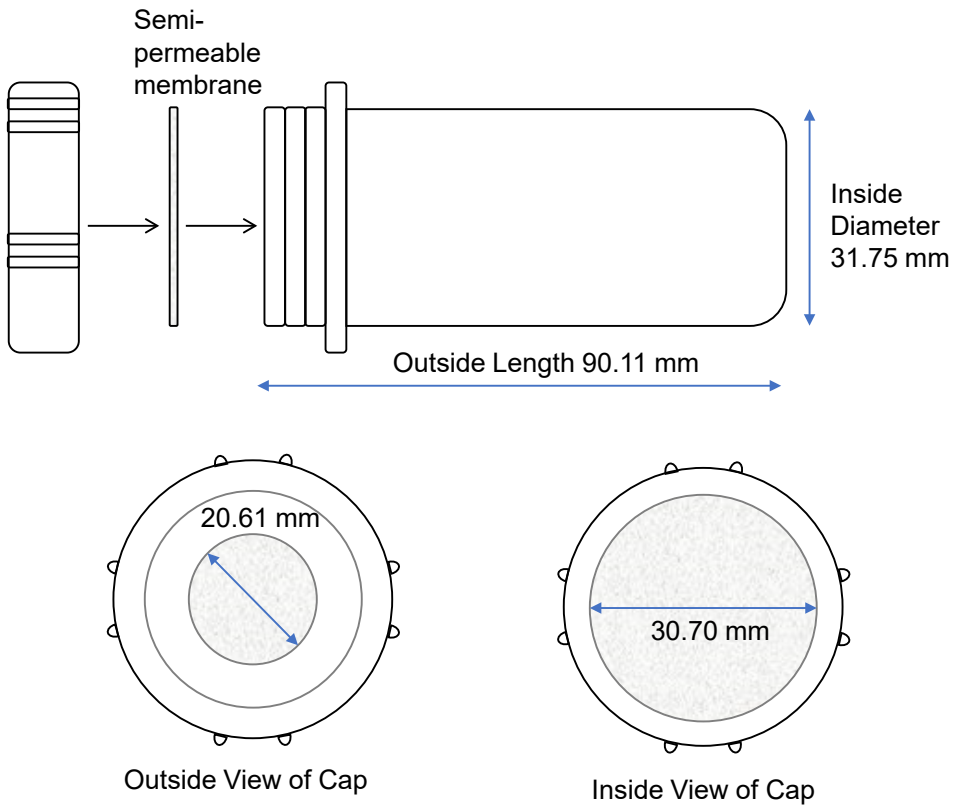
PFASsive™ Deployment and Retrieval Diverless Method

Introduction



PFASsive™ Vial Dimensions

- Each vial should yield about 60 mL of sample pore water.
- To avoid accidental high bias or sample loss, processing requires care and precision. All field materials should be certified PFAS free.

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Materials for Deployment:

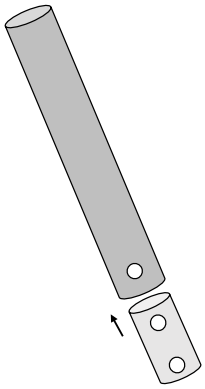
- PFASsive™ Vial frames
- PFASsive™ vials
- Frame wings
- Polycarbonate screws and nuts
- Push poles (optional)
- Deployer attachment
- Wing weight materials (i.e. sandbags)
- Release pin and line
- Zip-ties
- Ziplock bags for wing weights
- DI water
- Camera system:
    - GoPro
    - Batteries and chargers
    - Watertight case
    - Light with batteries and charger
    - Camera transmission cable
    - Mounting system to attach to push poles
- Anchor lines (leaded or sinking rope)
- Grappling hook
- Retrieval rope

Preparation for Deployment

1. Check shipment inventory to ensure the proper quantity of sampling supplies have been received and are in good working order.
2. Identify the associated blanks and ensure they are not deployed.
3. If using the diverless equipment, test the GoPro equipment 1 day prior to deployment to familiarize yourself with the software and ensure a smooth start to the field campaign. Check that the batteries are fully charged by plugging them in with the included chargers.

Deployment

1. Push pole and camera system preparation:
    a. Attach together as many poles as is required to reach the sediment from the deployment location, each pole has an approximate length of 7 feet.
    b. Attach the frame adapter that will secure the frame, do not attach the frame yet.

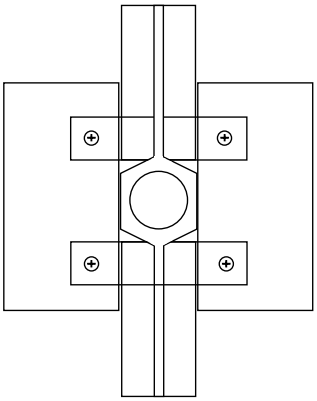


c. Attach and secure the camera system. Secure the camera cable along the length of the push pole by using small amounts of tape or cable ties.

d. To prevent the loss of the push poles in the water during deployment, a retrieval line needs to be attached to the push poles. The retrieval line needs to be firmly attached to the push poles and taped or tied along the length of the push pole to avoid getting in the way of deployment. Make sure the rope is long enough so that if the push poles where to fall and sink, the retrieval line would still be with the operator on the shore or boat.

2. Remove a frame, two wings, two wing support, four screws and nuts from their respective clean bags.

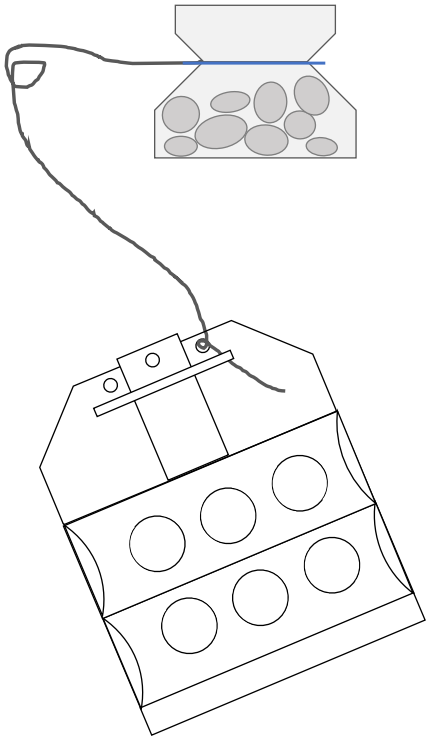
3. Attach the wings to the frame using the supports.



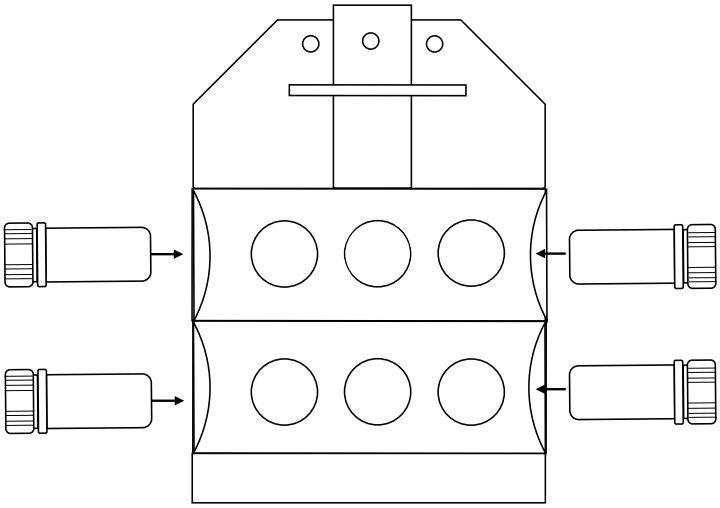
4. Fill two plastic zip sealable bags with about 500-g of clean sand and attach them to each of the peeper frame wings with cable ties. Alternatively, use a 1- to 2-pound weight.

5. Label each frame by attaching a laminated sample ID card to the frame with a cable tie.

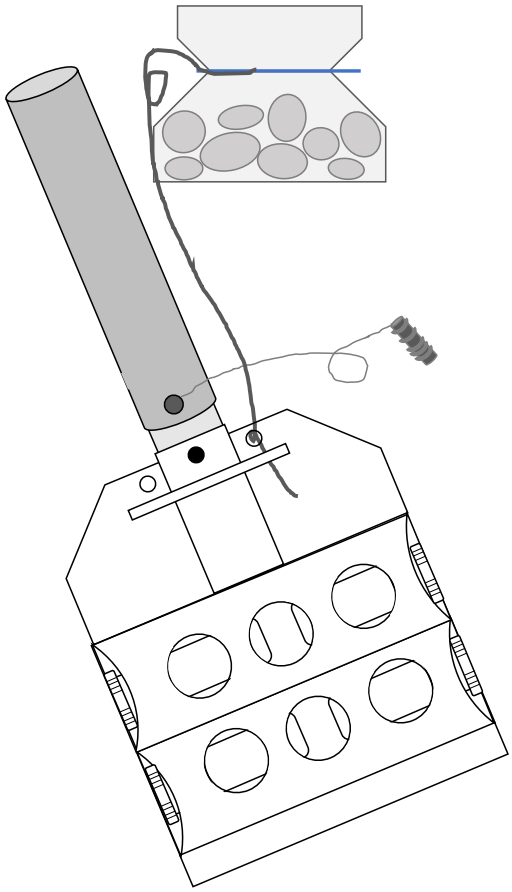
6. Attach a leaded or sinking rope (i.e. anchor line) to an attachment point at the top corner of the peeper frame. The length of rope should equal the measured water depth, plus an additional ten feet. Secure the other end of the rope to a weight (e.g. a 10- to 15-pound weight or a 1-liter sized zip sealable bag filled with sand, depending on flow conditions at the site. Alternatively, if the deployment is close to an accessible shoreline the rope can be tied to a tree or a stake.



7. Remove the vials from the mylar bag and secure in the frame until they snap in place.



8. Insert the frame into the slot on the push-pole deployment device (i.e. whale tail). Insert the spring-loaded pin through the whale tail and the peeper frame. Secure the two parts with the hitch pin on the opposite side of the whale tail. The hitch pin is attached to a rope that will allow the operator to release the pin from the surface. Make sure that the rope is securely attached and can be clearly pulled to release the peeper frame.

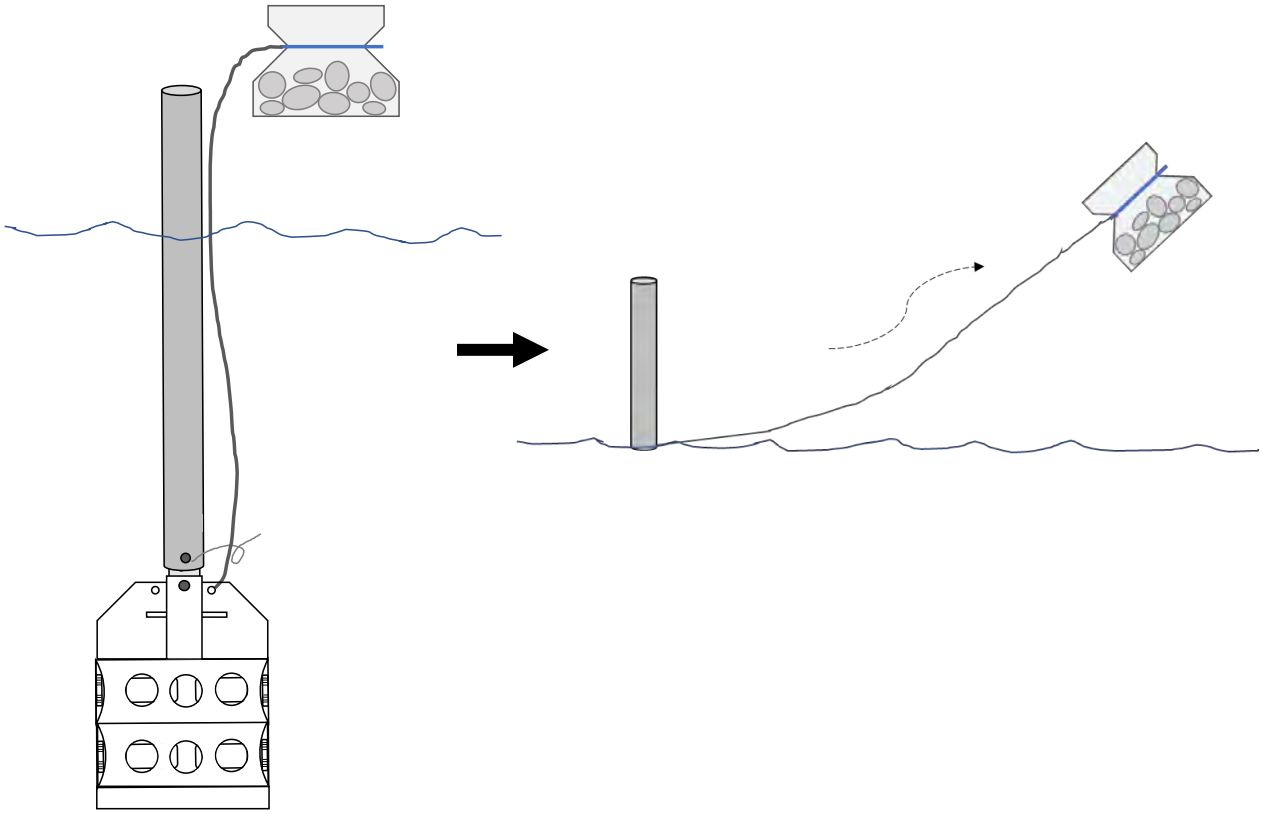


Frame inserted into slot in push pole attachment, with spring-loaded pin shown (hitch pin on reverse side of whale tail used to hold spring-loaded pin in place; not shown)

9. Turn on the camera system and connect it to a phone or tablet via Wi-Fi and the GoPro app using the following directions:
    a. Download the GoPro Quik App
10. Lower the pole and frame slowly into the water, while holding the retrieval rope, anchor rope and release pin rope above the water. Monitor the camera for when the frame hits the sediments. For deeper deployment the push pole can be assembled as they are lowered in the water. This methods requires two people
11. Insert the assembly into the sediment until the frame wings are flush with the sediment, using the camera feed to confirm complete insertion. If deployment is made from a boat

or moving platform, a clear line of communication need to be maintained with the captain to ensure maximum stability while deploying. Failing to do so can result in the lost of the sampler assembly or the push poles. If full insertion cannot be achieved or movement from the boat/platform prevents vertical insertion, pull up the frame and retry insertion a few feet away.

12. Note coordinates of deployed peeper and then toss the anchor line and attached weight. Record the line direction.
13. Pull the rope secured to the hitch pin to release the spring-loaded pin and the frame from the whale tail. The frame should remain in the sediment, while the whale tail lifts out of the water. If the peeper frame doesn't release from the whale-tail, gently shake and twist the push pole. The camera system can be useful to ensure the pin is properly released.



Retain the anchor line and weight above water while deploying the frame into the sediment

Toss the anchor line and weight approximately 20-feet downstream and record the direction

14. Task 11, 12 and 13 should be done in quick succession to ensure proper deployment, thus it is recommended to have one person helping with the camera, lines and recording of coordinates.

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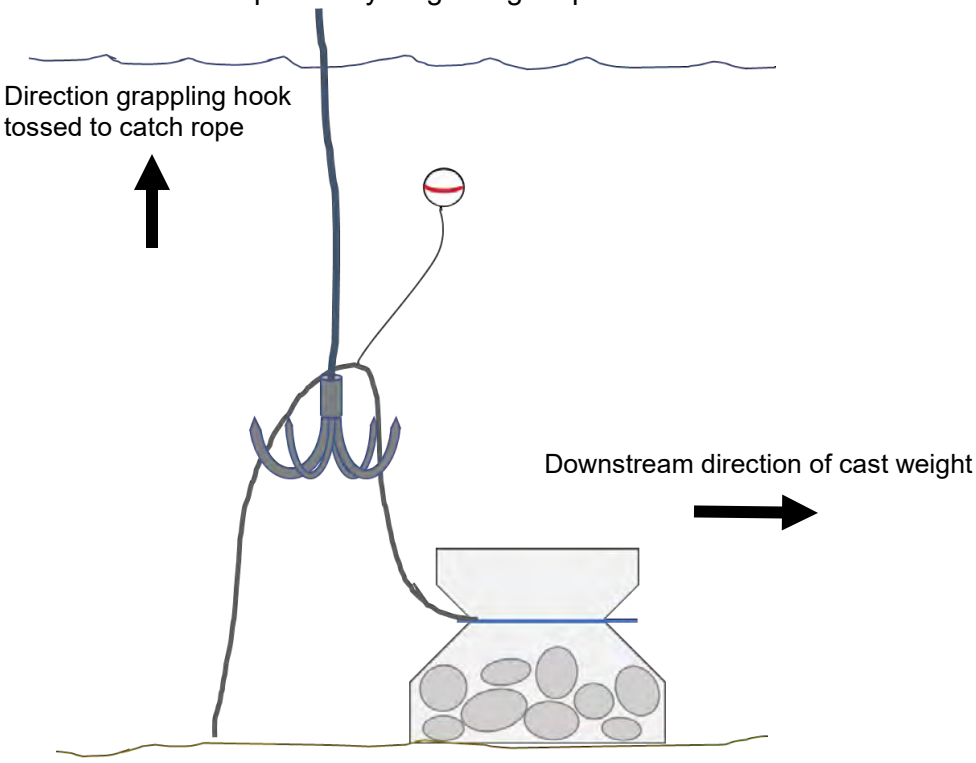
Retrieval

1. Locate the peeper using the GPS coordinates and note the orientation of the weighed anchor line.
2. Using a grappling hook, catch the weighted rope by tossing the hook in a direction perpendicular to that in which the weight and anchor line were deployed. Drag the grappling hook on the bottom of the sediment until snagged on the rope. Pull the boat or platform above the hook and pull everything straight up.



3. Store the frame with the tag in a sealable clean Mylar bag if the water vials will not be immediately transferred to laboratory bottles. Ensure all field equipment that may come in contact with the sampler assembly is PFAS free.

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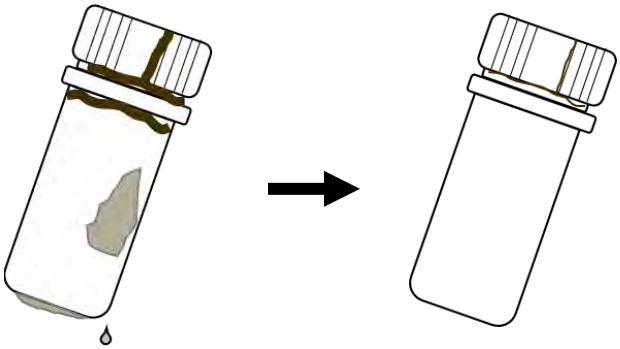
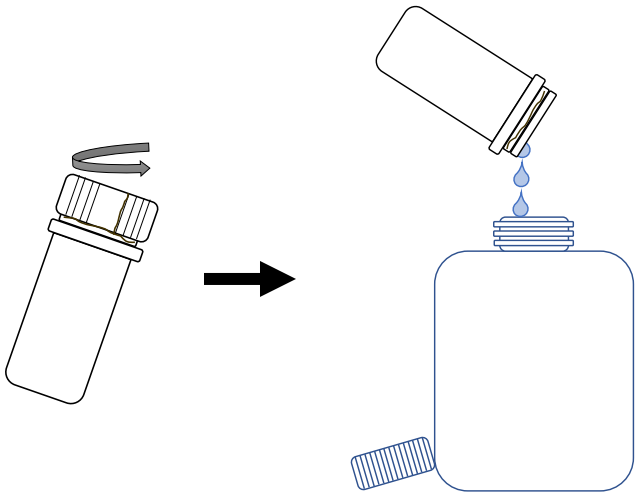
Processing in Field Lab

1. Prepare a clean workstation (i.e. table), ideally in a sheltered area. Essential elements include:
    a. PFAS-free Roll of paper towel;
    b. Box of Kimwipes®;
    c. Squeeze bottle of PFAS free DI or distilled water;
    d. Extra PFAS free DI or distilled water;
    e. Laboratory supplied sample bottles to transfer sample from vials;
    f. PFAS-free Nitrile gloves;
    g. Garbage bag or container to contain waste.

2. Rinse the vial with PFAS-free DI water to clean off sediment. Paper towel can be used to remove most of the sediment. Ensure to flush thoroughly around the threads of the lid. **There should be no trace of sediment along the vial shaft and bottom.** Flush sediment off gloves. Use a Kimwipe and DI water to perform a final cleaning and drying. The lid should be mostly free of sediment, such that general holding of the vial will not lead to contaminating the shaft with residual sediment from the lid.



3. Open the lid and carefully pour the vial water into the laboratory supplied bottles, without transferring any residual particles. Note that the 4-vials from a location frame are to be added to a single bottle.



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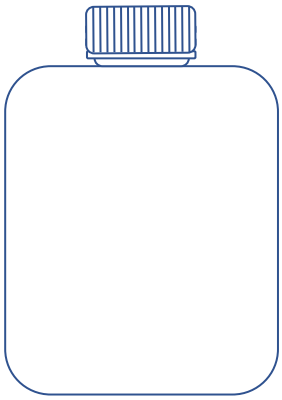
4. Cap the now-filled sample bottle and ensure a legible label is in place. Retain filled sample bottles in a cooler with ice.



5. Repeat steps 2 to 4, as necessary.
6. Once all field samples have been collected, open one of the trip blank PFASsive bags and collect the trip blank samples from the 4 trip blank vials into one sample container, as in Steps 3 and 4. Repeat for the remaining trip blank bags.
7. Once all samples have been transferred, prepare the samples for laboratory submission (e.g. fill out COC, initiate transfer of samples to receiving laboratory for analysis, etc.).
8. Shipping details for collected PFASsive™ water:
    a. Include ice (double-ziploc bagged, or bagged blue ice packs
    b. Collected water in laboratory bottles
    c. Chain of custody
        i. Note draft EPA 1633 or modified EPA 537 for PFAS
        ii. Eurofins Environment Testing America contact is Laura Turpen (laura.turpen@et.eurofinsus.com)
    d. Address to ship:

        Eurofins Environment Testing America
        800 Riverside Parkway
        West Sacramento, CA 95605
        Attn: Sample Receiving, Laura Turpen
        Phone: 916-373-5600

    e. Ship overnight for next morning delivery

Attachment A:

Approximate Method Detection Limits

Approximate Method Detection and Reporting Limits for concentrations of freely-dissolved (Cfree) PFAS, as measured using the PFASsive™ Sampler, 28-day static deployment period.

Compound	Group	Approximate Freely-dissolved (Cfree) MDL (ng/L)	Approximate Freely-dissolved (Cfree) MRL (ng/L)	Note
Perfluorobutanoic acid (PFBA)	PFAS	3.00	4.0	1
Perfluoropentanoic acid (PFPeA)	PFAS	0.60	2.0	1
Perfluorohexanoic acid (PFHxA)	PFAS	0.70	2.0	1
Perfluoroheptanoic acid (PFHpA)	PFAS	0.30	2.0	1
Perfluorooctanoic acid (PFOA)	PFAS	1.00	2.0	1
Perfluorononanoic acid (PFNA)	PFAS	0.30	1.0	1
Perfluorodecanoic acid (PFDA)	PFAS	0.4	2.0	1
Perfluoroundecanoic acid (PFUnA)	PFAS	2.00	3.0	1
Perfluorododecanoic acid (PFDoA)	PFAS	1.00	4.0	1
Perfluorotridecanoic acid (PFTrDA)	PFAS	5.0	6.0	1
Perfluorotetradecanoic acid (PFTeA)	PFAS	3.00	6.0	1
Perfluorobutanesulfonic acid (PFBS)	PFAS	0.20	1.0	1
Perfluoropentanesulfonic acid (PFPeS)	PFAS	0.40	2.0	1
Perfluorohexanesulfonic acid (PFHxS)	PFAS	0.70	2.0	1
Perfluoroheptanesulfonic acid (PFHpS)	PFAS	0.20	2.0	1
Perfluorooctanesulfonic acid (PFOS)	PFAS	0.70	2.0	1
Perfluorononanesulfonic acid (PFNS)	PFAS	0.50	2.0	1
Perfluorodecanesulfonic acid (PFDS)	PFAS	0.50	2.0	1
Perfluorododecanesulfonic acid (PFDoS)	PFAS	1.00	2.0	1
Perfluorooctanesulfonamide (FOSA)	PFAS	1.00	2.0	1
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	PFAS	1.00	4.0	1
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	PFAS	1.0	4.0	1
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	PFAS	0.30	1.0	1
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	PFAS	3.00	5.0	1
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	PFAS	0.70	2.0	1
N-ethylperfluorooctane sulfonamide (NEtFOSA)	PFAS	1.00	2.0	1
N-methylperfluorooctane sulfonamide (NMeFOSA)	PFAS	0.50	1.0	1
N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	PFAS	2.00	3.0	1
N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	PFAS	1.00	2.0	1
9Cl-PF3ONS	PFAS	0.20	1.0	1
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	PFAS	2.00	3.0	1
11Cl-PF3OUdS	PFAS	0.30	1.0	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	PFAS	0.40	1.0	1
3:3 FTCA	PFAS	0.60	2.0	1
5:3 FTCA	PFAS	0.50	2.0	1
7:3 FTCA	PFAS	0.80	2.0	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	PFAS	0.60	1.0	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFAS	0.30	1.0	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFAS	0.30	1.0	1
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	PFAS	0.30	1.0	1

Notes

1: Levels are approximate. The ability to quantify Cfree for each analyte, as well as the overall analytical performance of the sampler, is subject to site- and sampler-specific sampling conditions.

SAP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Water

Analytical Group: PFAS

Analyte	CAS Number	Project Action Limit (ng/L)	Project Action Limit Reference[1]	Laboratory-specific		
				LOQ (ng/L)	LOD (ng/L)	DLs (ng/L)
Perfluorobutanoic acid (PFBA)	375-22-4	NE[2]	NA	8	3.2	0.942
Perfluoropentanoic acid (PFPeA)	2706-90-3	NE[2]	NA	4	1.6	0.553
Perfluorohexanoic acid (PFHxA)	307-24-4	NE[2]	NA	2	1.28	0.454
Perfluoroheptanoic acid (PFHpA)	375-85-9	NE[2]	NA	2	1.28	0.501
Perfluorooctanoic acid (PFOA)	335-67-1	6	EPA RSL	2	0.8	0.367
Perfluorononanoic acid (PFNA)	375-95-1	6	EPA RSL	2	1.6	0.657
Perfluorodecanoic acid (PFDA)	335-76-2	NE[2]	NA	4	2.4	0.81
Perfluoroundecanoic acid (PFUnA)	2058-94-8	NE[2]	NA	4	1.28	0.61
Perfluorododecanoic acid (PFDoA)	307-55-1	NE[2]	NA	4	1.28	0.603
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	NE[2]	NA	2	1.28	0.478
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	NE[2]	NA	2	1.28	0.554
Perfluorobutanesulfonic acid (PFBS)	375-73-5	601	EPA RSL	2	0.707	0.289
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	NE[2]	NA	2	0.75	0.352
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	39	EPA RSL	2	1.15	0.393
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	NE[2]	NA	2	1.23	0.395
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	4	EPA RSL	2	1.18	0.441
Perfluorononanesulfonic acid (PFNS)	68259-12-1	NE[2]	NA	2	1.23	0.402
Perfluorodecanesulfonic acid (PFDS)	335-77-3	NE[2]	NA	2	0.77	0.328
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	NE[2]	NA	2	1.24	0.431
Perfluorooctanesulfonamide (PFOSA)	754-91-6	NE[2]	NA	4	0.8	0.346
N-ethylperfluorooctane sulfonamide (NEtFOSA)	4151-50-2	NE[2]	NA	2	0.8	0.365
N-methylperfluorooctane sulfonamide (NMeFOSA)	31506-32-8	NE[2]	NA	4	1.28	0.453
N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	1691-99-2	NE[2]	NA	20	8	2
N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	24448-09-7	NE[2]	NA	20	8	2.33
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	NE[2]	NA	2	1.28	0.554
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	NE[2]	NA	4	1.6	0.735
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	NE[2]	NA	8	4.79	1.65
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	NE[2]	NA	8	3.04	1.07
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	NE[2]	NA	8	3.06	1.41
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	NE[2]	NA	8	2.98	0.757
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	NE[2]	NA	8	3.01	0.818
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	NE[2]	NA	8	4.82	1.67
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	6	EPA RSL	8	5.12	1.85
3-Perfluoropropylpropanoic acid (3:3 FTCA)	356-02-5	NE[2]	NA	10	4	1
3-Perfluoropentylpropanoic acid (5:3 FTCA)	914637-49-3	NE[2]	NA	50	20	5.54
3-Perfluoroheptylpropanoic acid (7:3 FTCA)	812-70-4	NE[2]	NA	50	20	6.53
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	NE[2]	NA	4	1.6	0.63
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	NE[2]	NA	4	2.28	0.731
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	NE[2]	NA	4	1.6	0.578
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	NE[2]	NA	4	1.6	0.608

1) The PALs are the May 2022 EPA tap water RSLs based on a target cancer risk (TR) of 1E-06 and target hazard quotients (THQ) of 0.1. The RSLs are presented in a Memorandum from the Office of the Assistant Secretary of Defense, Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program, distributed on July 6, 2022.

2) Health-based screening values have not been established. The compounds are being analyzed to monitor for presence in water samples.

NE = Not established

NA = Not applicable.

DLs & LODs are subject to change.

SAP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Solid

Analytical Group: PFAS

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference	Laboratory-specific		
				LOQ (ug/kg)	LOD (ug/kg)	DLs (ug/kg)
Perfluorobutanoic acid (PFBA)	375-22-4	NE[2]	NA	0.8	0.4	0.14
Perfluoropentanoic acid (PFPeA)	2706-90-3	NE[2]	NA	0.4	0.2	0.0715
Perfluorohexanoic acid (PFHxA)	307-24-4	NE[2]	NA	0.2	0.16	0.058
Perfluoroheptanoic acid (PFHpA)	375-85-9	NE[2]	NA	0.2	0.1	0.0429
Perfluorooctanoic acid (PFOA)	335-67-1	19	EPA RSL	0.2	0.1	0.0453
Perfluorononanoic acid (PFNA)	375-95-1	19	EPA RSL	0.2	0.16	0.0523
Perfluorodecanoic acid (PFDA)	335-76-2	NE[2]	NA	0.4	0.3	0.128
Perfluoroundecanoic acid (PFUnA)	2058-94-8	NE[2]	NA	0.4	0.3	0.102
Perfluorododecanoic acid (PFDoA)	307-55-1	NE[2]	NA	0.4	0.3	0.11
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	NE[2]	NA	0.2	0.1	0.0403
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	NE[2]	NA	0.2	0.16	0.0562
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	EPA RSL	0.2	0.0884	0.0301
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	NE[2]	NA	0.2	0.0938	0.0254
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	130	EPA RSL	0.2	0.0902	0.015
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	NE[2]	NA	0.2	0.0951	0.0427
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	13	EPA RSL	0.2	0.092	0.0414
Perfluorononanesulfonic acid (PFNS)	68259-12-1	NE[2]	NA	0.2	0.154	0.0631
Perfluorodecanesulfonic acid (PFDS)	335-77-3	NE[2]	NA	0.2	0.154	0.057
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	NE[2]	NA	0.2	0.155	0.059
Perfluorooctanesulfonamide (PFOSA)	754-91-6	NE[2]	NA	0.4	0.2	0.0977
N-ethylperfluorooctane sulfonamide (NEtFOSA)	4151-50-2	NE[2]	NA	0.2	0.16	0.0515
N-methylperfluorooctane sulfonamide (NMeFOSA)	31506-32-8	NE[2]	NA	0.4	0.2	0.0933
N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	1691-99-2	NE[2]	NA	2	1	0.25
N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	24448-09-7	NE[2]	NA	2	1	0.4
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	NE[2]	NA	0.2	0.16	0.0541
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	NE[2]	NA	0.4	0.3	0.101
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	NE[2]	NA	0.8	0.748	0.317
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	NE[2]	NA	0.8	0.38	0.144
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	NE[2]	NA	0.8	0.383	0.108
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	NE[2]	NA	0.8	0.596	0.238
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	NE[2]	NA	0.8	0.602	0.287
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	NE[2]	NA	0.8	0.603	0.189
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	23	EPA RSL	0.8	0.639	0.217
3-Perfluoropropylpropanoic acid (3:3 FTCA)	356-02-5	NE[2]	NA	1	0.799	0.287
3-Perfluoropentylpropanoic acid (5:3 FTCA)	914637-49-3	NE[2]	NA	5	2.5	0.748
3-Perfluoroheptylpropanoic acid (7:3 FTCA)	812-70-4	NE[2]	NA	5	2.5	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	NE[2]	NA	0.4	0.32	0.114
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	NE[2]	NA	0.4	0.178	0.0537
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	NE[2]	NA	0.4	0.2	0.0872
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	NE[2]	NA	0.4	0.2	0.051

1) The PALs are the May 2022 EPA residential soil RSLs based on a target cancer risk (TR) of 1E-06 and target hazard quotients (THQ) of 0.1. The RSLs are presented in a Memorandum from the Office of the Assistant Secretary of Defense, Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program, distributed on July 6, 2022.

2) Health-based screening values have not been established. The compounds are being analyzed to monitor for presence in soil and sediment samples.

ng/g = nanograms / gram

DLs & LODs are subject to change.

SAP Worksheet #19 & 30

Analytical SOP Requirements Table

Analyte/Analyte Group	Matrix	Analytical and Preparation Method/ SOP Reference[1]	Containers (Number, Size, and Type per Sample)	Preservation Requirements (Chemical, Temperature, Light Protected)	Preparation Holding Time[2]	Analytical Holding Time[2]	Data Package Turnaround
Perfluorinated Compounds	Water	Draft Method 1633/WS-LC-0039	2 x 500 mL + 1-125 mL HDPE Bottles	Cool to 0 to 6 C	28 days (0-6C)	90 days	Standard
Perfluorinated Compounds	Soils	Draft Method 1633/WS-LC-0039	1 x 4-ounce HDPE jar	Cool to 0 to 6 C	28 days (0-6C)	90 days	Standard

[1] See Worksheet 23

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. (Not VTSR)

SAP Worksheet #24

Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Mass Calibration	Prior to initial use and after any major maintenance is performed.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Range must bracket the ion masses of interest. Mass calibration verified to 0.5 amu of true value by acquiring a full scan continuum of mass spectrum of PFAS stock standard.	If problem found, correct as appropriate, then recalibrate.	Lab Manager / Analyst [b]	WS-LC-0039
LC/MS/MS	Mass Spectral Acquisition Rate	Each Target, EIS, and NIS compound.	A minimum of 10 spectra scans are acquired across each chromatographic peak	If problem found, correct as appropriate, then recalibrate.	Lab Manager / Analyst b	WS-LC-0039
LC/MS/MS	Ion transitions (Precursor --> Product)	Every field sample, standard, blank and QC samples	Use ion transitions from Table 2 of Draft Method EPA 1633.	If problem found, correct as appropriate, then recalibrate.	Lab Manager / Analyst b	WS-LC-0039
LC/MS/MS	Minimum six-point initial calibration for target analytes, lowest concentration standard at or below the LOQ.	Prior to initial use and after ICV or CCV failure, prior to sample analysis.	S/N ratio $\geq$ 3:1 for all ions used for quantitation. The %RSD/RSE for all analytes must be $\leq$20%.	Evaluate standards, chromatography, and mass spectrometer response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0039
LC/MS/MS	Instrument blanks	Immediately following the highest standard analyzed, daily prior to sample analysis and after each CCV.	Concentration of each analyte must be $\leq$ 1/2 the LOQ.	If acceptance criteria are not met after the highest standard, the ICAL must be performed at a lower concentration until the acceptance criteria (<1/2 LOQ) are met. If not met after samples, additional blanks are needed until the acceptance criteria are met. Samples shall not be analyzed until the acceptance criteria are met.	Lab Manager / Analyst [b]	WS-LC-0039

SAP Worksheet #24

Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Second-source or initial calibration verification (ICV)	Once after each initial calibration (ICAL) prior to sample analysis.	All reported analytes and labelled compounds within ± 30% of their true value.	Evaluate data. If problem (e.g., concentrated standard, plugged transfer line) found, correct, then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst [b]	WS-LC-0039
LC/MS/MS	Instrument sensitivity check (ISC)	Prior to analysis. ISC can serve as a beginning CCV.	Analyte concentrations must be at the LOQ and within ± 30% of their true values.	Correct problem, rerun ISC. If problem persists repeat ICAL.	Lab Manager / Analyst [b]	WS-LC-0039
LC/MS/MS	Continuing calibration verification (CCV)	Before sample analysis, after every 10 field samples, and at the end of the sequence.	All reported analytes and labelled compounds within ± 30% of their true values.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. Or evaluate failure and impact on samples. If samples non-detect for analytes which have a high bias, report non-detect results with case narrative comment. For closing CCVs, if compounds are not identified as critical compounds of concern report results with qualifiers. For closing CCVs, if the compound is identified as a critical compound of concern, then recalibrate, and reanalyze all affected samples since the last acceptable CCV.	Lab Manager / Analyst [b]	WS-LC-0039
LC/MS/MS	Bile Salt Standard	Daily, prior to analysis of all matrix types.	The difference in retention time between the bile salt peaks and PFOS must be > 1 minute.	If problem found, correct as appropriate, then recalibrate.	Lab Manager / Analyst [b]	WS-LC-0039

[b] *The analyst initiates the corrective action and the lab manager and analyst are responsible for the corrective action.*

SAP Worksheet #25

Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table								
Instrument/ Equipment	**Maintenance Activity**	**Testing Activity**	**Inspection Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Responsible Person**	**SOP Reference**
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check (Worksheet 24)	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Eurofins Chemist	WS-LC-0039

SAP Worksheet #28
Laboratory QC Samples Table

Matrix	Aqueous and Solid
Analytical Group	PFAS
Analytical Method/ SOP Reference	Draft Method 1633/WS-LC-0039

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Extracted Internal Standards (EIS) or (Isotope Dilution Analyte (IDA), added prior to extraction)	Every sample, spiked sample, standard, and method blank	Use in-house limits if project limits are not specified. Prelim limits of 20-150% until in-house limits are generated. See Table 28B for IDA limits for aqueous samples.	If EIS out check for errors and correct. Re-analyze sample. If EIS still out high: ND samples, report and narrate; if detections, but EIS<200% report and narrate; if detections and EIS>200%, dilute, re-analyze, report and narrate. If EIS still out low; ND samples evaluate S/N of CCVL, report and narrate; if detections report and narrate. If EIS < 10% re-extract. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Lab Manager / Analyst	Accuracy/Bias	Project or laboratory statistically derived control limits
Non-extracted Internal Standards (NIS) added following extraction and prior to analysis.	Every sample, spiked sample, standard, and method blank	NIS areas must be greater than 40% of the area of the continuing calibration standard in undiluted sample extracts and sample extracts that require NIS to be added.	If fails, repeat the analysis using a fresh aliquot of the extract. If the failure confirms examine project requirements and contact the client.	Lab Manager / Analyst	Accuracy/Bias	Results within acceptance limits.
Method Blank	One per preparation batch	No target analytes > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Verify instrument clean (evaluate calibration blank & samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination	No target analytes > 1/2 LOQ
Low-level LCS (LLCS)	One LLCS per preparation batch	Use in-house limits if project limits are not specified. Prelim limits of 40-150% until in-house limits are generated. See Table 28A for LLCS limits for aqueous samples.	Reanalyze LLCS once. If acceptable, report. Evaluate samples for detections, and LLCS for high bias. If LLCS has high bias, and samples non-detect, report with case narrative comment. If LLCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LLCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Project or laboratory statistically derived control limits
LCS	One LCS per preparation batch	Use in-house limits if project limits are not specified. Prelim limits of 40-150% until in-house limits are generated. See Table 28A for LCS limits for aqueous samples.	Reanalyze LCS once. If acceptable, report. Evaluate samples for detections, and LCS for high bias. If LCS has high bias, and samples non-detect, report with case narrative comment. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Project or laboratory statistically derived control limits

SAP Worksheet #28
Laboratory QC Samples Table

Matrix	Aqueous and Solid
Analytical Group	PFAS
Analytical Method/ SOP Reference	Draft Method 1633/WS-LC-0039

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Lab Duplicate (DU)	One DU per preparation batch	RPD ≤ 30%	Examine project specific requirements. Contact the client as to additional measures to be taken. Evaluate the data, and re-prepare/reanalyze the native sample and DU pair if laboratory error is indicated.	Lab Manager / Analyst	Precision	Project or laboratory statistically derived control limits
MS/MSD	One MS/MSD pair per preparation batch	Use in-house LCS limits if project limits are not specified. Prelim LCS limits of 40-150% until in-house limits are generated. RPD ≤ 30%	Examine project specific requirements. Contact the client as to additional measures to be taken. Evaluate the data, and re-prepare/reanalyze the native sample and MS/MSD pair if laboratory error is indicated.	Lab Manager / Analyst	Precision and Accuracy/Bias	Project or laboratory statistically derived control limits
Ion Ratio	Each detected analyte (except PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA & PFMBA)	Acceptance window of 50-150% of the ratio in the mid-point calibration standard or daily CCV standard.	Reanalyze affected sample(s) once. If acceptable, report. If not, verify instrument performance, and verify that all sample prep steps to alleviate matrix taken (e.g., cleanups, dilutions). If no improvement, report with qualifier & narrate ion transition ratios outside criteria.	Lab Manager / Analyst	Accuracy/Contamination	50-150% of daily CCV or ICAL midpoint for compounds with sufficient secondary transitions.

SAP Worksheet #28 B
Laboratory QC Samples Table

Matrix	Aqueous
Analytical Group	PFAS
Analytical Method/ SOP Reference	Draft Method 1633/WS-LC-0039

	LCS		LLCS	
Analyte	**Lower Limit**	**Upper Limit**	**Lower Limit**	**Upper Limit**
Perfluorobutanoic acid (PFBA)	58	148	44	157
Perfluoropentanoic acid (PFPeA)	54	152	57	148
Perfluorohexanoic acid (PFHxA)	55	152	62	149
Perfluoroheptanoic acid (PFHpA)	54	154	56	150
Perfluorooctanoic acid (PFOA)	52	161	57	161
Perfluorononanoic acid (PFNA)	59	149	53	157
Perfluorodecanoic acid (PFDA)	52	147	43	158
Perfluoroundecanoic acid (PFUnA)	48	159	50	155
Perfluorododecanoic acid (PFDoA)	64	142	60	141
Perfluorotridecanoic acid (PFTrDA)	49	148	52	140
Perfluorotetradecanoic acid (PFTeDA)	47	161	52	156
Perfluorobutanesulfonic acid (PFBS)	62	144	63	145
Perfluoropentanesulfonic acid (PFPeS)	59	151	58	144
Perfluorohexanesulfonic acid (PFHxS)	57	146	44	158
Perfluoroheptanesulfonic acid (PFHpS)	55	152	51	150
Perfluorooctanesulfonic acid (PFOS)	58	149	43	162
Perfluorononanesulfonic acid (PFNS)	52	148	46	151
Perfluorodecanesulfonic acid (PFDS)	51	147	50	144
Perfluorododecanesulfonic acid (PFDoS)	36	145	30	138
Perfluorooctanesulfonamide (PFOSA)	61	148	47	163
N-ethylperfluorooctane sulfonamide (NEtFOSA)	65	139	49	156
N-methylperfluorooctane sulfonamide (NMeFOSA)	63	145	54	155
N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	69	137	60	147
N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	71	136	56	151
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	59	146	51	154
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	58	144	32	160
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	67	146	52	158
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	61	151	48	158
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	63	152	46	165
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	56	156	44	167
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	46	156	36	158
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	68	146	61	148
Hexafluoropropylene oxide dimer acid (HFPO-DA)	63	144	58	154
3-Perfluoropropylpropanoic acid (3:3 FTCA)	62	129	32	161
3-Perfluoropentylpropanoic acid (5:3 FTCA)	63	134	39	156
3-Perfluoroheptylpropanoic acid (7:3 FTCA)	50	138	36	149
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	48	161	47	160
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	56	151	56	144
Perfluoro-3-methoxypropanoic acid (PFMPA)	51	145	48	150
Perfluoro-4-methoxybutanoic acid (PFMBA)	55	148	49	154

SAP Worksheet #28 B
Laboratory QC Samples Table

Matrix	Aqueous
Analytical Group	PFAS
Analytical Method/ SOP Reference	Draft Method 1633/WS-LC-0039

	LCS		LLCS	
Analyte	**Lower Limit**	**Upper Limit**	**Lower Limit**	**Upper Limit**
IDA/EIS				
13C4 PFBA	10	130	10	130
13C PFPeA	40	150	40	150
13C PFHxA)	40	150	40	150
13C PFHpA)	40	150	40	150
13C PFOA)	30	140	30	140
13C PFNA)	30	140	30	140
13C PFDA)	20	140	20	140
13C PFUnA)	20	140	20	140
13C PFDoA)	10	150	10	150
13C PFTeDA)	10	130	10	130
13C PFBS)	25	150	25	150
13C PFHxS)	25	150	25	150
13C PFOS)	20	140	20	140
13C 4:2 FTS)	25	200	25	200
13C 6:2 FTS)	25	200	25	200
13C 8:2 FTS)	25	200	25	200
13C PFOSA)	10	130	10	130
d5 NMeFOSA)	10	130	10	130
d3 NEtFOSA)	10	130	10	130
d3 (NMeFOSAA)	10	200	10	200
d5 NEtFOSAA)	10	200	10	200
d7 NMeFOSE)	10	150	10	150
d9 NEtFOSE)	10	150	10	150
13C HFPO-DA)	25	160	25	160

SAP Worksheet #28 B
Laboratory QC Samples Table

Matrix	Aqueous
Analytical Group	PFAS
Analytical Method/ SOP Reference	Draft Method 1633/WS-LC-0039

IDA	Lower Limit	Upper Limit	
13C4 PFBA	10	130	*
13C PFPeA	35	150	
13C PFHxA)	55	150	
13C PFHpA)	55	150	
13C PFOA)	60	140	
13C PFNA)	55	140	
13C PFDA)	50	140	
13C PFUnA)	30	140	
13C PFDoA)	10	150	
13C PFTeDA)	10	130	*
13C PFBS)	55	150	
13C PFHxS)	55	150	
13C PFOS)	45	140	
13C 4:2 FTS)	60	200	*
13C 6:2 FTS)	60	200	*
13C 8:2 FTS)	50	200	*
13C PFOSA)	30	130	
d5 NMeFOSA)	15	130	
d3 NEtFOSA)	10	130	
d3 (NMeFOSAA)	45	200	*
d5 NEtFOSAA)	10	200	
d7 NMeFOSE)	10	150	*
d9 NEtFOSE)	10	150	*
13C HFPO-DA)	25	160	

* In the multi-laboratory validation study data for waste water matrices, some laboratories had difficulties achieving IDA recoveries in this range.

Title: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, Biosolids and Tissue

[Method 1633]

Approvals (Signature/Date):

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Facility Distribution No. Uncontrolled **Distributed To:** Sacramento QA

1. SCOPE AND APPLICATION

1.1. This procedure describes the analysis of water, soil, solids, biosolids, and tissue samples for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS).

Table 1.1
PFAS Supported

Compound Name	Abbreviations	CAS #
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
Perfluoro-n-hexanoic acid	PFHxA	307-24-4
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluoro-n-decanoic acid	PFDA	335-76-2
Perfluoro-n-undecanoic acid	PFUnA	2058-94-8
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8
Perfluoro-n-tetradecanoic acid	PFTeDA	376-06-7
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1
Perfluoro-nonanesulfonic acid	PFNS	68259-12-1
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3
Perfluoro-1-dodecansulfonic acid	PFDoS	79780-39-5
Perfluorinated sulfonamides (FOSAs)		
Perfluoro-1-octanesulfonamide	PFOSA, (FOSA)	754-91-6
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA (Et-FOSA)	4151-50-2
N-methylperfluoro-1-octanesulfonamide	NMeFOSA (Me-FOSA)	31506-32-8
Perfluorinated sulfonamide ethanols (FOSEs)		
2-(N-ethylperfluoro-1-octanesulfonamido) ethanol	NEtFOSE (Et-FOSE)	1691-99-2
2-(N-methylperfluoro-1-octanesulfonamido) ethanol	NMeFOSE (Me-FOSE)	24448-09-7

Table 1.1 PFAS Supported		
Compound Name	**Abbreviations**	**CAS #**
Perfluorinated sulfonamidoacetic acids (FOSAAs)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA (EtFOSAA)	2991-50-6
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA (MeFOSAA)	2355-31-9
Fluorotelomer sulfonic acids (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctane sulfonic acid *(6:2)*	6:2 FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonic acid *(8:2)*	8:2 FTS	39108-34-4
Fluorotelomer carboxylic acids (FTCAs)		
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Per-and Polyfluoroether carboxylic acids		
Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid	HFPO-DA, GenX	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	ADONA(1) (DONA)	919005-14-4
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFMPA, (PFECA F)	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFMBA,(PFECA A)	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	NFDHA (PFECA B)	151772-58-6
Ether sulfonic acids		
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA (PES)	113507-82-7

***Note**: Abbreviations in parenthesis are the abbreviations used by the laboratory's LIMS where they differ from the abbreviation listed in Method 1633.*

(1) In some literature, the acronym ADONA refers to the ammonium salt, CAS 958445-44-8, and DONA refers to the parent acid. In Method 1633, ADONA refers to the parent acid. DONA is the acronym present on the laboratory raw data.

1.2. The working range of the method is listed below. The linear range can be extended by diluting the extracts. Note that all compounds are reported in their acid form.

Reporting limits and Method Detection Limits for individual compounds are stored in the laboratory's LIMS.

Table 1.2
Reporting Limits and Working Range

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	500 mL	2.0 ng/L – 50 ng/L	2.0 ng/L - 1560 ng/L
Leachate	100 mL	10 ng/L – 250 ng/L	10 ng/L – 7800 ng/L
Solid	5 g	0.2 ng/g – 5.0 ng/g	0.2 ng/g - 156 ng/g
Biosolids	0.5 g	2 ng/g – 50 ng/g	2 ng/g – 1560 ng/g
Tissue	2 g	0.5 ng/g – 12.5 ng/g	0.4 ng/g – 625 ng/g

2. SUMMARY OF METHOD

2.1. Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide (NH4OH)/methanol solution.

2.2. Solid/biosolids samples are extracted with a NH4OH/methanol solution using agitation for 1 hour. The mixture is centrifuged and the solvent filtered.

2.3. Tissue samples are extracted with a potassium hydroxide (KOH)/methanol and acetonitrile solutions using agitation for 16 hours and sonication for 30 minutes. The mixture is centrifuged and the solvent filtered.

2.4. The final extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 20 mM ammonium acetate/water and methanol. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.5. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs or deuterated analogs of the compounds of interest, and they are fortified into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

2.6. Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak response is measured as the area of the peak.

3. DEFINITIONS

3.1. PFCAs: Perfluorocarboxylic acids

3.2. PFSAs: Perfluorinated sulfonic acids

3.3. FOSA: Perfluorinated sulfonamide

3.4. PFOA: Perfluorooctanoic acid

3.5. PFOS: Perfluorooctane sulfonic acid

3.6. PTFE: Polytetrafluoroethylene (e.g. Teflon®)

3.7. SPE: Solid phase extraction

3.8. PP: Polypropylene

3.9. PE: Polyethylene

3.10. HDPE: High density polyethylene

3.11. AFFF: Aqueous Film Forming Foam

3.12. TDCA: Taurodeoxycholic acid

3.13. TCDA: Taurochenodeoxycholic acid

3.14. TUDCA: Tauroursodeoxycholic acid

3.15. IDA: Isotope dilution analyte (equivalent to EIS in reference method)

3.16. IS: Internal Standard (equivalent to NIS in reference method)

3.17. LCS: Laboratory control sample (equivalent to OPR in reference method)

3.18. Further definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Assurance Manual (QAM).

4. INTERFERENCES

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean (i.e., no contribution greater than the method detection limit (MDL). These items are listed below in Section 6.

4.2. To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

4.3. PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use. Polypropylene (PP) or polyethylene (PE, HDPE) products may be used in place of PTFE products to minimize PFOA contamination.

4.3.1. Standards and samples are injected from polypropylene autosampler vials with polypropylene screw caps once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

4.3.2. Random evaporation losses have been observed with the polypropylene caps causing high IDA recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence.

4.3.3. Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same Teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is best to use polypropylene screw caps.

4.4. Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFOA. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

4.5. Both branched and linear PFAS isomers can potentially be found in the environment. Linear and branched isomers are known to exist for PFOS, PFOA, PFHxS, PFBS, Et-FOSAA, and Me-FOSAA based upon the scientific literature. If multiple isomers are present for one of these PFAS they might be adjacent peaks that completely resolve or not, but usually with a deflection point resolved during peak integration. The later of these peaks matches the retention time of its labeled linear analog. In general, earlier peaks are the branched isomers and are not the result of peak splitting.

As of this writing, only PFOS, PFOA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

4.6. In an attempt to reduce PFOS bias, it is required that m/z 499>80 transition be used as the quantitation transition.

4.7. Aluminum foil should not be used for this analysis due to the potential interferences from the PFAS used as release agents.

5. SAFETY

Employees must abide by the policies and procedures in the NDSC Safety Manual, Sacramento Supplement to the HSEM, and this document. All work must be stopped in the

event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.1. Specific Safety Concerns

5.1.1. Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS and PFAS samples must be handled in the laboratory as hazardous and toxic chemicals.

5.1.2. The use of a filtering syringe with the SPE cartridge, if and when needed, presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, and the set-up and body geometry of the individual using the syringe/SPE cartridge. Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down, rather than just using your arm and shoulder muscles. Ensure that this task is rotated amongst staff members so that no one has to do it repeatedly for weeks or months. Ensure that routine breaks are taken, and that muscles and joints involved with this task are routinely stretched to offset this hazard.

5.1.3. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.1.4. Laboratory procedures such as manual use of Vortex mixers or similar equipment, hand shaking samples beyond several inversions, repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it. This specifically includes identification and use of mechanical options that reduce the amount of manual handling required to perform extraction procedures such as Vortex mixing and shaking.

5.1.5. Eye protection that satisfies ANSI Z87.1 (as per the NDSC Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.1.6. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.1.7. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed, or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

5.2. Primary Materials Used

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

Material[1]	**Hazards**	**Exposure Limit[2]**	**Signs and Symptoms of Exposure**
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Acetonitrile (2-3-0)	Flammable Poison	20 ppm-TWA	Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body.
Ammonium Hydroxide (3-1-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Formic Acid (3-2-1)	Flammable Corrosive Toxic Irritant	5 ppm TWA 10 ppm STEL	Extremely destructive on contact with skin, mucous membranes, eyes, upper respiratory tract. Inhalation may result in spasms, inflammation and edema. Symptoms include burning sensation, coughing, wheezing, shortness of breath, headache, nausea, vomiting, and depression.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm PEL 250 ppm STEL	Harmful if swallowed, or absorbed through the skin. Causes eye, skin and respiratory tract irritation, and may cause central nervous system depression. A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison	2 mg/m^3 (Ceiling)	Symptoms of inhalation may include coughing, sneezing, damage to the nasal or respiratory tract. High concentrations can cause lung damage. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes with tearing, redness, and swelling.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6. EQUIPMENT AND SUPPLIES

Due to the ubiquitous nature of PFAS, all disposable equipment (including, but not limited to vials, pipet tips, and SPE manifold parts) that directly contacts a sample or extract is subject to QC checks on a by-lot basis prior to use. At a minimum, the QC checks include either a rinse with DI water or an extraction with basic methanol to mimic the usage encountered during sample preparation. QC check data is kept on file for reference as needed. Processes for cleaning extraction manifolds and associated components are described in WS-OP-0011, "Glassware Cleaning".

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 500, 250 and HDPE bottles with HDPE screw caps. The average weight of the HDPE bottles with HDPE screw caps are calibrated once per year. The calibration is

performed by weighing 10 bottles with caps and dividing by 10 to get the average weight. The average weight is used in Section 11.3.6.1 Step 4.

6.4. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with WS-QA-0041.

6.5. Extract concentrator or nitrogen manifold with water bath heating to 65°C.

6.6. Syringe filter, PALL/Acrodisc 0.2 um Nylon membrane, 25 mm, or equivalent. Do not use PTFE type filters.

6.7. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.8. SPE columns

6.8.1. Waters Oasis WAX 150 mg/6 cc (PN 186002493) or equivalent.

6.9. Graphitized carbon (Envi-Carb™ or equivalent) for samples.

6.10. Silanized glass wool, Sigma-Aldrich PN 20411. Rinse with methanol 2 times and store in clean glass jar prior to use. Pack to half the high of WAX SPE cartridge barrel.

6.11. Vacuum manifold for Solid Phase Extraction (SPE).

6.12. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use.

6.13. pH indicator paper, JT Baker Baker-pHIX pH 2.0-9.0, or equivalent.

6.14. Centrifuge (Thermo Scientific Sorvall Legend X1, or equivalent), capable of reaching at least 4500 rpm.

6.15. Vortex Mixer (Scientific Industries model SI-0236 or equivalent)

6.16. Shaker table (Eberbach model 6010, or equivalent) for soil extractions

6.17. Desiccator, part # B002VBW9XW or equivalent

6.18. Drierite desiccant, part # 23005-UOM-EA or equivalent

6.19. Oven, capable of maintaining a temperature of 104°C (+ 1°C), Symphony part # 15-103-0503, or equivalent

6.20. Pre-weighed 47 mm filters, Environmental Express part # F93447MM or equivalent

6.21. Vacuum pump, CPS Products VP2D Pro-set 2 State, part # UX-07164-83 or equivalent

6.22. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, may be used for this method. The HPLC is equipped with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.3 or equivalent. The MS/MS is capable of running in the NI-ESI mode at the recommended flow rate with a minimum of 10 scans per peak.

6.22.1. SCIEX LC/MS/MS

This system consists of a Shimadzu HPLC interfaced with a SCIEX 5500 Triple Quad MS, or equivalent. The instrument control and data acquisition software is SCIEX Analyst, version 1.6.3 or equivalent.

6.22.1.1. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent.

6.22.1.2. Phenomenex Gemini C_{18} 3 µm, 3.0 mm x 100 mm, Part No. 00D-4439-Y0, or equivalent.

6.22.1.3. PFAS Isolator column, Phenomenex Luna C_{18} 5 µm, 50 mm x 4.6 mm, part no. 00B-4252-E0 or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.23. Preventive and routine maintenance is described in the table below

Table 6.23
HPLC/MS/MS Preventative Maintenance

As Needed:	**Daily (When in use)**
Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Clean corona needle. Replace sample inlet tube in APCI (10.1 cm). Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes. Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use.	Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Verify that corona and multiplier are functioning.

Table 6.23 HPLC/MS/MS Preventative Maintenance	
Semi-Annually	**Annually**
Replace rough-pump oil (4-6 months). Replace oil mist and odor elements. Replace activated alumina filter if applicable	Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

7. REAGENTS AND STANDARDS

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1.1. Acetic acid, glacial

7.1.2. Acetonitrile, HPLC Grade

7.1.3. Ammonium acetate (solid salt).

7.1.4. Ammonium acetate (20 mM in water): Prepared by weighing 1.54 g of ammonium acetate and dissolving in 1 L of water. This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.5. Ammonium hydroxide (NH_4OH), 30% in water, ACS reagent grade

7.1.6. Ammonium hydroxide (NH_4OH), 3% in water: Prepared by diluting 10 mL of ammonium hydroxide (30%) with 90 mL of reagent water for a total volume of 100 mL. Replace after 3 months.

7.1.7. Ammonium hydroxide (NH_4OH), 0.3% in methanol (v/v): Prepared by diluting 10 mL of ammonium hydroxide (30%) into 990 mL of methanol for a total of 1 L.

7.1.8. Ammonium hydroxide (NH4OH), 1% in methanol (v/v): Prepared by diluting 33 mL of ammonium hydroxide into 967 mL of methanol for a total of 1 L.

7.1.9. Formic Acid, greater than 96% purity or equivalent, ACS reagent grade

7.1.10. Formic Acid, 0.1 M, in water: Prepared by dissolving 4.6 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.11. Formic Acid, 0.3 M, in water: Prepared by dissolving 13.8 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.12. Formic Acid, 5% in water(v/v): Prepared by diluting 5 mL of formic acid with 95 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.13. Formic Acid, 50% in water(v/v): Prepared by diluting 50 mL of formic acid with 50 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.14. 1:1 0.1 M formic acid:methanol (v/v); Prepared by mixing equal volumes of methanol and 0.1 M formic acid. Replace after 2 years.

7.1.15. Methanol (MeOH)

7.1.16. Potassium Hydroxide (KOH) (solid, reagent grade).

7.1.17. Potassium hydroxide, 0.4% in methanol (w/v): Prepared by weighing 16 g of potassium hydroxide and dissolving in 4 L of methanol.

7.1.18. Ottawa Sand (blank matrix for solid samples)

7.1.19. Store bought chicken breast or tilapia (blank matrix for tissue samples)

7.1.20. Water, Nanopure or Millipore, must be free of interference and target analytes.

7.1.21. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.22. Air, Ultra-Pure, used for vacuum and source gas.

7.1.23. 30:70 methanol:water (v/v), prepared by diluting 30 mL methanol with 70 mL HPLC reagent water or equivalent volume in respect to the ratio.

7.1.24. Instrument Blanks solution (94.375% MeOH, 4% H2O, 1% NH_4OH, 0.625% acetic acid): Prepare by combining 18.848 mL of MeOH, 0.348 mL reagent water, 0.128 mL glacial acetic acid and 0.676 mL 30% Ammonium Hydroxide in water.

7.2. Standards

7.2.1. PFAS are purchased as high purity solids (96% or greater) or as certified solutions. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor.

7.2.2. As of this writing, only PFOS, PFOA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical

mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

7.2.3. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 0 - 6°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.2.4. PFBS, PFHxS, PFHpS, PFOS, PFDS, and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$Mass_{acid} = Measured\ Mass_{salt} \times MW_{acid} / MW_{salt}$$

Where: MW_{acid} is the molecular weight of PFAA

MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be adjusted by a factor of 0.956.

7.2.5. For the primary source calibration solutions, individual solutions for each PFAS (both native and isotopically labelled) are purchased from Wellington Laboratories, or other reputable vendors, and are predominantly at a concentration of 50 ug/mL in basic methanol. In the case of the sulfonic compounds, the concentration is 50ug/mL of the alkali (potassium or sodium) salt. The laboratory uses the concentration of the acid form when determining the concentration of individual sulfonic acids in solution (See Section 7.2.4 above).

7.2.6. While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers. Vortex all standard solutions prior to removing aliquots.

7.3. 1633 /LCS (LCS/Matrix PFC Spike Solution), 14-400 ng/mL (nominal) in 250 ml of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

Table 7.3
1633 IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)
PFBA	50	0.320	0.064	6:2 FTS	47.4	0.320	0.061
PFPeA	50	0.160	0.032	8:2 FTS	47.9	0.320	0.061
PFHxA	50	0.080	0.016	FOSA	50	0.080	0.016
PFHpA	50	0.080	0.016	Me-FOSA	50	0.080	0.016
PFOA	50	0.080	0.016	Et-FOSA	50	0.080	0.016
PFNA	50	0.080	0.016	Me-FOSAA	50	0.080	0.016
PFDA	50	0.080	0.016	Et-FOSAA	50	0.080	0.016
PFUdA	50	0.080	0.016	Me-FOSE	50	0.080	0.016
PFDoA	50	0.080	0.016	Et-FOSE	50	0.080	0.016
PFTrDA	50	0.080	0.016	HFPO-DA	50	0.320	0.064
PFTeDA	50	0.080	0.016	4,8-dioxa-3H-PFNA (DONA)	47.1	0.320	0.060
PFBS	44.2	0.080	0.014	PFMPA (PFECA F)	50	0.160	0.032
PFPeS	46.9	0.080	0.015	PFMBA (PFECA A)	50	0.160	0.032
PFHxS	45.5	0.080	0.015	NFDHA (PFECA B)	50	0.160	0.032
PFHpS	47.6	0.080	0.015	9Cl-PF3ONS	46.6	0.320	0.060
PFOS	46.6	0.080	0.015	11Cl-PF3OUdS	47.1	0.320	0.060
PFNS	48	0.080	0.015	PFEESA (PES)	44.5	0.160	0.028
PFDS	48.2	0.080	0.015	3:3 FTCA	50	0.400	0.080
PFDoS	48.4	0.080	0.015	5:3 FTCA	50	2.000	0.400
4:2 FTS	46.7	0.320	0.015	7:3 FTCA	50	2.000	0.400

7.4. 1633 Isotope Dilution Analyte Solution (Extracted Internal Standards), 25-500 ng/mL

The 1633-IDA solution is added to all samples prior to extraction and used as an intermediate solution for preparation of the instrument calibration standards. 200 mL of the solution at a nominal concentration of 0.025-0.5 ug/mL (25-500 ng/mL) is prepared from the individual solutions described in Section 7.2.5. using the recipe below:

Table 7.4
1633-IDA Recipe
The solutions below are combined and diluted to 200 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C4-PFBA	50	1.200	0.20	13C8-PFOS	47.8	0.300	0.0478
13C5-PFPeA	50	0.600	0.10	13C2-4:2FTS	46.7	0.600	0.0934
13C5-PFHxA	50	0.300	0.050	13C2-6:2FTS	47.5	0.600	0.0950
13C4-PFHpA	50	0.300	0.050	13C2-8:2FTS	47.9	0.600	0.0958
13C8-PFOA	50	0.300	0.050	13C8-FOSA	50	0.300	0.050
13C9-PFNA	50	0.150	0.025	d3-MeFOSA	50	0.300	0.050
13C6-PFDA	50	0.150	0.025	d5-EtFOSA	50	0.300	0.050
13C7-PFUdA	50	0.150	0.025	d3-MeFOSAA	50	0.600	0.10
13C2-PFDoA	50	0.150	0.025	d5-EtFOSAA	50	0.600	0.10
13C2-PFTeDA	50	0.150	0.025	d7-Me-FOSE	50	3.000	0.50
13C3-PFBS	46.5	0.300	0.0465	d9-Et-FOSE	50	3.000	0.50
13C3-PFHxS	50	0.300	0.050	13C3-HFPO-DA	50	1.200	0.20

7.5. 1633 Internal Standard Solution, 100-400 ng/mL

The 1633 IS solution is added to all extracts prior to analysis and used as an intermediate solution for preparation of the instrument calibration standards. 20 mL of the solution at a nominal concentration of 0.1-0.4 ug/mL (100-400 ng/mL) is prepared from the individual solutions described in Section 7.2.5 using the recipe below.

Table 7.5
1633-IS Recipe
The solutions below are combined and diluted to 60 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/mL)
13C3-PFBA	50	0.48	0.400	13C2-PFDA	50	0.12	0.100
13C2-PFHxA	50	0.24	0.200	18O2-PFHxS	47.3	0.24	0.189
13C4-PFOA	50	0.24	0.200	13C4-PFOS	47.8	0.24	0.191
13C5-PFNA	50	0.12	0.100				

7.6. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, and 7.5, above. For each level, a 100 mL volumetric flask is filled with 4 mL of water, and methanol added. The appropriate amount (see table below) of the solutions are

added, and then the flask is filled to the mark with methanol to achieve the ratio of 96% methanol to 4% water, v/v.

Table 7.6
1633 Calibration Solution Recipe

PFAS Standards	Volume (mL) to add in 100 mL FV							
	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
1633 IM/LCS (0.02 µg/mL)	0.125	0.25	1.25	5	12.5	25	50	250
1633 IDA Mix (0.025µg/mL)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1633 IS Mix (0.1-0.4 µg/mL)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

7.6.1. Initial Calibration (ICAL) Levels (ng/mL)

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
PFBA	0.4	0.8	2	5	10	20	50	250
PFPeA	0.2	0.4	1	2.5	5	10	25	125
PFHxA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFHpA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFOA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFNA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFUdA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDoA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTrDA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTeDA	0.01	0.2	0.5	1.25	2.5	5	12.5	62.5
PFBS	0.0884	0.1768	0.442	1.105	2.21	4.42	11.05	55.25
PFPeS	0.0938	0.1876	0.469	1.1725	2.345	4.69	11.725	58.625
PFHxS*	0.091	0.182	0.455	1.1375	2.275	4.55	11.375	56.875
PFHpS	0.0952	0.1904	0.476	1.19	2.38	4.76	11.9	59.5
PFOS*	0.0928	0.1856	0.464	1.16	2.32	4.64	11.6	58
PFNS	0.096	0.192	0.48	1.2	2.4	4.8	12	60
PFDS	0.0964	0.1928	0.482	1.205	2.41	4.82	12.05	60.25
PFDoS	0.0968	0.1936	0.484	1.21	2.42	4.84	12.1	60.5
4:2 FTS	0.3736	0.7472	1.868	4.67	9.34	18.68	46.7	233.5
6:2 FTS	0.3792	0.7584	1.896	4.74	9.48	18.96	47.4	237
8:2 FTS	0.3832	0.7664	1.916	4.79	9.58	19.16	47.9	239.5
FOSA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Et-FOSA	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
MeFOSAA*	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
EtFOSAA*	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSE	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Et-FOSE	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
HFPO-DA	0.4	0.8	2	5	10	20	50	250
DONA	0.37680	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFMPA (PFECA F)	0.2	0.4	1	2.5	5	10	25	125
PFMBA (PFECA A)	0.2	0.4	1	2.5	5	10	25	125
NFDHA (PFECA B)	0.2	0.4	1	2.5	5	10	25	125
9Cl-PF3ONS	0.3728	0.7456	1.864	4.66	9.32	18.64	46.6	233
11Cl-PF3OUdS	0.3768	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFEESA (PES)	0.178	0.356	0.89	2.225	4.45	8.9	22.25	111.25
3:3 FTCA	0.4992	0.9984	2.496	6.24	12.48	24.96	62.4	312
5:3 FTCA	2.49	4.992	12.48	31.2	62.4	124.8	312	1560
7:3 FTCA	2.49	4.992	12.48	31.2	62.4	124.8	312	1560
Labeled Isotope Dilution Analytes (IDA)								
13C4-PFBA	10	10	10	10	10	10	10	10
13C5-PFPeA	5	5	5	5	5	5	5	5
13C5-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C7-PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C3-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C2-4:2 FTS	5	5	5	5	5	5	5	5
13C2-6:2FTS	5	5	5	5	5	5	5	5
13C2-8:2FTS	5	5	5	5	5	5	5	5
13C8-FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSAA	5	5	5	5	5	5	5	5
d5-EtFOSAA	5	5	5	5	5	5	5	5
d7-Me-FOSE	25	25	25	25	25	25	25	25
d9-Et-FOSE	25	25	25	25	25	25	25	25
13C3-HFPO-DA	10	10	10	10	10	10	10	10
Internal Standard (IS)								
13C3-PFBA	5	5	5	5	5	5	5	5

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
13C2-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	2.365	2.365	2.365	2.365	2.365	2.365	2.365	2.365
13C4-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

** Both branched and linear isomers are used.*

***Note**: Sample extracts are in 80% MeOH/H_2O.*

***Note**: The above calibration levels are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.*

7.6.2. A technical (qualitative) grade standard which contains both linear and branched isomers for PFOA and PFNA is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of these analytes in environmental samples while relying on the initial calibration with the linear isomer quantitative standard. This technical (qualitative) grade standard is analyzed with every initial calibration and at the beginning of an analytical sequence.

7.6.2.1. Additionally, standards of the bile acids (TDCA, {TUDCA and TCDA, only if eluent is not acetonitrile}) at 1.0 ug/mL are to be analyzed, after the qualitative standard for the initial calibration, and after the LCS, but prior to samples on non-ICAL days. Be certain to attach those chromatograms to the document listed in Section 7.6.2.2.

7.6.2.2. Attach this document to the ICV from the associated ICAL by scanning the document and associating it to the file as a single document type of High Res MS Tune in TALS and to the CCVL on non-CAL days. Use the following naming convention: "_TSTD_Instrument_Date." Example: _TSTD_A10_15Mar2019.

7.6.2.3. The daily checks are attached to the initial CCV of the sequence.

7.7. Initial Calibration Verification Standard (ICV)

7.7.1. The ICV is prepared from commercially available mixed solutions (the PFC-MXB mixture from Wellington) augmented by individual stock solutions for those components not present in the commercial mixture. When available,

individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second lot from Wellington is sourced, and if that is not available, a second laboratory chemist will prepare the intermediate mixed solution for the ICV. Currently, the commercially available mixture contains the following compounds at the listed concentrations in methanol:

Table 7.7.1
PFC-MXB composition

Analyte	Stock Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)
PFHxA	2	PFBS	2
PFHpA	2	PFHxS	2
PFOA	2	PFOS	2
PFNA	2	EtFOSAA	2
PFDA	2	MeFOSAA	2
PFUdA	2	HFPO-DA	2
PFDoA	2	9Cl-PF3ONS	2
PFTrDA	2	11Cl-PF3OUdS	2
PFTeDA	2	4,8-dioxa-3H- PFNA (DONA)	2

7.7.2. ICV-IM: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.7.2
ICV-IM Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
PFBA	50	0.1	0.5	FOSA	50	0.1	0.5
PFPeA	50	0.1	0.5	Et-FOSA	50	0.1	0.5
PFPeS	46.9	0.1	0.469	Me-FOSA	50	0.1	0.5
PFHpS	47.6	0.1	0.476	Et-FOSE	50	0.1	0.5
PFNS	48	0.1	0.480	Me-FOSE	50	0.1	0.5
PFDS	48.2	0.1	0.482	4:2 FTS	46.7	0.1	0.467
PFDoS	48.4	0.1	0.484	6:2 FTS	47.4	0.1	0.474
				8:2 FTS	47.9	0.1	0.479

7.7.3. ICV-IM2: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.7.3 ICV-IM2 Recipe							
Analyte	**Stock Conc. (µg/mL)**	**Aliquot (mL)**	**ICV-IM Conc. (µg/mL)**	**Analyte**	**Stock Conc. (µg/mL)**	**Aliquot (mL)**	**ICV-IM Conc. (µg/mL)**
3:3 FTCA	50	0.1	0.5	PFEESA (PES)	44.5	0.1	0.445
5:3 FTCA	50	0.1	0.5	PFMPA (PFECA F)	50	0.1	0.5
7:3 FTCA	50	0.1	0.5	PFMBA (PFECA A)	50	0.1	0.5
				NFDHA (PFECA B)	50	0.1	0.5

7.7.4. Finally, the ICV solution is created, at a nominal concentration of 2.5 ng/mL for target analytes (sulfonic acids slightly less), and the same concentrations as the calibration solutions for IS and IDA, by filling a 100 mL flask with 20 mL of water, then adding methanol. After adding the solutions below, the contents are diluted to the mark with methanol:

Table 7.7.4 1633 ICV Recipe	
PFAS Standards	**Volume (mL) to add in 100 mL FV**
Commercial PFAS Mix	0.1
1633 ICV_IM	0.40
1633 ICV_IM2	1.0
1633 IDA Mix	2.5
1633 IS Mix	0.250

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Laboratory default requirements for sample containers, sample size, preservation and holding time are detailed in the table below.

Table 8 Sample Collection, Preservation, and Storage Requirements				
Matrix	**Sample Container**	**Minimum Sample Size**	**Preservation**	**Holding Time[1]**
Water	500 mL HDPE Bottle	500	0-6°C	28 days if 0-6°C or 90 days if stored at ≤ -20°C[2]
Soil/Sediment	4 oz. HDPE wide-mouth container	100 g	0-6°C	90 days
Tissue	4 oz. HDPE wide-mouth container	50 g	≤ -20 °C	90 days

[1] *Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.*

[2] *By default, aqueous samples for Draft Method 1633 are stored at 0-6 Centigrade and held for up to 28 days prior to extraction. During initial development of Draft Method 1633, potential issues were observed with NMeFOSE,*

NEtFOSE, NMeFOSAA, and NEtFOSAA, after 7 days of storage at 0-6 C. 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.

8.1. Extracts are stored at 0 - 6°C and must be analyzed within 90 days of extraction.

8.2. Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

8.3. Biphasic samples

8.3.1. Samples denoted as aqueous (groundwaters, surface waters, and wastewaters) with less than 50 mg of solids content are prepared and handled as a liquid sample (Section 11.2). Compare the sample to a reference container with 50 mg solid content. If the sample contains more than 50 mg solids, determine the total suspended solids (TSS) in the sample to then assess an appropriate dilution. If required contractually, contact the client for authorization to extract the sample at a smaller aliquot or as a solid. Detailed descriptions of any deviations from the procedure must be documented in the LIMS NCM program.

TSS Procedure (be certain to use the 250 mL or 125 mL container)

8.3.1.1. Use a pre-weighed filter (ProWeigh filter).

8.3.1.2. Label each dish with a sample identifier

8.3.1.3. Scan each dish into the “Dish Value” field of the TALS batch.

8.3.1.4. Copy the documented weight into the TALS batch as the tare weight.

8.3.1.5. Assemble the needed filtering apparatus.

8.3.1.6. Insert the reweighed filter into the apparatus.

8.3.1.7. Condition the filter with 10 mL of reagent water.

8.3.1.8. Filter 10.0 ± 0.02 mL of well mixed sample through the filter.

8.3.1.9. Dry the filter for ~10 seconds by drawing vacuum through that single port.

8.3.1.10. Use tweezers to carefully transfer the filter from the filtering apparatus to its reweighed dish.

8.3.1.11. Dry the filter for a minimum of 1 hour at 104 ± 1°C.

8.3.1.12. Transfer the filter to a desiccator for 1 hour or until cool.

8.3.1.13. Weigh the filter and residue using the analytical balance in Gen. Chem.

8.3.1.14. Enter this value into the TALS batch as the "WT1" value.

8.3.1.15. Make sure the following values are entered correctly into the TALS batch.

- Initial Amount = 10 mL
- Final Amount = 10 mL
- Nominal Amount Used = 10 mL (on batch information page)

8.3.1.16. TALS will calculate the TSS as follows:

Equation 1

$$TSS\ (\frac{mg}{L}) = \frac{Weight\ after\ drying\ (WT1)(mg) - Tare\ Weight\ (\mathrm{mg})}{0.01\ \mathrm{L}}$$

8.3.1.17. If the TSS >100 mg/L (50 mg/500 mL), then extract the sample at a reduced volume.

8.3.1.18. An appropriate dilution will target a TSS of <100 mg/L, i.e. if TSS = 200 mg/L then prep at 2X, if TSS = 890 mg/L then prep at 10X, etc.

8.3.1.18.1. Factors of 2, 5 and 10 should be used when determining the appripriate dilution.

8.3.2. Samples considered solids (biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 11.6. Correction for moisture content is provided through the LIMS when required by the client.

8.3.3. In the event that results are required individually for the solid and aqueous phases of a sample, the phases are separated via centrifugation, and extracted separately using the appropriate preparation (Section 11.2 for the aqueous phase and Section 11.6 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

9. QUALITY CONTROL

9.1. Initial Demonstration of Capability (IDOC)

The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (WS-PQA-003) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a low level laboratory control sample (LLCS), a laboratory control sample (LCS), a laboratory duplicate (DU) and a method blank. Laboratory generated QC samples (Blank, LLCS, LCS, DU) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, a matrix spike/matrix spike duplicate (MS/MSD) may be included in the batch. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.3. One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is an aliquot of Ottawa sand wetted with reagent water. For tissue samples the method blank is an aliquot of stored purchased chicken breast or tilapia. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC and the affected samples are required when the method blank is deemed unacceptable. See policy WS-PQA-003 for specific acceptance criteria.

9.3.1. If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

9.3.2. The method blank must not contain any analyte at or above the reporting limit, greater than 1/3 the regulatory compliance limit or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.3.2.1. DoD/DOE QSM: in addition to the above criteria, the method blank must not contain any analyte at or above ½ the reporting limit.

9.3.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.3.4. Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.3.5. Refer to WS-PQA-003 for further details of the corrective actions.

9.3.6. The position of the method blank in the SPE manifold during SPE extraction is rotated across batches.

9.4. A laboratory control sample (LCS), defined as OPR (on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria.

9.4.1. The control limits for the LCS are stored in TALS. As of this revision (1.4), control limits for aqueous samples are method defined. Limits for soil and tissue are advisory.

9.4.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%.

9.5. Low level LCS (LLCS), defined as LLOPR (low-level on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LLCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and at a concentration of twice the RL. The LLCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LLCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria.

9.5.1. The control limits for the LLCS are stored in TALS. As of this revision (1.4), control limits for aqueous samples are method defined. Limits for soil and tissue are advisory.

9.5.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%. As of this revision (1.4), control limits for aqueous samples are method defined. Limits for soil and tissue are advisory.

9.6. A laboratory duplicate (DU) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. A DU is a second aliquot of a selected field

sample that must be processed in the same manner and at the same time as the associated samples. Any RPD failures must be documented on a nonconformance memo. RPD limits are stored in TALS.

9.7. Matrix spikes are not required for this method because any deleterious effect of the matrix is evident in the recoveries of the IDA. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) can be processed per client request. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any spiked analyte are outside of the control limits provided by TALS or by the client. Recovery limits for MS/MSD are the same as those used for the LCS.

9.7.1. For DoD/DOE QSM, the RPD limit for the MS/MSD pair is less than or equal to 30%.

9.8. A laboratory control sample duplicate (LCSD) may be added when insufficient sample volume is provided to process either a DU and/or MS/SD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS. See WS-PQA-003 for specific acceptance criteria.

9.9. Instrument blanks (RB or CCB) are required at the beginning of an analytical sequence, after high level samples (>UCL) and every CCV. The blank should contain IDA and IS to quantitate results. The blank should not contain any analyte > MDL. See WS-PQA-003 for specific acceptance criteria.

9.10. Initial calibration verification (ICV) –A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid-range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.
- Rerun the initial calibration.

9.11. Isotope Dilution Analytes

9.11.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.11.2. IDA recoveries are flagged if they are outside of the acceptance limits stored

in TALS. If IDA recoveries are outside of these limits, additional clean-up is needed. If the recoveries cannot be met after clean up then re-extract a smaller aliquot.

9.11.2.1. If the IDA recovery is just outside of the control limits, re-analyze the extract at 1X prior to re-extraction. If in control, report the data.

9.11.3. Once sufficient data has been gathered, limits based on historical recoveries may be generated and implemented.

9.11.4. For DoD/DOE QSM, limits based on historical recoveries are required. The lower recovery limit must be greater than or equal to 20%.

9.12. Ion Ratio

9.12.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

Equation 2

$$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1°\ Transition)}{Area\ Qualitative\ Ion\ (2°\ Transition)}$$

9.12.2. The quantifier/qualifier SRM ion ratio should be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the mid-level ICAL point.

9.12.2.1. If data is reported to the MDL the ratio should also be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the initial daily CCV.

9.12.2.1. Please note that two transitions are monitored for PFPeA, but no corrective action is required if the ratio is outside of the limits due to the extremely poor response for the qualifier transition.

9.12.3. If the ion ratio does not meet criteria after corrective actions, (extract clean-up, sample dilution, etc.), then data should be qualified "I" if the ratio is not met.

9.12.3.1. Ion ratios must be in control in calibration solutions. If they are outside of limits, stop the analysis and correct the issues.

9.13. Internal Standards

Internal standards (IS) are spiked into every field sample, QC sample, standard, and instrument blank. They are used for quantitation of the IDA.

9.13.1. The area of the IS in field and QC samples should be within 40-200% of the area of the most recent CCV.

9.13.2. For DoD/DOE QSM, the following instances are required to be greater than the 30% of the average area of the calibration standards:

- the internal standard areas in undiluted extracts
- the internal standard areas in sample extracts where additional IS was added post-dilution.
- the internal standard areas in diluted extracts, once corrected for the dilution factor, when additional IS was not added post-dilution.

10. CALIBRATION

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP NDSC-QA-QP44940 "Calibration Curves and Selection of Calibration Points".

10.2. Routine instrument operating conditions are listed in the table in Section 11.12.

10.3. Instrument Tuning & Mass Calibration

10.3.1. Mass Calibration is performed by instrument manufacturer service representatives in accordance with the manufacturer's procedures during installation, and annually thereafter.

10.3.2. Instrument tuning is done initially when the method is first developed and thereafter as needed during troubleshooting. Tuning is done by infusing each individual compound (native and/or IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and updated as needed. The mass assignments must be within ± 0.5 amu of the values shown in the table in Section 11.12.

10.3.3. Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the tune criterion.

10.3.3.1. The instrument must have a valid mass calibration prior to sample analysis. This is verified through the acquisition of a full scan continuum mass spectrum of a PFAS stock standard.

All masses must be verified to be within ± 0.5 amu of true value.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in SOP NDSC-QA-QP44940, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Initial Calibration

Refer to Section 12.4.3 for details relating to setting retention times and evaluating retention times.

10.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.8.1.1. A minimum of six analytical standards is used when using average response factor and/or linear calibration fits, five of which must be ≥ RL.

10.8.1.2. A minimum of seven analytical standards is used when a quadratic fit is used to generate the curve, six of which must be ≥ RL.

10.8.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

10.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds must be ≤ 20% for the curve to be valid.

10.8.2.2. Alternatively, for average response factor (RFa), the relative standard error (RSE) for all compounds must be ≤ 20% for the curve to be valid.

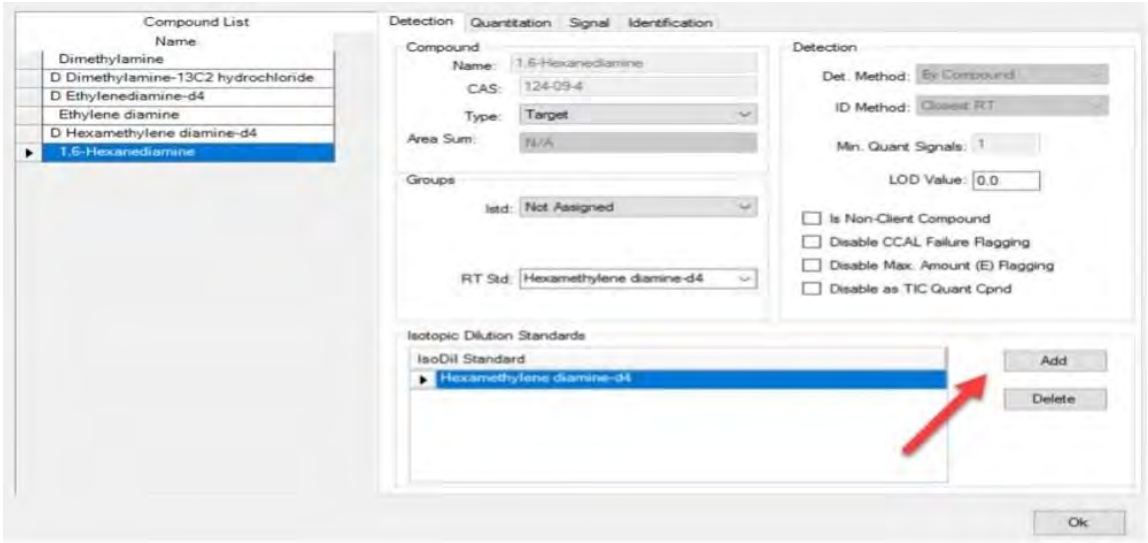
10.8.2.3. For linear fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.2.4. For quadratic fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.2.5. While not a requirement, analyte read back should be 70-130% of the true value.

10.8.2.6. Please note for this method PFTrDA is quantitated against the average areas of the IDA 13C2-PFTeDA and 13C2-PFDoA. In order to set this quantitation up correctly in Chrom be certain to update the analyte PFTrDA per the example below (Figure 10.8.2.6).

Figure 10.8.2.6



10.9. Calibration Curve Fits

10.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in SOP NDSC-QA-QP44940, “Calibration Curves and Selection of Calibration Points”.

10.9.2. The Chrom data system is programmed to complement the calibration evaluation guidelines in policy NDSC-QA-QP44940 by evaluating calibration curve fits in the order listed below. An optimal fit is recommended to the analyst, who may override based on evaluation of the

residuals for each calibration level, as per SOP NDSC-QA-QP44940.

- Average Response Factor
- Linear, 1/concentration^2 weighting
- Linear, 1/concentration weighting, forced through zero
- Quadratic, 1/concentration^2 weighting

10.9.3. The linear curve uses the following function:

Equation 3

$$y = bx + c$$

Where:

y = $\frac{Area\ (Analyte)}{Area\ (IDA)} \times Concentration(IDA)$
x = concentration
b = slope
c = intercept

10.9.4. The quadratic curve uses the following function:

Equation 4

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

10.9.5. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- The signal to noise ratio for each analyte with primary and confirmation masses must be greater than or equal to 3:1 and for those analytes with a single mass the signal to noise ratio must be greater than or equal to 10:1 in the lowest calibration standard.
- Response must increase with increasing concentration.
- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high CAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.9.6. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x

weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.9.7. Bile Salts Interference Check

The laboratory must analyze a bile salts standard (TDCA, TCDA and TUDCA only if the eluent is not acetonitrile}) after the initial calibration and prior to the analysis of samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference of TDCA (e.g. changing the retention time of TDCA such that it falls outside the retention time window for PFOS by more than 15 seconds with baseline resolution), and the initial calibration is repeated.

10.10. Initial Calibration Blank (ICB)

10.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of final extract solvent containing both IDA and IS.

10.10.2. The result for the calibration blank must be less than the MDL.

10.10.3. If the ICB is greater than the MDL then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.11. Initial Calibration Verification (ICV)

10.11.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

10.11.2. The recovery for the ICV must be equal to or within 70-130% for all natives and IDA.

10.11.3. See Section 9.10 for corrective actions in the event that the ICV does not meet the criteria above.

10.12. Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are at the mid-level range of the curve. The curve and ICV do not need to be run every day. To start an analytical sequence on days when an ICAL is not performed, a CCVL (low standard at the RL) is analyzed and if it meet acceptance criteria a run can be started.

10.12.1. The recovery for the CCV standards must be equal to or within 70-130% for all natives and IDA.

10.12.1.1. If the analyte in a CCV fails due to high recovery, but that analyte is not detected in the sample extract, then the sample extract need not be re-analyzed, i.e. high and ND. Report the data with narration.

10.12.2. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

11. PROCEDURE

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a non-conformance memo (NCM). The NCM process is described in more detail in SOP WS-QA-0023. The NCM shall be filed in the project file and addressed in the case narrative.

Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

Differences for samples run in accordance with the DoD/DOE QSM version 5.4 or higher are called out as needed in the procedures below.

11.2. Water Sample Preparation

11.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. Samples >50 mg solids should be mitigated. See Section 8.3.1.1 for TSS procedure. Compare sample to comparison/reference bottle. If the sample should be processed as a solid or biphasic or reduced volume contact the client for guidance prior to such action, if contractually required. Invert samples to homogenize prior to adding any spiking solutions.

11.2.1.1. If the TSS > 100 mg/L, centrifugation can be used to mitigate the sample in lieu of/or in conjunction with dilution.

Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.2.2. Unknown samples may be screened prior to extraction using the following:

11.2.2.1. Weigh out 10 (+ 0.10) g of sample into a 50 mL centrifuge tube.

11.2.2.2. Add 0.625 mL of IDA and 62.5 uL of IS. Vortex.

11.2.2.3. Transfer 300 µL of sample into an injection vial.

11.2.2.4. Submit for analysis.

11.2.2.5. The screening analysis is to follow the same analytical specifications as the definitive analysis, i.e. ICAL, CCV and all analytes.

11.2.2.6. Evaluate the screening results to determine an appropriate volume to extract:

- If < 0.625 ng/mL (on-column) = 1X (500 mL)
- If > 0.625 ng/mL but < 6.25 ng/mL = 10 X (50 mL)
- If > 6.25 ng/mL but <62.5 ng/mL = 100X (5 mL)
- If > 62.5 ng/mL but < 625 ng/mL = 1000X (0.5 mL)
- If > 625 ng/mL but < 6250 ng/mL = 10,000X (0.05 mL)

11.2.3. Weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume. Unless otherwise directed by client, use the entire sample volume, and spike directly into the sample container.

11.2.3.1. If the sample is identified as a leachate please prep at 100 mL. The sample should be collected in an appropriately sized container, i.e. 100-125 mL. If not, please document such and that a 100 mL aliquot was used for the analysis.

11.2.4. Prepare additional aliquots of a field sample for the DU and MS/MSD, if requested.

11.2.5. Prepare three 500 mL aliquots of HPLC-grade water for the method blank, LLCS and LCS, dependent upon container type submitted by the client.

11.2.6. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use.

11.2.7. Add 0.625 mL of the IDA PFC solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

11.2.8. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix PFC Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.2.9. Spike the LLCS with the 100 uL of the LCS/Matrix PFS Spike solution (Section 7.3), for a fixed concentration of 0.32-80 ng/mL in the final sample vial.

11.2.10. Swirl or vortex all samples after adding spike solutions.

11.2.11. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

11.3.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

11.3.2. Condition the SPE cartridges by passing the following without drying the column.

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.3.3. Wash with 15.0 mL of 1.0% NH_4OH/methanol.

11.3.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.3.5. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.3.6. Pour the samples into the reservoirs attached to the SPE columns and with vacuum, pull the entire sample volume (500 mL) through the cartridge at a rate of approximately 2 to 5 drops per second.

11.3.6.1. If the SPE column should plug (flow rate <1 drop per minute) prior to the entire content of the sample container passing through the column do the following:

1. Stop adding sample to the reservoir.
2. Return any remaining sample volume back to the original container.
3. Weigh the original container and record this weight into the worksheet notes field within the TALS extraction batch.
4. Determine the full volume of sample fortified by using the "Gross Weight" – (remaining sample volume – default tare weight of a sample container (44.6 g)).
5. Enter this value into the "Initial Amount" field in the TALS extraction batch.
6. Proceed to Section 11.4, noting that additional vacuum or pressure might be needed to elute the SPE column.

11.3.7. After the entire sample has been loaded onto the column, rinse the sample

bottle with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.3.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1 M formic acid/MeOH.

11.3.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds.

11.3.10. Discard the rinses.

11.4. SPE Elution of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.4.1. Add the collection tubes to the manifold. Rinse sample bottles with 5 mL of 1.0% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.4.2. Air dry and weigh the bottles (record as the tare weight in TALS) to get the sample volume extracted.

11.4.3. Proceed to Section 11.11.1

11.5. Final volume for Aqueous Sample extracts

11.5.1. Add 25 uL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

11.5.2. Vortex the IS solution prior to use.

11.5.3. Add 62.5 uL of IS (Section 7.5) at 100-400 ng/mL concentration, into a new centrifuge tube.

11.5.4. Place a syringe filter (25 mm filter, 0.2 um nylon membrane) on a polypropylene syringe.

11.5.5. Decant the sample extract from section 11.5.1 into the polypropylene syringe fitted with a syringe filter.

11.5.6. Filter into the centrifuge tube that contains IS from section 11.5.3.

WARNING: Ongoing, regular use of a filtering syringe with the SPE cartridge presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing

the syringe plunger down. Ensure that this task is rotated amongst staff members. Ensure that routine breaks are taken, and that muscles involved with this task are routinely stretched to offset this hazard.

11.5.7. Adjust the volume to 5 mL. Cap and vortex.

11.5.8. Transfer a portion of the extract to a 1 mL polypropylene micro vial. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.5.9. Seal the vial with a polypropylene snap top cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.6. Solid and Biosolids Sample Preparation and Extraction

11.6.1. Visually inspect soil samples. Homogenize the entire sample in accordance with SOP WS-QA-0018. If the sample cannot be mixed in the container, pour into a larger QC'd PFAS-free container and mix thoroughly. Transfer the sample label to the new container.

11.6.2. All solid and biosolids samples must have their default mass increased by the percent moisture content prior to extraction.

11.6.2.1. Review TALS for the percent moisture results. Use the following equation to determine what adjustment is needed to the default masses listed in Section 11.7.3.

11.6.2.1.1. Dry wt. adjusted mass = default mass X (1+ percent moisture as a decimal)

11.6.2.1.2. Do not add more that 2X the default mass, regardlesss of percent moisture value.

11.6.3. Weigh a representative dry weight adjusted 5 g aliquot of sample (0.5g for biosolids) into a 50 mL centrifuge tube. Weigh additional sample amounts for the sample duplicate, matrix spike and matrix spike duplicate analyses if they are requested.

11.6.3.1. Do not batch solid sample and biosolids samples together due to the different masses.

11.6.4. For the method blank, LLCS and LCS matrix, use 5 g each of Ottawa sand wetted with 2.5g of DI water or 0.5 g of Ottawa sand wetted with 0.25g of DI water for biosolids.

11.6.5. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.6.6. Add 0.625 mL of the 1633 IDA solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample

vial.

11.6.7. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.6.8. Spike the LLCS with 100 uL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 0.32-8 ng/mL in the final sample vial.

11.6.9. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.6.10. Add 10 mL of 0.3% NH_4OH/methanol to each sample. Cap and vortex.

11.6.11. Shake each sample on an orbital shaker at room temperature for 30 minutes.

11.6.12. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.13. Collect and decant the solvent into a new container.

11.6.14. Add 15 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

11.6.15. Shake each sample again on an orbital shaker at room temperature for 30 minutes.

11.6.16. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.17. Collect/decant the solvent into the new centrifuge tube from Section 11.6.13.

11.6.18. Add 5 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

11.6.19. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.20. Collect/decant the solvent into the new centrifuge tube from Section 11.6.13. *Note All samples proceed to Section 11.11, prior to Section 11.6.21.*

11.6.21. Bring the volume up to 250 mL with reagent water for each sample. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.6.22. Proceed to Section 11.7.

11.7. Solid Phase Extraction (SPE) of Solid, Biosolids and Tissue Samples

11.7.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

11.7.2. Condition the SPE cartridges by passing the following without drying the column.

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.7.3. Wash with 15.0 mL of 1% NH_4OH/methanol.

11.7.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.7.5. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.7.6. Add samples to the columns and with vacuum, pull the entire 250 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

11.7.7. After the entire sample has been loaded onto the column, rinse the centrifuge tube with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.7.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1M formic acid/methanol.

11.7.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds. Discard the rinses.

11.8. SPE Elution of Solid, Biosolids and Tissue Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.8.1. Vortex the 1633 IS solution prior to use.

11.8.2. Add 62.5 uL of 1633 IS (Section 7.5) at 100-400 ng/mL concentration into a new centrifuge tube.

11.8.3. Place the centrifuge tubes containing the IS in the manifold.

11.8.4. Rinse centrifuge tubes with 5 mL of 1% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.8.5. Proceed to Section 11.9 for final volume.

11.9. Final volume for Solid, Biosolids and Tissue Sample extracts

11.9.1. Add 25 uL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

11.9.2. Transfer a portion of the extract to a 300 µL polypropylene microvial. Archive the rest of the extracts for re-injection and dilution.

11.9.3. Seal the vial with a blue screw cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.10. Tissue Sample Preparation and Extraction

Prior to subsampling tissue matrices, ensure that they have been appropriately homogenized in accordance with SOP WS-WI-0018, Tissue Handling and Extraction.

11.10.1. Weigh a representative 2 g aliquot of sample into a 50 mL centrifuge tube. Weigh additional sample amounts for the sample duplicate, matrix spike and matrix spike duplicate analyses if they are requested.

11.10.2. For the method blank, LLCS and LCS matrix, use 2 g each of tissue reference material (chicken breast or fish).

11.10.3. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.10.4. Add 0.625 mL of the 1633 IDA solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

11.10.5. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.10.6. Spike the LLCS with 100 uL of the LCS/Matrix Spike solution (Section 7.3) for a fixed concentration of 0.32- 8 ng/mL in the final sample vial.

11.10.7. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.10.8. Add 10 mL of 0.05M KOH/methanol to each sample. Cap and vortex.

11.10.9. Shake each sample on an orbital shaker at room temperature for at least 16 hours.

11.10.10. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.11. Collect and decant the solvent into a new container.

11.10.12. Add 10 mL of acetonitrile (ACN) to the residue. Cap and vortex.

11.10.13. Sonicate each sample for 30 minutes.

11.10.14. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.15. Collect/decant the solvent into the new centrifuge tube from Section 11.10.11.

11.10.16. Add 5 mL of 0.05M KOH/methanol to the residue. Cap and vortex.

11.10.17. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.18. Collect/decant the solvent into the new centrifuge tube from Section 11.10.11.

Note: All samples proceed to Section 11.11, prior to Section 11.10.19.

11.10.19. [redacted]

11.10.20. Proceed to Section 11.7 SPE for Solid, Biosolids, and Tissue Samples, followed by Section 11.8 SPE Elution of Solid, Biosolids, and Tissue Samples, and Section 11.9 Final volume for Solid, Biosolids, and Tissue Samples

11.11. Use of Loose Graphitized Carbon (Envi-Carb)

Instructions for performing this cleanup are provided below:

11.11.1. **Water** Samples: Immediately following Section 11.4 (SPE elution) add 25 uL of acetic acid to each sample eluted in the collection tubes and vortex to mix. Add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.2. **Solid/Biosolids** Samples: Immediately following Section 11.6.20 add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.3. **Tissue** Samples: Immediately following Section 11.10.18 add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.4. Hand-shake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon.

11.11.5. Immediately vortex for 30 seconds and centrifuge at 2800 rpm for 10 minutes.

11.11.6. **Water** Samples: Proceed to Section 11.5.2.

11.11.7. **Solid/Biosolid** Samples: Immediately decant into a new centrifuge tube. Proceed to Section 11.6.21

11.11.8. **Tissue** Samples: Immediately decant into a new centrifuge tube. Proceed to Section 11.10.19.

11.12. Instrument Analysis

Suggested operating conditions are listed in Tables 11.12-1 through 11.12--4 for the SCIEX LCMS systems:

Table 11.12 - 1
Recommended Instrument Operating Conditions

HPLC Conditions (Shimadzu HPLC)				
Column (Column temp = 45°C)	Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm			
Mobile Phase Composition	A = 20 mM Ammonium Acetate in Water B = Methanol			
Gradient Program	**Time**	**%A**	**%B**	**Flow Rate - mL/min**
	0	90	10	0.60
	0.1	45	55	0.60
	4.5	1	99	0.60
	5.9	1	99	0.60
	5.95	90	10	0.60
	Maximum pressure limit = 5,000 psi			
Injection Size	20 µL (fixed amount throughout the sequence).			
Run Time	~6.6 minutes			
Mass Spectrometer Interface Settings (SCIEX 5500)				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.			
Ion Spray Voltage (kV)	4.5			
Entrance Potential (V)	5			
Declustering Potential (V)	25			
Desolvation Temp	600ºC			
Curtain Gas	35 psi			
Collision Gas	8 psi			

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
11Cl-PF3OUdS	Native Analyte	630.9	450.9	8.31
11Cl-PF3OUdS_2	Native Analyte	632.9	452.9	8.31
13C2_PFDA	Internal Standard	515.1	470.1	6.95

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
13C2_PFDoA	Isotope Dilution Analyte	615.1	570	7.86
13C2_PFHxA	Internal Standard	315.1	270	4.5
13C2_PFHXA_2	Internal Standard	315.1	119.4	4.5
13C2_PFTeDA	Isotope Dilution Analyte	715.2	670	8.68
13C3_HFPO-DA	Isotope Dilution Analyte	286.9	168.9	4.78
13C3_HFPO-DA_2	Isotope Dilution Analyte	286.9	184.9	4.78
13C3_PFBA	Internal Standard	216	172	1.87
13C3_PFBS	Isotope Dilution Analyte	302.1	79.9	4.36
13C3_PFBS_2	Isotope Dilution Analyte	302.1	98.9	4.36
13C3_PFHxS	Isotope Dilution Analyte	402.1	79.9	5.96
13C3_PFHxS_2	Isotope Dilution Analyte	402.1	98.8	5.96
13C4_PFBA	Isotope Dilution Analyte	216.8	171.9	1.87
13C4_PFHpA	Isotope Dilution Analyte	367.1	322	5.25
13C4_PFOA	Internal Standard	417.1	172	5.89
13C4_PFOS	Internal Standard	502.8	79.9	7.06
13C4_PFOS_2	Internal Standard	502.8	98.9	7.06
13C5_PFHxA	Isotope Dilution Analyte	318	273	4.5
13C5_PFHxA_2	Isotope Dilution Analyte	318	120.3	4.5
13C5_PFNA	Internal Standard	468	423	6.44
13C5_PFPeA	Isotope Dilution Analyte	268.3	223	3.51
13C6_PFDA	Isotope Dilution Analyte	519.1	474.1	6.95
13C7_PFUdA	Isotope Dilution Analyte	570	525.1	7.41
13C8_PFOA	Isotope Dilution Analyte	421.1	376	5.89
13C8_PFOS	Isotope Dilution Analyte	507.1	79.9	7.06
13C8_PFOS_2	Isotope Dilution Analyte	507.1	98.9	7.06
13C8_PFOSA	Isotope Dilution Analyte	506.1	77.8	7.91
13C9_PFNA	Isotope Dilution Analyte	472.1	427	6.44
18O2_PFHxS	Internal Standard	403	83.9	5.96
3:3 FTCA	Native Analyte	241	177	2.96
3:3 FTCA_2	Native Analyte	241	117	2.96
4.2FTS_2	Native Analyte	327.1	80.9	4.22
4:2 FTS	Native Analyte	327.1	307	4.22
5:3 FTCA	Native Analyte	341	237.1	4.85
5:3 FTCA_2	Native Analyte	341	217	4.85
6:2 FTS	Native Analyte	427.1	407	5.67
6:2 FTS_2	Native Analyte	427.1	80.9	5.67
7:3 FTCA	Native Analyte	441	316.9	6.14
7:3 FTCA_2	Native Analyte	441	336.9	6.14

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
8:2 FTS	Native Analyte	527.1	507	6.74
8:2 FTS_2	Native Analyte	527.1	80.8	6.74
9Cl-PF3ONS	Native Analyte	530.8	351	7.4
9Cl-PF3ONS_2	Native Analyte	532.8	353	7.4
d3MeFOSA	Isotope Dilution Analyte	515	219	9.45
d3-MeFOSAA	Isotope Dilution Analyte	573.2	419	6.98
d5EtFOSA	Isotope Dilution Analyte	531.1	219	9.77
d5-EtFOSAA	Isotope Dilution Analyte	589.2	419	7.17
d7N-MeFOSE	Isotope Dilution Analyte	623.2	58.9	9.32
d9N-EtFOSE	Isotope Dilution Analyte	639.2	58.9	9.64
DONA	Native Analyte	376.9	250.9	5.5
DONA_2	Native Analyte	376.9	84.8	5.5
EtFOSA	Native Analyte	526	219	9.79
EtFOSA_2	Native Analyte	526	169	9.79
HFPO-DA	Native Analyte	284.9	168.9	4.78
HFPO-DA_2	Native Analyte	284.9	184.9	4.78
M2-4:2FTS	Isotope Dilution Analyte	329.1	80.9	4.22
M2-4:2FTS_2	Isotope Dilution Analyte	329.1	309	4.22
M2-6:2FTS	Isotope Dilution Analyte	429.1	80.9	5.67
M2-6:2FTS_2	Isotope Dilution Analyte	429.1	409	5.67
M2-8:2FTS	Isotope Dilution Analyte	529.1	80.9	6.74
M2-8:2FTS_2	Isotope Dilution Analyte	529.1	509	6.74
MeFOSA	Native Analyte	511.9	219	9.45
MeFOSA_2	Native Analyte	511.9	169	9.45
N-EtFOSAA	Native Analyte	584.2	419.1	7.17
N-EtFOSAA_2	Native Analyte	584.2	526	7.17
N-EtFOSE	Native Analyte	630	58.9	9.66
NFDHA (PFECA B)	Native Analyte	295	201	4.36
NFDHA_2 (PFECA B_2)	Native Analyte	295	84.9	4.36
N-MeFOSAA	Native Analyte	570.1	419	6.98
N-MeFOSAA_2	Native Analyte	570.1	483	6.98
N-MeFOSE	Native Analyte	616.1	58.9	9.32
PFBA	Native Analyte	212.8	168.9	1.87
PFBS	Native Analyte	298.7	79.9	4.36
PFBS_2	Native Analyte	298.7	98.8	4.36
PFDA	Native Analyte	512.9	469	6.95
PFDA_2	Native Analyte	512.9	219	6.95
PFDoA	Native Analyte	613.1	569	7.86

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
PFDoA_2	Native Analyte	613.1	319	7.86
PFDoS	Native Analyte	699.1	79.9	8.83
PFDoS_2	Native Analyte	699.1	98.8	8.83
PFDS	Native Analyte	599	79.9	8
PFDS_2	Native Analyte	599	98.8	8
PFEESA (PES)	Native Analyte	314.8	134.9	4.8
PFEESA_2 (PES_2)	Native Analyte	314.8	82.9	4.8
PFHpA	Native Analyte	363.1	319	5.25
PFHpA_2	Native Analyte	363.1	169	5.25
PFHpS	Native Analyte	449	79.9	6.54
PFHpS_2	Native Analyte	449	98.8	6.54
PFHxA	Native Analyte	313	269	4.5
PFHxA_2	Native Analyte	313	118.9	4.5
PFHxS	Native Analyte	398.7	79.9	5.96
PFHxS_2	Native Analyte	398.7	98.9	5.96
PFMBA (PFECA A)	Native Analyte	279	85.1	3.85
PFMPA (PFECA F)	Native Analyte	229	84.9	2.65
PFNA	Native Analyte	463	419	6.44
PFNA_2	Native Analyte	463	219	6.44
PFNS	Native Analyte	548.8	79.9	7.55
PFNS_2	Native Analyte	548.8	98.8	7.55
PFOA	Native Analyte	413	369	5.89
PFOA_2	Native Analyte	413	169	5.89
PFOS	Native Analyte	498.9	79.9	7.06
PFOS_2	Native Analyte	498.9	98.8	7.06
PFOSA	Native Analyte	498.1	77.9	7.93
PFOSA_2	Native Analyte	498.1	478	7.93
PFPeA	Native Analyte	263	219	3.51
PFPeA_2	Native Analyte	263	68.9	3.51
PFPeS	Native Analyte	349.1	79.9	5.27
PFPeS_2	Native Analyte	349.1	98.9	5.27
PFTeDA	Native Analyte	713.1	669	8.68
PFTeDA_2	Native Analyte	713.1	168.9	8.68
PFTrDA	Native Analyte	663	619	8.29
PFTrDA_2	Native Analyte	663	168.9	8.29
PFUdA	Native Analyte	563.1	519	7.41
PFUdA_2	Native Analyte	563.1	269.1	7.41
TCDA_1	Native Analyte	498.29	106.98	0

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
TCDA_2	Native Analyte	498.29	123.9	0
TCDA_3	Native Analyte	499.29	106.98	0
TCDA_4	Native Analyte	499.29	123.9	0
TCDCA	Native Analyte	464.21	126	0
TUDCA	Native Analyte	464.2	126	0

Table 11.12 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
0	TCDA_1	70	1	-65	-5	-58	-12
0	TCDA_2	70	1	-65	-5	-58	-12
0	TCDA_3	90	1	-65	-5	-58	-12
0	TCDA_4	90	1	-65	-5	-58	-12
0	TCDCA	120	1	-65	-5	-58	-12
0	TUDCA	120	1	-65	-5	-58	-12
1.87	13C3_PFBA	90	1	-25	-5	-12	-31
1.87	13C4_PFBA	90	1	-25	-5	-12	-31
1.87	PFBA	90	1	-25	-5	-12	-31
2.65	PFMPA (PFECA F)	70	1	-23	-10	-10	-16
2.96	3:3 FTCA	70	1	-46	-10	-11	-13
2.96	3:3 FTCA_2	70	1	-33	-10	-44	-15
3.51	13C5_PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA_2	80	1	-55	-7	-62	-15
3.85	PFMBA (PFECA A)	70	1	-5	-10	-16	-9
4.22	4.2FTS_2	70	1	-60	-10	-50	-12
4.22	4:2 FTS	70	1	-50	-7	-32	-10
4.22	M2-4:2FTS	70	1	-50	-7	-80	-10
4.22	M2-4:2FTS_2	70	1	-50	-7	-32	-10
4.36	13C3_PFBS	70	1	-55	-6	-58	-37
4.36	13C3_PFBS_2	70	1	-55	-6	-58	-37
4.36	NFDHA (PFECA B)	70	1	-35	-10	-14	-17
4.36	NFDHA_2 (PFECA B_2)	70	1	-35	-10	-34	-5
4.36	PFBS	70	1	-55	-6	-58	-37
4.36	PFBS_2	70	1	-55	-5	-40	-12

Table 11.12 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
4.5	13C2_PFHxA	50	1	-55	-5	-14	-13
4.5	13C2_PFHXA_2	50	1	-55	-5	-26	-7
4.5	13C5_PFHxA	50	1	-60	-5	-12	-15
4.5	13C5_PFHxA_2	50	1	-60	-5	-30	-9
4.5	PFHxA	50	1	-55	-5	-14	-13
4.5	PFHxA_2	50	1	-55	-5	-26	-7
4.78	13C3_HFPO-DA	70	1	-15	-10	-5	-17
4.78	13C3_HFPO-DA_2	70	1	-75	-10	-18	-15
4.78	HFPO-DA	70	1	-15	-10	-5	-17
4.78	HFPO-DA_2	70	1	-75	-10	-18	-15
4.8	PFEESA (PES)	70	1	-98	-12	-28	-12
4.8	PFEESA_2 (PES_2)	70	1	-98	-12	-28	-12
4.85	5:3 FTCA	70	1	-10	-10	-18	-13
4.85	5:3 FTCA_2	70	1	-10	-10	-38	-11
5.25	13C4_PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA_2	70	1	-25	-6	-20	-10
5.27	PFPeS	70	1	-57	-9	-66	-40
5.27	PFPeS_2	70	1	-57	-9	-45	-12
5.5	DONA	70	1	-55	-10	-16	-17
5.5	DONA_2	70	1	-55	-10	-35	-17
5.67	6:2 FTS	70	1	-50	-7	-32	-10
5.67	6:2 FTS_2	70	1	-80	-10	-72	-12
5.67	M2-6:2FTS	70	1	-50	-7	-90	-10
5.67	M2-6:2FTS_2	70	1	-50	-7	-32	-10
5.89	13C4_PFOA	70	1	-110	-6	-24	-20
5.89	13C8_PFOA	70	1	-110	-6	-18	-20
5.89	PFOA	70	1	-110	-6	-18	-20
5.89	PFOA_2	70	1	-110	-6	-24	-20
5.96	13C3_PFHxS	65	1	-145	-12	-88	-11
5.96	13C3_PFHxS_2	65	1	-145	-12	-80	-13
5.96	18O2_PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS_2	65	1	-145	-12	-80	-13
6.14	7:3 FTCA	70	1	-27	-12	-18	-10
6.14	7:3 FTCA_2	70	1	-22	-12	-31	-35
6.44	13C5_PFNA	70	1	-25	-6	-14	-48

Table 11.12 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
6.44	13C9_PFNA	70	1	-25	-6	-14	-48
6.44	PFNA	70	1	-25	-6	-14	-47
6.44	PFNA_2	70	1	-25	-6	-24	-47
6.54	PFHpS	70	1	-65	-11	-88	-46
6.54	PFHpS_2	70	1	-65	-11	-50	-12
6.74	8:2 FTS	70	1	-50	-7	-40	-15
6.74	8:2 FTS_2	70	1	-60	-10	-82	-9
6.74	M2-8:2FTS	70	1	-50	-7	-90	-15
6.74	M2-8:2FTS_2	70	1	-50	-7	-40	-15
6.95	13C2_PFDA	70	1	-25	-6	-16	-51
6.95	13C6_PFDA	70	1	-25	-6	-16	-51
6.95	PFDA	70	1	-25	-6	-16	-51
6.95	PFDA_2	70	1	-25	-6	-26	-12
6.98	d3-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA_2	90	1	-75	-10	-22	-12
7.06	13C4_PFOS	90	1	-140	-9	-130	-13
7.06	13C4_PFOS_2	90	1	-140	-9	-98	-5
7.06	13C8_PFOS	90	1	-205	-9	-112	-11
7.06	13C8_PFOS_2	90	1	-205	-9	-112	-11
7.06	PFOS	90	1	-140	-9	-130	-13
7.06	PFOS_2	90	1	-140	-9	-98	-5
7.17	d5-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA_2	90	1	-90	-10	-28	-12
7.4	9Cl-PF3ONS	70	1	-120	-10	-30	-17
7.4	9Cl-PF3ONS_2	70	1	-120	-10	-30	-15
7.41	13C7_PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA_2	70	1	-25	-7	-28	-12
7.55	PFNS	70	1	-75	-10	-113	-52
7.55	PFNS_2	70	1	-75	-8	-71	-12
7.86	13C2_PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA_2	70	1	-25	-5	-30	-12
7.91	13C8_PFOSA	75	1	-90	-8	-92	-11
7.93	PFOSA	75	1	-90	-8	-92	-11

Table 11.12 – 3
Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
7.93	PFOSA_2	75	1	-60	-10	-40	-8
8	PFDS	70	1	-30	-11	-130	-11
8	PFDS_2	70	1	-30	-11	-110	-17
8.29	PFTrDA	90	1	-25	-7	-20	-54
8.29	PFTrDA_2	90	1	-25	-7	-36	-12
8.31	11Cl-PF3OUdS	70	1	-160	-10	-40	-17
8.31	11Cl-PF3OUdS_2	70	1	-160	-10	-40	-15
8.68	13C2_PFTeDA	120	1	-25	-7	-22	-54
8.68	PFTeDA	120	1	-25	-7	-22	-10
8.68	PFTeDA_2	120	1	-25	-7	-36	-30
8.83	PFDoS	90	1	-10	-11	-76	-11
8.83	PFDoS_2	90	1	-10	-11	-130	-5
9.32	d7N-MeFOSE	70	1	-20	-5	-70	-10
9.32	N-MeFOSE	70	1	-20	-5	-70	-10
9.45	d3MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA_2	70	1	-50	-2	-40	-6
9.64	d9N-EtFOSE	70	1	-20	-5	-70	-10
9.66	N-EtFOSE	70	1	-20	-5	-70	-10
9.77	d5EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA_2	70	1	-50	-8	-40	-6

Table 11.12 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	2.54	13C4_PFBA	2.54	Isotope Dilution
3:3 FTCA	2.9	13C5_PFPeA	2.98	Isotope Dilution
PFPeA	2.97	13C5_PFPeA	2.97	Isotope Dilution
PFBS	2.98	13C3-PFBS	2.98	Isotope Dilution
PFECA A (PFMBA)	3	13C5_PFPeA	2.97	Isotope Dilution
PES (PFEESA)	3.09	13C5_PFHxA	2.98	Isotope Dilution
PFECA B (NFDHA)	3.21	13C5_PFHxA	3.35	Isotope Dilution
4:2 FTS	3.28	13C2-4:2FTS	3.28	Isotope Dilution
PFHxA	3.35	13C5_PFHxA	3.35	Isotope Dilution

Table 11.12 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFPeS	3.45	13C3_PFHxS	2.98	Isotope Dilution
HFPO-DA	3.46	13C3_HFPO-DA	3.46	Isotope Dilution
5:3 FTCA	3.7	13C5_PFHxA	3.77	Isotope Dilution
PFECA_F (PFMPA)	3.08	13C5_PFPeA	3.77	Isotope Dilution
PFHpA	3.74	13C4_PFHpA	3.74	Isotope Dilution
PFHxS	3.74	13C3_PFHxS	3.74	Isotope Dilution
DONA	3.79	13C3_HFPO-DA	4.5	Isotope Dilution
6:2 FTS	4.12	13C2-6:2FTS	4.12	Isotope Dilution
PFOA	4.14	13C8_PFOA	4.14	Isotope Dilution
PFHpS	4.14	13C8_PFOS	4.5	Isotope Dilution
7:3 FTCA	4.5	13C5_PFHxA	4.55	Isotope Dilution
PFOS	4.5	13C8_PFOS	4.5	Isotope Dilution
PFNA	4.52	13C9_PFNA	4.52	Isotope Dilution
9Cl-PF3ONS	4.69	13C3_HFPO-DA	4.5	Isotope Dilution
PFOSA	4.82	13C8_PFOSA	4.82	Isotope Dilution
PFNS	4.83	13C8_PFOS	4.5	Isotope Dilution
PFDA	4.86	13C6_PFDA	4.86	Isotope Dilution
8:2 FTS	4.86	13C2-8:2FTS	4.86	Isotope Dilution
N-MeFOSAA	5.03	d3-MeFOSAA	5.03	Isotope Dilution
PFDS	5.16	13C8_PFOS	4.5	Isotope Dilution
PFUdA (PFUnA)	5.19	13C7_PFUdA	5.19	Isotope Dilution
N-EtFOSAA	5.19	d5-EtFOSAA	5.19	Isotope Dilution
N-MeFOSE	5.25	d7N-MeFOSE	5.25	Isotope Dilution
MeFOSA	5.26	d3MeFOSA	5.26	Isotope Dilution
11Cl-PF3OUdS	5.31	13C3_HFPO-DA	4.5	Isotope Dilution
N-EtFOSE	5.4	d9N-EtFOSE	5.4	Isotope Dilution
EtFOSA	5.44	d5EtFOSA	5.44	Isotope Dilution
PFDoA	5.47	13C2_PFDoA	5.47	Isotope Dilution
PFDoS	5.72	13C8_PFOS	4.5	Isotope Dilution
PFTrDA	5.75	13C2_PFDoA	5.47	Isotope Dilution
PFTeDA	5.99	13C2_PFTeDA	5.99	Isotope Dilution

Table 11.12 – 5
Retention Times & Quantitation

IDA	Typical IDA RT (minutes)	IS analog	Typical RT (minutes)	Quantitation Method
13C4_PFBA	2.08	13C3_PFBA	2.09	Internal Standard

Table 11.12 – 5
Retention Times & Quantitation

IDA	Typical IDA RT (minutes)	IS analog	Typical RT (minutes)	Quantitation Method
13C5_PFPeA	3.71	13C2_PFHxA	4.62	Internal Standard
13C5_PFHxA	4.62	13C2_PFHxA	4.62	Internal Standard
13C4_PFHpA	5.34	13C2_PFHxA	4.62	Internal Standard
13C8_PFOA	5.94	13C4_PFOA	5.94	Internal Standard
13C9_PFNA	6.43	13C5_PFNA	4.52	Internal Standard
13C6_PFDA	6.88	13C2_PFDA	4.86	Internal Standard
13C7_PFUnA	7.32	13C2_PFDA	6.88	Internal Standard
13C2_PFDoA	7.72	13C2_PFDA	6.88	Internal Standard
13C2_PFTeDA	8.42	13C2_PFDA	6.88	Internal Standard
13C3-PFBS	4.50	18O2_PFHxS	6.00	Internal Standard
13C3_PFHxS	6.00	18O2_PFHxS	6.00	Internal Standard
13C8_PFOS	6.98	13C4_PFOS	6.98	Internal Standard
13C2_4:2FTS	4.41	18O2_PFHxS	6.00	Internal Standard
13C2_6:2FTS	5.75	18O2_PFHxS	6.00	Internal Standard
13C2_8:2FTS	6.72	18O2_PFHxS	6.00	Internal Standard
13C8_PFOSA	8.01	13C4_PFOS	6.98	Internal Standard
d3MeFOSA	9.49	13C4_PFOS	6.98	Internal Standard
d5EtFOSA	9.81	13C4_PFOS	6.98	Internal Standard
d3-MeFOSAA	6.93	13C4_PFOS	6.98	Internal Standard
d5-EtFOSAA	7.10	13C4_PFOS	6.98	Internal Standard
d7N-MeFOSE	9.37	13C4_PFOS	6.98	Internal Standard
d9N-EtFOSE	9.68	13C4_PFOS	6.98	Internal Standard
13C3_HFPO-DA	4.90	13C2-PFHxA	4.62	Internal Standard

11.12.1. Tune and calibrate the instrument as described in Section 10.

11.12.2. A typical run sequence is as follows:

- Rinse Blank (RB, not linked to anything)
- CCVL (referred to as an ISC in Method 1633)
- CCVIS
- Qualitative verification standard (can be combined with salt check)
- Rinse Blank (RB, not linked to anything)
- Method blank
- LLCS
- LCS
- Bile salt interference check
- 10 samples
- CCV: link to midpoint of ICAL

- CCB
- 10 more samples
- CCV: link to midpoint of ICAL
- CCB
- Etc.

11.13. Vortex all sample aliquots and standards prior to placing on the autosampler.

11.14. Samples analyzed subsequent to any sample with results at or above the upper calibration limit must be evaluated for potential carryover, and corrective actions taken, as detailed below.

11.14.1. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e. go the archive of the extract).

11.14.2. Should there be instrument contamination, as evident by sample carryover, any sample >5X the UCL or instrument blanks with detections > RL:

- Analyze 20 blanks alternating between 1% formic acid/methanol and 1% formic acid/water.
- Then analyze 3 methanol only blanks.
- If the system is clean resume analyses. Proceed to 11.14.4. If not clean, proceed as directed below.

11.14.3. If the system is still contaminated the following items might need to be cleaned or replaced:

- Reverse flush the analytical column
- Reverse flush the isolation column
- Replace the column (isolation, analytical or both)
- Clean the cones/entry port
- Replace the PEEK tubing in the sample pathway
- Then, repeat 11.14.2.

11.14.4. Should a high level sample be analyzed that triggers these steps then detections for those analytes over the next 2-3 days require additional evaluation (are all instrument blanks from the sequence < ½ RL) and possible re-analysis. If sample results replicate and the associated instrument blanks from the sequences are <1/2 RL then one can assume the system is under control and confirmation of positive detections can stop.

12. CALCULATIONS / DATA REDUCTION

12.1. If the concentration of the analyte ions exceeds the working range as defined by the

calibration standards, then the sample might require to be diluted and reanalyzed, based upon client need. It may be necessary to dilute samples due to matrix.

12.2. Extracts can be diluted up to no more than 10X without diluting out the IDA, in most cases, and thus preserving quantitation via isotope dilution. IDA recovery must be >5% in the dilution. Use the IDA recoveries in the undiluted analysis to select the dilution factor, with the objective of keeping the IDA recoveries in the dilution above the 5% lower limit.

12.2.1. For example, if the IDA recovery for the affected analyte in the undiluted analysis is 50%, then the extract cannot be diluted more than 10X. If the IDA recovery of the affected analyte in the undiluted analysis is 30%, then the extract cannot be diluted more than 6X.

12.2.2. If the IDA response in the dilution is < 10:1 signal to noise or RT is off then the sample is to be re-extracted at a smaller aliquot.

12.2.3. If a dilution greater than 10X is needed, then the sample should be re-extracted at a smaller aliquot.

12.2.4. If a dilution is required, report the 1X data, including IDA, as primary data, and analyte of interest and associated IDA only from the dilution as secondary data.

12.3. Results less than the reporting limit are flagged in the client report as estimated. Generally, the "J" flag is used to denote ≥ MDL and ≤ RL, but the specific flag may change based on client requirements.

12.4. Qualitative Identification

12.4.1. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA's to within 0.1 min. For PFAS with no labeled standards, the RT must be within ± 0.4 minutes of the ICAL or the most recent CCV standard.

Note: The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.

12.4.2. PFBS, PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions specified in the method due to the linear and branch isomers of these compounds. Most PFAS compounds are produced by one of two processes. One gives rise to linear PFAS only while the other process produces both linear and branched isomers. Both branched and linear PFAS compounds can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in the

sample must be integrated in the same way as the calibration standard and concentrations reported as a total for each of these analytes.

12.4.3. The expected retention times (RT) are established in the Chrom data processing module during the processing of the ICAL by selecting Edit>Method>Update RT. Once the retention times are established Chrom will look for a peak within ± 0.25 minutes of the RT. The analyst confirms that the branched isomers present in the quantitative calibration standards for PFOS, PFHxS, NEtFOSAA and NMeFOSAA are within the ± 0.25 minute window. If they are not, an adjustment to the RT window is made. The analyst confirms the presence of the branched isomers in the technical (qualitative) standard as well, and adjusts the RT window for an analyte if it is not present within the ± 0.25 minute window.

12.4.3.1. If a peak is detected within this window of ±0.25 minutes, Chrom will assign the absolute retention time at the apex of the peak. Chrom assigns the RT to the most predominant peak within this window. As the linear peak is the predominant peak in calibration solutions for those PFAS that are calibrated with the combination of both branched and linear isomers, those PFAS require additional evaluation in the event that the branched isomer is the predominant peak in a field sample and Chrom has not positively identified the peak due to the RT shift, as the apex may now be the branched isomer.

12.4.3.2. Additional evaluation is required if the field samples contain branched isomers not present in the quantitative or qualitative standards. The analyst confirms that only the peaks present in the calibration standards are included in the peak integration, or adjusts the peak integration to assure that only the peaks present in the standards are identified and quantitated.

12.4.3.3. RT are updated as needed based upon evaluation of the daily CCV.

12.4.4. The signal to noise ratio for both quantitative and qualitative ions/transitions must be ≥ 3:1 or >10:1 if the analyte only has a single transition for a baseline deflection to be considered a peak. If this criterion is not met, the analyte is not considered and reported as “non-detect”.

12.5. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.6. Extract concentrations are calculated as below. The first equation applies Average Response Factor model, the second to a linear fit, and the third to the quadratic line fit.

Equation 5

$$Concentration\ (ng/mL) = \frac{y}{RRF}$$

Equation 6 $$Concentration\ (ng/mL) = \frac{y-c}{b}$$

Equation 7 $$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2-4ac-y}}{2a}$$

Where:

y = $\frac{Area_{Target}}{Area_{IDA}} \times Concentration(IDA)$

RRF = Relative Response Factor

x = concentration

a = curvature

b = slope

c = intercept

12.7. Water Sample Result Calculation:

Equation 8 $$Concentration\ (ng/L) = \frac{C_{ex}V_t}{V_0}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)

V_t = Volume of total extract (mL)

V_o = Volume of water extracted (L), i.e. total volume fortified with IDA

12.8. Soil Sample Result Calculation:

Equation 9 $$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_s D}$$

Where ng/g = µg/kg and:

C_{ex} = Concentration measured in sample extract (ng/mL)

V_t = Volume of total extract (mL)

W_s = Weight of sample extracted (g)

D = Fraction of dry solids, which is calculated as follows:

$\frac{100-\%\ moisture\ in\ sample}{100}$ (for dry weight result)

12.9. IDA Recovery Calculation:

Equation 10 $$\%\ Recovery = \frac{A_{IDA}Q_{IS}}{A_{IS}Q_{IDA}RRF_{IDA}} \times 100$$

Where:

RRF_{IDA} = Response Factor for IDA compound

A_{IDA} = Area response for IDA compound

A_{IS} = Area Response for IS compound

Q_{IS} = Amount of IS added

Q_{IDA} = Amount of IDA added

12.10. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (WS-PQA-0012). These reviews are documented in TALS.

13. METHOD PERFORMANCE

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP WS-QA-0006 and policy WS-PQA-003. MDLs are available in the Quality Assurance Department.

13.3. Initial Demonstration of Capability (IDOC)

13.3.1. The method initial demonstration of capability is performed by processing 4 LCS samples and a method blank. Compare the average recovery and RSD to the IPR limits in Table 5 of the reference method.

13.3.2. Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits in the LIMS. IDOCs are approved by the Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.

14. POLLUTION PREVENTION

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the HSE Manual (NDSC-US EHS-QP46060) for “Waste Management and Pollution Prevention.”

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. WASTE MANAGEMENT

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs and cartridges. Dump the dry solid waste into a yellow contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the hazardous waste – landfill steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.2. Extracted soil samples, used sodium sulfate, paper funnel filters, glass wool, thimbles, and extracted solids saturated with solvents. Dump these materials into an orange contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the incineration steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.3. Waste Methanol. Collect the waste solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When the drum is full to between four and six inches of the top, or after no more than 75 days, move the steel flammable solvent drum to the waste collection area for shipment.

15.4. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.5. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.6. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow

methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, where they are disposed through the vial eater or by consolidation into 55-gallon open top plastic drum, which is shipped after no more than 90 days.

16. REFERENCES

16.1. Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, August 2021.

16.2. 2nd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, June 2022.

16.3. 3rd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, December 2022.

17. METHOD MODIFICATIONS

17.1. Modifications from Method 1633 are detailed below:

17.1.1. The TDCA separation window is changed from 60 seconds to less than 15 seconds and baseline resolution.

17.1.2. The CCVL (ISC) will be used to start the analytical sequence on non-ICAL days and is to meet both S/N (3:1 and 10:1 as required) and CCV acceptance criteria.

17.1.3. The corrective action to be taken in the event of clogging occurring in the SPE columns that is described in Section 11.3.6.1 is in lieu of using a second SPE cartridge as described in the reference method.

17.1.4. Immediately following the loading of aqueous samples onto the SPE columns, sample bottles are rinsed with reagent water, and the reagent water added to the column reservoir. This step is addition to the basic methanol rinse as part of the SPE elution step.

18. ATTACHMENTS

18.1. Table 18.1, Water IDA Limits.

19. REVISION HISTORY

19.1. WS-LC-0039, Revision 1.4, Effective 03/02/2023

19.1.1. All references to the Multi-Lab Validation Study (MLVS) were deleted.

19.1.2. Water and leachate RL were updated in Table 1.2.

19.1.3. Section 4.1, PFAS- free definition changed from ½ RL to now be the < MDL.

19.1.4. Section 7.6.2, Qualitative Standard reduced to PFOA and PFNA only. Other previously listed analytes (FOSA, Et-FOSA, Me-FOSA, Et-FOSE and Me-FOSE) are now incorporated into the calibration solutions.

19.1.5. Updated Section 8.1 from 28 to 90 days for the analytical holding time.

19.1.6. Section 8.3.1 was updated to align the TSS procedure to that in Draft 3 of the referenced method.

19.1.7. Added Section 9.6 for a laboratory duplicate per extraction batch.

19.1.8. Added Section 9.8 for LCSD, if needed.

19.1.9. Sections 9.9, 10.10.2 and 10.10.3 ICB/CCB acceptance changed from <RL to <MDL.

19.1.10. Section 9.12.2.2 was added.

19.1.11. Section 10.12.1.1 was added.

19.1.12. Section 11.2.1.1 was added.

19.1.13. Added reference to 3rd Draft December 2022.

19.1.14. Appendix I deleted and Table 1 added.

19.1.15. Revised 50 mL aliquot to 250 mL aliquot throughout.

19.1.16. Revised 1 mL to 300 µL and cap type throughout.

19.1.17. Editorial changes.

19.2. WS-LC-0039, Revision 1.3, Effective 10/12/2022

19.2.1. Section 8.3.1 rewritten to clarify process for determining solids.

19.2.2. Section 8.3.2, removed, “including aqueous samples with more than 50 mg solids”

19.2.3. Section 11.2.2.3, changed to read, “Transfer 1mL of sample into an injection vial.”

19.2.4. Section 11.2.2.6, changed all values to be multiples of 0.625 rather than 0.25, added 10,000X dilution bullet.

19.2.5. Inserted Table 11.12-5.

19.2.6. Editorial changes.

19.3. WS-LC-0039, Revision 1.2, Effective 09/27/2022

19.3.1. Section 11.5.7 revised to, “Adjust the volume to 5 mL. Cap and vortex.”

19.3.2. Section 11.9.2 revised to, “Adjust final volume to 5 mL.”

19.3.3. Editorial changes.

TABLE 18.1 Water IDA Limits			
IDA	**Lower Limit**	**Upper Limit**	
13C4 PFBA	10	130	*
13C PFPeA	40	150	
13C PFHxA	40	150	
13C PFHpA	40	150	
13C PFOA	30	140	
13C PFNA	30	140	
13C PFDA	20	140	
13C PFUnA	20	140	
13C PFDoA	10	150	
13C PFTeDA	10	130	*
13C PFBS	25	150	
13C PFHxS	25	150	
13C PFOS	20	140	
13C PFOSA	10	130	
d3 NEtFOSA	10	130	
d5 NMeFOSA	10	130	
d9 NEtFOSE	10	150	*
d7 NMeFOSE	10	150	*
d5 NEtFOSAA	10	200	
d3 NMeFOSAA	10	200	*
13C 4:2 FTS	25	200	*
13C 6:2 FTS	25	200	*
13C 8:2 FTS	25	200	*
13C HFPO-DA	25	160	

* In the multi-laboratory validation study data for waste water matrices, some laboratories had difficulties achieving IDA recoveries in this range. For these analytes only, if IDA >5% (10% for FTS) and S/N >10.1, then report the data and narrate the excursion.

APPENDIX D: RESPONSE TO COMMENTS

Army's Response to Comments from the New York State Department of Environmental Conservation (NYSDEC) and NYS Department of Health (NYSDOH)

Subject: Final Work Plan – PFAS Remedial Investigation Work Plan (RIWP) and the Final UFP-QAPP for Remedial Investigation

Seneca Army Depot

NYSDEC Site No. 850006

Romulus, New York

Comments Dated: 31 March 2023

Date of Comment Response: 29 June 2023

NYSDEC COMMENTS (RIWP)

Note: Comments 2 and 3 below reference DEC comments and Army responses which were included in the Final Work Plan. The original comment and response are provided below with the follow-up comment in green font.

Comment 1: Response to NYSDEC comment 3: We accept the PALs for water and soil as they are more stringent than the NY proposed AWQ values, except in the case of PFOS. NY's proposed AWQ Value for PFOS is more stringent therefore more protective.

> **Army Response to Comment 1:** At this time, DoD direction for CERCLA sites is to use the guidance provided in the Office of the Assistant Secretary of Defense (OSD) Memorandum, Subject: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program, dated 06 July 2022 and correspond to the EPA Regional Screening Level (HQ=0.1) for PFAS. The EPA RSLs will be considered ARARs during the investigation. The NY AWQGs will be identified as To Be Considered (TBC) during the RI reporting.

Comment 2: Response to NYSDEC Comment 13: This RTC does not address the lack of spatial delineation of the plume, only depth. One of the data gaps identified in the report was the lack of surface and subsurface soil contaminant delineation.

> **Army Response to Comment 2:** At this time, the Army believes the proposed soil sampling locations are adequate to spatially delineate the potential PFAS source areas. Upon review of these data, if the source area soils are not adequately delineated additional step-out sampling will be conducted.
>
> **Final DEC Comment 13:** Figure 5, SEAD-25 Proposed Soil Locations: The number, locations, and depths of the soil samples collected around SEAD-25 is inadequate in order to characterize the PFAS contamination in both the source area soils as well as outside that source area. Significantly more soil samples should be collected from the surface to the groundwater table.
>
> **Final Army Response to Comment 13:** Soil samples in the area of MWFH-04 target the suspected overland flow path that wash water or spilled foam may have flowed from the paved area near the firehouse and the drainage ditch along the western edge. To account for contamination in site soils detected to a depth of 3ft bgs during the ESI, the subsurface soil interval was adjusted from 1.5-2ft bgs to 2-4ft bgs. In some cases, the 2-4ft bgs interval will be the soil interval that is above the water table. RI analytical results from surface (0-0.5ft bgs) and subsurface (2-4ft bgs) soil sampling will be reviewed by the project team prior to proposing additional soil samples.

Comment 3: Response to NYSDEC comment 19: Disagree, the farmer is being exposed by both pathways via Soils like the outdoor workers and ingestion of animal products like the hunter. Was exposure via both pathways evaluated?

Army Response to Comment 3: Exposure via both pathways is evaluated for the hunter. This receptor is assumed to be exposed to soil via incidental ingestion and dermal contact, in addition to the indirect exposure via venison consumption.

Final DEC Comment 19: Appendix A, Section 5.1: The future farmer should be considered as they have both exposure as an outdoor worker and a potential consumer of impacted livestock and/or their products (i.e., milk).

Final Army Response to Comment 19: Do not concur. Because current farming in the area consists of primarily livestock and/or hay production, potential exposure to soil for the farmer receptor is expected to be less than for the outdoor worker. Similarly, potential exposure via ingestion of livestock and/or their products (e.g., milk) for the farmer is expected to be less than for the wild game/deer meat consumer who is assumed to ingest wild game/deer meat 350 days per year. The outdoor worker and hunter receptors being evaluated are protective of a farmer. No changes were made in response to this comment.

END OF COMMENTS

Army's Response to Comments from the New York State Department of Environmental Conservation (NYSDEC) and NYS Department of Health (NYSDOH)

Subject: Draft Final Work Plan – PFAS Remedial Investigation Work Plan (RIWP) and the Final UFP-QAPP for Remedial Investigation

Seneca Army Depot

NYSDEC Site No. 850006

Romulus, New York

Comments Dated: 14 December 2022

Date of Comment Response: 27 February 2022

NYSDEC COMMENTS (RIWP)

Comment 1: General: As this investigation has reached the Remedial Investigation stage, an Operable Unit # should be designated.

Army Response to Comment 1: The Firehouse (Building 103) and SEADs 25, 26, 122B, and 122E will be assigned to new Operable Unit (OU) 18: PFAS. Additional text was added to the second paragraph of Section 1.2.2.

> During cleanup, a site may be divided into a number of distinct areas depending on the complexity of the problems associated with the site. These areas called operable units may address geographic areas of a site, specific site problems, or areas where a specific action is required. An example of a typical operable unit could include removal of drums and tanks from the surface of a site. All four AOCs with confirmed PFAS presence are proposed to be included in new Operable Unit (OU) 18: Per- and polyfluoroalkyl substances (PFAS).

Comment 2: Section 1.1: This section, refers to Screening Levels, however the last sentence states that Screening Levels are presented in worksheet 15 of the QAPP. However, PALs are presented in worksheet 15. This would indicate that Screening Levels and PALs are synonymous and as such this should be indicated or the language changed in one of the documents.

Army Response to Comment 2: The text was clarified. The OSD memo (OSD, 2022b) reference in RTC#3 refers to screening levels (SLs). The PALs presented in the QAPP are synonymous with the SLs in the OSD memo.

Comment 3: Section 1.1, Screening Levels: Discuss the rationale for not including pending promulgation NYS Water Guidance Values and Soil Cleanup Objectives for PFAS.

Army Response to Comment 3: Additional text was added to Section 1.1 to explain the rationale behind the SLs.

> The DoD has adopted a policy within the CERCLA process to compare analytical results for PFAS to risk-based human health screening levels (SLs) for soil and groundwater, as described in a memorandum from the OSD dated 06 July 2022 (OSD, 2022b). The 2022 OSD memorandum recommends using the May 2022 USEPA RSLs for screening soil and groundwater to be protective of human receptors. The USEPA RSLs were updated in November 2022, but there were no changes to the PFAS RSLs. The program under which this RI is being performed follows this DoD policy. The USEPA RSLs (presented to 2 significant figures) are consistent with the USEPA RSL table format rather than the values as presented in the memorandum. The SLs established in the OSD memorandum apply to six compounds: PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA. Risk-based human health

screening levels for surface water and sediment were also calculated using the May 2022 RSL calculator (USEPA, 2022).

Comment 4: Section 2.1: Is Eurofins DOD-certified for PFAS analysis by Draft Method 1633 in addition to the ELAP certification?

Army Response to Comment 4: Eurofins is DoD ELAP certified for 1633 using the latest QSM version. The revised QAPP includes an updated ELAP certification in the QAPP, Attachment 3. ELAP is a DoD accreditation program.

Comment 5: General: The CSM should address what the previous remedies for SEAD-25 and -26 were and how those may have impacted the site since the AFFF contamination.

Army Response to Comment 5: Concur. Additional information was added to Section 1.2.2 regarding SEADs in proximity to RI AOCs and previous remedies. The site specific CSM sections (Section 3.2.2 and 3.3.2) were updated to include discussion of the potential impacts that the remedies may have had on the site.

Comment 6: Section 3.03 and 3.0.4: These sections indicate if Turbidity exceeds 10 NTU in an aqueous sample the lab will then centrifuge the sample and only use the water portion for analysis. However, recommended practice is to consider a "total" measurement. "Total" can be defined as centrifuge, decant, and extract both phases, to report the dissolved concentration and the suspended/solid concentrations either individually or summed in the report.

Army Response to Comment 6: The text was revised to adopt a total measurement for PFAS when turbidity is a concern.

Every reasonable attempt to minimize the presence of suspended particulates will be taken during well installation, well development and while groundwater sampling. There is a potential for suspended solids to accumulate PFAS, specifically some long-chain PFAS constituents, if not prepared thoroughly at the laboratory (ITRC, 2022). It is the goal of the project team to collect groundwater samples with turbidity values less than 10 nephelometric turbidity units (NTUs). However, should the sample turbidity be greater than 10 NTUs with no means of collecting an aliquot at a lower turbidity, then the sample will be collected, and the laboratory will be notified of the potential for high total suspended solids (TSS) on the CoC. According to Draft Method 1633, aqueous samples containing less than 50mg of suspended solids per 500mL sample may be processed without modification to the preparation protocol. Through the regular course of Draft Method 1633, the laboratory will determine if an aqueous sample contains more than 50mg/500mL of TSS and should a groundwater sample produce a TSS concentration greater than 50mg/500mL, the project team will be notified immediately for direction on how to proceed. If resampling is not an option and at the concurrence of the USACE chemist, the lab may be instructed to centrifuge the sample and decant the aqueous portion for processing separately from the solid pellet. The aqueous and solid phases will be extracted and analyzed according to the appropriate matrix protocol specified within Draft Method 1633, with the aqueous phase results considered as the dissolved PFAS concentrations and the PFAS results from the solids pellet completing the measurement for each groundwater sample to yield "total" PFAS concentrations.

Comment 7: Section 3.2.3: No new bedrock wells are planned for SEAD-25. Please provide justification for the lack of investigation of the deeper portion of the aquifer. Only three groundwater bedrock well samples are planned for the investigation in SEAD-25. Provide justification for so few samples. The State feels this is an inadequate sample set to reliably characterize the deep groundwater in and around SEAD-25.

Army Response to Comment 7: At this time, no additional bedrock wells are proposed. Past RIs at SEAD-25 have found no interconnectivity between the upper overburden and bedrock zones. Recent PFAS ESI results indicate limited PFAS impacts in bedrock even in source zones with shallow groundwater total PFAS concentrations over 100,000 ppt. Additional sampling of the existing bedrock well network during the RI will further delineate any trends in the PFAS concentrations and allow the CSM to be updated. Results from sampling the existing bedrock wells during the RI will be examined and will drive decision making regarding additional bedrock wells. No changes made to the workplan.

Comment 8: General: The new monitoring wells should be surveyed into the rest of the network.

Army Response to Comment 8: The following sentence was added to Section 3.0.2 Monitoring Well Installation and Development. "*Monitoring wells will be surveyed by a NY licensed surveyor and tied into the existing ESI well network.*"

Comment 9: Section 3.5: Please present a figure showing the general area where the hunt occurs on the Site.

Army Response to Comment 9: A figure showing the area of deer hunting is available as Attachment B – Biota Sampling SOP, Exhibit 1. Deer are harvested from the numbered areas and within the maroon polygon labeled "Remaining Area".

Comment 10: Figure 2 & Table 1: Firehouse groundwater samples:

a) Given the high PFAS concentrations seen in MWFH-01 during the ESI, it should be sampled during the RI.
b) Well MWFH-01 is labeled on Figure 3, but not on Figure 2. Please add the label to Figure 2.
c) A surface water sample should be collected at SWFH-03 to understand the upgradient contributions to the surface water samples collected in SEAD-25.

Army Response to Comment 10a: Well MWFH-01 was sampled twice during the PFAS ESI and is known to have elevated concentrations of PFAS in the 1,000s ppt. Additional sampling of this well provides limited value in further delineating the source area. The well (MWFH-02) directly downgradient of MWFH-01 is proposed for sampling in Round 1 of the RI.

Army Response to Comment 10b: The well label was added to Figure 2.

Army Response to Comment 10c: Water flow in this location is inconsistent and subject to precipitation. Any water flowing out of the Administrative Area through stormwater infrastructure will flow into the ditch northwest of SEAD-25. A surface water/sediment sample (SW/SD25-00, Figure 4) will be collected from the stormwater outfall that flows into the ditch.

Comment 11: Figure 3 & Table 2: Firehouse soil samples: Additional soil samples should be biased around MWFH-04 due to the highest concentration of PFAS being seen in this AOC. In addition, due to the significantly higher concentrations of PFAS, the soil should be characterized to the groundwater table if this area is identified as a source.

Army Response to Comment 11: Soil samples in the area of MWFH-04 target the suspected overland flow path that wash water or spilled foam may have flowed from the paved area near the firehouse and the drainage ditch along the western edge. To account for contamination in site soils detected to a depth of 3ft bgs during the ESI, the subsurface soil interval was adjusted from 1.5-2ft bgs to 2-4ft bgs. In some cases, the 2-4ft bgs interval will be the soil interval that is above the water table. RI analytical results from surface (0-0.5ft bgs) and subsurface (2-4ft

bgs) soil sampling will be reviewed by the project team prior to proposing additional subsurface soil samples.

Comment 12: Figure 4, SEAD-25, Proposed Groundwater, Surface Water and Sediment Location & Table 5:

a) SD25-00 should be both a sediment and surface water sample, unless there is no sediment.
b) An inset of SEAD-25's central area should be included as the current view does not allow for differentiation and identification of the wells in that area in Figure 4.
c) A monitoring well should be installed to the southeast of the AOC to delineate the plume in that direction.
d) Although Figure 4 shows location SWSD25-03, no samples are indicated for this location on Table 5. At least one sample should be collected from this location as its indicated on the figure.
e) The following existing monitoring wells should have a groundwater sample collected from them in addition to the ones included in Table 5: MW25-02, MW25-03, MW25-9, MW25-10, MW25-17, and MW25-18.

Army Responses to Comment 12:

a) Agree. Surface water will be collected at SW25-00. Sediment will also be collected, if present.
b) Figure 5 provides a view of the central area in which the monitoring wells in the central area are identifiable. Additional labels were added to identify all the wells.
c) Shallow groundwater to the southeast of SEAD-25 will be investigated by sampling the wetland area east of SEAD-25. The results from the surface water sampling and the resampling of existing wells MW25-24, MW25-25 and MW25-33 will be reviewed before the final placement of new wells MW25-39 and MW25-40 is made.
d) A note was added to sample location SWSD25-03 in Figure 4 indicating that this sample will be collected as part of the Seneca background study (submitted under separate cover) and will be sampled for PFAS using Draft Method 1633.
e) The groundwater source area is well defined by PFAS analytical results from the Parsons (2022) ESI. Additional Draft Method 1633 PFAS data will be gathered at the edges of the source area in wells MW25-1, MW25-6, MW25-8, MW25-13, MW25-15, MW25-19, MW25-20, MW25-21, and MW25-22 and from the source area at wells MW25-31 and MW25-31D.

Comment 13: Figure 5, SEAD-25 Proposed Soil Locations: The number, locations, and depths of the soil samples collected around SEAD-25 is inadequate in order to characterize the PFAS contamination in both the source area soils as well as outside that source area. Significantly more soil samples should be collected from the surface to the groundwater table.

Army Response to Comment 13: See RTC #11.

Comment 14: Figure 6, Table 6, Proposed Groundwater Sampling in SEAD-26: It's unclear from Figure 6 as to the locations of SDSW26-01 through SDSW26-03. Do these locations correspond to SW26-01 through SW26-03? These locations should be shown on the figure.

Army Response to Comment 14: Table 8 was mislabeled. Surface water/sediment locations were mistakenly started with ID -01. Table 8 was revised to start with sample SWSD26-04 and end with sample SWSD26-13. No change to Figure 6 based on this comment.

Comment 15: Figure 7, Table 7: Proposed Soil Sampling Locations, SEAD-26: The depth of the proposed soil sampling locations in the area with the highest concentrations of PFAS, most likely source areas, are inadequate. Soils should be sampled and analyzed to the groundwater table to establish depth of PFAS contamination.

Army Response to Comment 15: See RTC #11.

Comment 16: Figure 10, Project Schedule: What is the purpose of several public meetings in 2023?

Army Response to Comment 16: The project schedule presented is a contract wide schedule and includes public meetings related to the FS. Figure 10 was revised to only show tasks related to the RI.

Comment 17: Figure 10, Project Schedule: The project schedule should be adjusted to the submission of the RIWP and the UFP-QAPP for review.

Army Response to Comment 17: The project schedule was adjusted.

Comment 18: Appendix A, Section 5.1: Children should also be considered under the recreational user category.

Army Response to Comment 18: Do not concur. The child resident receptor is assumed to be exposed to sediment and surface water under a recreational exposure setting (i.e., 24 days per year). The child resident receptor will be protective of the child recreational user. No changes were made in response to this comment.

Comment 19: Appendix A, Section 5.1: The future farmer should be considered as they have both exposure as an outdoor worker and a potential consumer of impacted livestock and/or their products (i.e., milk).

Army Response to Comment 19: Do not concur. Because current farming in the area consists of primarily livestock and/or hay production, potential exposure to soil for the farmer receptor is expected to be less than for the outdoor worker. Similarly, potential exposure via ingestion of livestock and/or their products (e.g., milk) for the farmer is expected to be less than for the wild game/deer meat consumer who is assumed to ingest wild game/deer meat 350 days per year. The outdoor worker and hunter receptors being evaluated are protective of a farmer. No changes were made in response to this comment.

Comment 20: Appendix A, Section 5.2: This section states that "COPCs will consist of those PFASs that are site-related contaminants and are present at concentrations greater than health-based screening values." The determination of COPCs in the PFAS family should also take into account the chemistry of PFAS and breakdown of long chain to short chain PFAS and how the comparison can lead to a better understanding of the source of the PFAS.

Army Response to Comment 20: Do not concur. The requested forensic analysis is not applicable to the HHRA or SLERA, both of which evaluate potential exposure to detected concentrations of PFAS in site media and the associated risks. The quantitative HHRA and SLERA will focus on the PFAS compounds that have toxicity values, which currently includes only a subset of PFAS compounds. Potential risks associated with PFAS compounds that do not have toxicity values will be discussed qualitatively in the uncertainty assessment. No changes were made in response to this comment.

Comment 21: Appendix B, Biota Sampling SOP: Section 5.3.3 refers to "wet sediment sample collection" rather than tissue sampling.

Army Response to Comment 21: The error was corrected.

Comment 22: Appendix B: Given the handling of biological tissue, a stronger cleaning agent prior to decontamination may be necessary.

> **Army Response to Comment 22:** Appendix B was modified to include a methanol rinse after initial washing with soap.

Comment 23: Appendix B: The use and proper disposal of scalpels should be considered in the HASP.

> **Army Response to Comment 23:** Proper disposal of scalpels was added to the HASP.

Comment 24: General: Please include a Health and Safety Plan (HASP) among the RIWP or UFP-QAPP submission for this phase of activities.

> **Army Response to Comment 24:** An Accident Prevention Plan (APP) / Site Safety and Health Plan (SSHP) will be submitted under separate cover.

END OF COMMENTS

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Army's Response to Comments from the US Environmental Protection Agency (EPA)

Subject: Final, Revision 1 Work Plan – PFAS Remedial Investigation Work Plan (RIWP)

Seneca Army Depot

NYSDEC Site No. 850006

Romulus, New York

Comments Dated: 17 July 2023

Date of Comment Response: 17 August 2023

EPA COMMENTS (RIWP)

The following comments and action items from the EPA were received by the Army via email on 17 July 2023.

Comment 1: Based on a meeting between EPA, NYSDEC, NYSDOH and the Army on 13 July 2023, the following action items were agreed upon:

1) Samples of surface soil would be collected from 0 to 6-inches - to be used for both Ecological and Human Health Risk Assessments. The Ecological Risk Assessment Uncertainty Analysis will include a discussion of the potential effects of not collecting samples from 6-inches to 1-foot.
2) Samples of sediment will be collected from 0 to 6-inches.

Army Response to Comment 1:

1) The Appendix A – Risk Assessment workplan, Section 6.4 Ecological Risk Assessment Uncertainty Analysis was updated to state: "*The SLERA will evaluate the uncertainty associated with sampling only the top 6 inches of soil and not collecting data for the 0.5 to 1 ft bgs interval, and the…*"
2) In the main workplan text, Section 3.0.5 Sediment Sampling, the sediment collection depth was changed from 0 to 1 foot bgs to 0 to 6-inches bgs.

Comment 2: The Army's previous RTC indicates that the Work Plan was not revised to address EPA Comment # 17, which read as follows:

> "Recommend keeping MW122E-10 at the initially-proposed location and installing an additional well near the northern boundary of the subarea (e.g. north of SB122E-21) in order to better characterize groundwater flow direction, potential contaminant transport, and possible comingling of plumes from adjacent SEADs."

EPA does not agree with the Army response. EPA reserves the right to request installation and sampling of the additional well again after the 1st round of data is evaluated.

Army Response to Comment 2: Comment acknowledged.

Comment 3: The Army response to EPA Comment 20, which touches on potential upgradient sources, is acceptable for the time being. The possible discovery of a significant upgradient source (e.g. SEAD11, SEAD64D) would likely require additional characterization, which could be handled as part of a future RI for those sites (which are currently being investigated as part of the 36 Site SI).

Army Response to Comment 3: Comment acknowledged.

END OF COMMENTS

Army's Response to Comments from the US Environmental Protection Agency (EPA)

Subject: Final Work Plan – PFAS Remedial Investigation Work Plan (RIWP) and the Final UFP-QAPP for Remedial Investigation

Seneca Army Depot

NYSDEC Site No. 850006

Romulus, New York

Comments Dated: 07 April 2023

Date of Comment Response: 29 June 2023

EPA provided comments on 07 April 2023 via email in response to the Army Response to Comments (RTC) dated 27 February 2023 which were provided in the Final Seneca Army Depot PFAS RI Work Plan issued February 2023. The original comment and response are provided below with the follow-up comment in green font. Additional ecological risk assessment comments are provided at the end of the RTC.

EPA COMMENTS (RIWP)

Comment 1: General: It is not clear within the text or in Table 8 which SEAD 26 sample locations involve passive pore water sampling. Please provide additional detail regarding sample methodology, justification for the three-day sampler deployment duration, a figure depicting sample locations, and information describing the suitability of the selected pore water monitoring technique for PFAS analysis at CERCLA sites.

Army Response to Comment 1: Table 8 was revised to include the pore water sample locations and sample IDs. The two pore water sampling locations were added to Figure 6. The methodology for sampling in the workplan was revised due to newer methodologies for passive sampling coming on the market. The paragraph was revised as follows:

> Two sediment pore water samples are proposed to be collected from the pond downgradient of SEAD-26 (**Figure 6**). The samples are proposed to be collected using a diffusion-based equilibrium passive sampler that has been developed and validated for targeted PFAS in sediment pore water (e.g., SiREM PFASsive™ sampler). Upon retrieval, the water from PFASsive™ is treated as a water sample and the PFAS can be concentrated and measured using EPA Draft Method 1633 without the need for additional extraction steps required when sorbents are present. The equilibrium sampler will be left deployed for approximately 4 weeks. The inclusion of a reverse tracer allows for the determination of the extent of equilibrium during deployment. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 8**.

EPA Response to RTC 1: Acknowledged. The new pore water sampling method needs to be fully integrated into the QAPP.

Army Response: SOPs and lab worksheets pertaining to the pore water sampling method were added to the workplan, Appendix C for reference and will be fully integrated into the next revision of the QAPP.

Comment 9: Section 3.1.4, and throughout: For all sites, it is recommended that all of the wells sampled in the first round of RI groundwater sampling also be included in the second round.

Army Response to Comment 9: The existing wells proposed to be sampled during the first round were previously sampled twice during the PFAS ESI and either define source areas or lateral extents of PFAS contamination. Resampling of a subset of the existing wells is proposed

to gain additional information at source areas regarding the PFAS signature by using Draft Method 1633 or to provide temporally similar plume data that is upgradient of newly proposed wells that will be installed and sampled during the RI. In general, the existing wells have known trends of elevated PFAS concentrations and additional sampling (a fourth round) will not be filling any data gaps at this time. No changes made to the workplan.

EPA Response to RTC 9: Will ESI results be fully integrated into the RI dataset? If sampling cannot be conducted at all of the site wells during each round of RI sampling, it is strongly recommended that groundwater elevation measurements be obtained at these locations at the very least.

Army Response: The risk assessment will consider all usable, historical data. Due to their transient natures, current groundwater and surface water data will supersede historical data for a given well or sampling location. Groundwater elevations will be collected from the full ESI and RI monitoring well network during both rounds of groundwater sampling.

Comment 17: Section 3.4.3: EPA recommends additional monitoring wells in the vicinity of SB122E-06, SB122E-16, and near the northern boundary of the southernmost subarea of SEAD- 122E in order to better characterize groundwater flow direction, potential contaminant transport, and possible comingling of plumes from adjacent SEADs. An additional shallow well in the field southwest of proposed well MW122E-07 would be useful for understanding groundwater flow in an area with multiple potential sources, including non-SEAD sources (fire house and fire training area).

Army Response to Comment 17: Northern-most SEAD-122E pad: one proposed well (MW122E-05) will be moved to the southeastern edge of the pad near soil boring (SB122E-06) (see below). The soil sample (SB122E-27) will remain along the western edge of the pad. Topography of the airfield indicates that surface topography at this pad slopes towards the western corner therefore proposed well MW122E-04 will remain in the western corner.

Central SEAD-122E pad: In the vicinity of SB122E-16, one shallow monitoring well will be added in a drainage ditch that may have received discharge from the county fire training area and would migrate down the ditch towards the northwest. An additional shallow well will be installed downgradient (southwest) of proposed location MW122E-07 to assist in delineating potentially multiple source plumes.

Southern SEAD-122E pad: Proposed well (MW122E-11) will move northwest to be centrally located downgradient of the pad. As requested, proposed well (MW122E-32) will move north to better capture potential comingling plumes between SEAD-122E and SEAD-122D.

Figure 1: Northern SEAD-122E pad area.

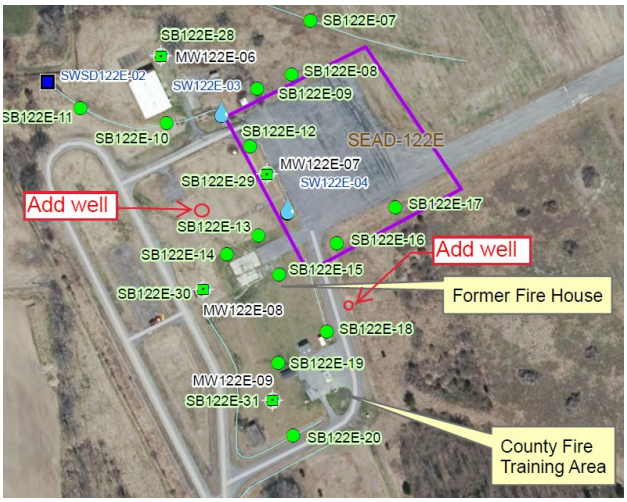

Figure 2: Central SEAD-122E pad area

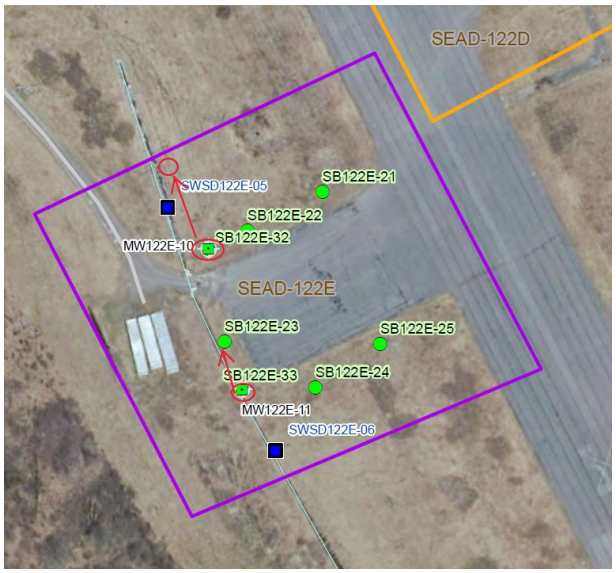

Figure 3: Southern SEAD-122E pad area and SEAD-122D to the northeast.

EPA Response to RTC 17: No additional input on the suggested additions/changes except for the southernmost SEAD-122E pad. Recommend keeping MW122E-10 at the initially-proposed location and installing an additional well near the northern boundary of the subarea (e.g. north of SB122E-21) in order to better characterize groundwater flow direction, potential contaminant transport, and possible comingling of plumes from adjacent SEADs.

Army Response: The Army believes the shifts of MW122E-10 and MW122E-11 to the north-northwest will provide characterization of the groundwater downgradient of the former pad and in a position to intercept groundwater and infiltration of surface water flow originating from the former pad (the surface elevation near the three trailers visible in the image above is higher than the surrounding area). The more northerly position of MW122E-10 will also intercept groundwater flowing downgradient of SEAD-122D. Additional wells are located to the north within SEAD-122D and will provide additional data points to determine groundwater flow across SEAD-122E.

Comment 20: Section 3.4.3: The addition of a monitoring well upgradient of SEAD-122D and the northernmost SEAD-122E site is suggested in order to capture any PFAS migrating onto the sites being investigated.

Army Response to Comment 20: Based on SI results at the Airfield, limited PFAS impacts are expected at SEAD-122D and the northern most SEAD-122E site. Upgradient areas are generally undeveloped and the nearest upgradient SEADs (SEAD-11 and SEAD-64D) will be investigated during the PFAS SI. No changes made to the workplan.

EPA Response to RTC 20: Given the low regulatory standards for the compounds of interest as well as the presence of potential sources which have not yet been investigated, EPA continues to recommend the installation of upgradient wells.

Army Response: Potential DoD related upgradient sources will be addressed as part of the PFAS SI. SEAD-64D and SEAD-11 are upgradient of the airfield and SI proposed wells are shown below in red.

Additional comments received from EPA Ecological Risk Assessor on 04/07/23.

ECOLOGICAL RISK ASSESSOR COMMENTS:

Comment 1: The text states that surface soil samples will be collected from 0-0.5 feet and sediment samples from 0-1 ft. However, for ecological purposes, EPA generally requires that soil samples be collected from 0-1 ft and sediment samples from 0-0.5 ft. Is this a typo in which the numbers are reversed? This needs to be reconciled.

> **Army Response to Comment 1:** The sample intervals are correct as written. Typically, the top 6 inches of surface soil is sampled to provide data that can be used in both the HHRA and ERA. Sampling the top foot of sediment will provide data for the interval most susceptible to turnover and mixing. No change was made to the planned approach.

Comment 2: Section 3.0.5, Sediment Sampling: The text uses the phrase "Inundation of less than 1 month". Does this mean less than month total in a year or consecutively? Put another way, does this mean "inundation of less than 1 month total in a year?" Is the Work Plan defining it as a few days a month each month over the course of the year or would it need to be all at once that it's inundated with water? Clarification is needed in the text.

> **Army Response to Comment 2:** The intent of the text is to state that the sample will be considered sediment if the location is continuously under water for 1 month or longer such that it would support a benthic population. The text was revised as follows: "*…(i.e., continuous inundation of less than 1 month)…*"

Comment 3: Figure 4: The legend has a symbol for "Proposed Sediment Sample". However, EPA did not find any solitary sediment samples (i.e., sediment samples that were not paired with surface water samples). Were there any sediment samples that were not paired with a surface water sample? This needs to be addressed.

Army Response to Comment 3: There are no longer any solitary sediment samples. The legend in Figure 4 was corrected.

Comment 4: Tables 5 and 11, Notes: What is "sedimen"? This needs to be reconciled.

Army Response to Comment 4: The error was corrected to read 'sediment'.

Comment 5: Appendix A, Section 6.1.4: Since deer are proposed as a receptor for the SLERA, will the results of the deer sampling be incorporated into the SLERA? Also please include raccoon as a mammalian omnivorous receptor.

Army Response to Comment 5: We are not aware of any mammal toxicity values based on actual tissue concentrations that can be used to evaluate toxicity of PFAS to deer. If you can provide applicable toxicological reference values against which deer tissue data can be compared, we will incorporate that evaluation into the risk assessment. The raccoon will be evaluated as requested.

END OF COMMENTS

Army's Response to Comments from the US Environmental Protection Agency (EPA)

Subject: Draft Final Work Plan – PFAS Remedial Investigation Work Plan (RIWP) and the Final UFP-QAPP for Remedial Investigation

Seneca Army Depot

NYSDEC Site No. 850006

Romulus, New York

Comments Dated: 05 January 2023

Date of Comment Response: 27 February 2023

EPA COMMENTS (RIWP)

Comment 1: General: It is not clear within the text or in Table 8 which SEAD 26 sample locations involve passive pore water sampling. Please provide additional detail regarding sample methodology, justification for the three-day sampler deployment duration, a figure depicting sample locations, and information describing the suitability of the selected pore water monitoring technique for PFAS analysis at CERCLA sites.

Army Response to Comment 1: Table 8 was revised to include the pore water sample locations and sample IDs. The two pore water sampling locations were added to Figure 6. The methodology for sampling in the workplan was revised due to newer methodologies for passive sampling coming on the market. The paragraph was revised as follows:

> Two sediment pore water samples are proposed to be collected from the pond downgradient of SEAD-26 (**Figure 6**). The samples are proposed to be collected using a diffusion-based equilibrium passive sampler that has been developed and validated for targeted PFAS in sediment pore water (e.g., SiREM PFASsive™ sampler). Upon retrieval, the water from PFASsive™ is treated as a water sample and the PFAS can be concentrated and measured using EPA Draft Method 1633 without the need for additional extraction steps required when sorbents are present. The equilibrium sampler will be left deployed for approximately 4 weeks. The inclusion of a reverse tracer allows for the determination of the extent of equilibrium during deployment. A sample matrix with sample identification, QC requirements and proposed analytes are presented in **Table 8**.

Comment 2: Section 1.2.2 and Figures 2 through 8: Additional information should be briefly provided about the SEADs that are upgradient, downgradient, or adjacent to the sites being investigated (e.g., SEADs- 42, 30, 33, 39, 36, 121-C/F/G, 5, 64, etc.). This information should include whether any future PFAS investigations are expected to occur at any of these other sites.

Army Response to Comment 2: Additional information was added to the AOC subsections in Section 1.2.2 to describe adjacent sites and their status with respect to future PFAS investigations.

Comment 3: Section 1.2.2: The second sentence of the Airfield section should be rephrased for clarity. Currently, it could be interpreted to state that four historical deicing pads comprise SEAD 122-E.

Army Response to Comment 3: The sentence was revised for clarity. "*The three deicing/refueling pads that comprise SEAD-122E are located along the western side of the northwest-southeast runway, and the aircraft refueling area (SEAD-122D) is located to the east near the southeastern end of the runway.*"

Comment 4: Section 1.2.2, last paragraph: Is there potential (present or historic) utilization of AFFF at the fire training area or former firehouse? This should be mentioned in this section. If so, would resultant contamination be handled as a part of SEAD-122E? If those two areas are considered

potential PFAS sources, additional groundwater sampling should be focused around and downgradient of these features given the potential for off-base migration.

> **Army Response to Comment 4:** There is no known utilization of AFFF anywhere at SEDA; however, based on the PFAS results of the PFAS ESI at the Firehouse, SEAD-25 and SEAD-26, historical use of AFFF is suspected. Downgradient monitoring wells and soil sampling are proposed in the areas of the former airfield firehouse and the county fire training area to determine presence or absence of PFAS. The results will be reviewed to determine if the airfield firehouse would be further investigated as part of the SEAD-122E RI and additional sampling would be conducted. The presence of PFAS associated with the airfield fire training area, which was built after DoD closure of SEDA (built between May 2002 and June 2003 based on historical aerial images), would involve a potentially responsible party (PRP) as the contamination is not associated with DoD mission related activities. Further information will be gathered to determine if AFFF was used during county fire training. No changes made to the workplan.

Comment 5: Section 1.3.4: The text states "Within the lower water bearing zone, well yields… are not considered potable based on their inability to meet the state regulations for water wells." In order to avoid confusion related to the ongoing groundwater quality investigation, please provide the citation and/or refer to the specific relevant state regulations within the text.

> **Army Response to Comment 5:** Reference to NYSDOH's guidance on Well Yield and Water Flow was added. Guidance can be found in 10 CRR-NY Appendix 5-B.4 at https://govt.westlaw.com/nycrr/Document/I4fff34cbcd1711dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

Comment 6: Section 1.3.4: The text states "There are unconfirmed local residences with drinking water wells outside the former SEDA boundary that are approximately 2 miles west of the Firehouse, SEAD-25, and SEAD-26 AOCs and within 0.25 miles of the Airfield parcel." EPA recommends conducting a survey of the areas downgradient of the sites in order to confirm the existence of any private drinking water/agricultural wells, obtaining construction details of these wells if possible, and then sampling these wells. This is particularly relevant for any residences downgradient of the SEAD-122 sites.

> **Army Response to Comment 6:** A drinking water well survey will be conducted as part of the RI. Initial results of the proposed RI sampling will be reviewed by the Army and presented to the regulators before a decision is made regarding sampling private drinking water or agricultural wells. An additional bullet was added to Section 2.0 describing the water well survey.
>
> > Well Inventory Survey. A drinking water well survey will encompass the boundary of the former Depot and the area between the western boundary of the former Depot and Seneca Lake, approximately 1 to 1.5 miles to the west (downgradient) of the Depot. The well survey will identify the location of drinking water wells and the well construction details, if available. Data will be collected from sources such as: past Seneca investigations, online well databases (e.g., NYSDEC), town/county records, county water department, NYSDOH records, and interviews with major landowners. These data will be used during initial review of RI data and will be provided in the RI report.

Comment 7: Section 1.4: If it exists, can existing residential/private well data be used to ensure no unacceptable exposures are occurring off-base? Personally identifiable information should be removed.

Army Response to Comment 7: The Army and the state are working on obtaining these results. The confidentiality of the results will be retained and if any results are included in the RI report, personally identifiable information (PII) will be removed.

Comment 8: **Sections 3.0.3 and 3.0.4**: The text states "*If the groundwater parameters are greater than 10 NTUs and there is not a means of collecting something with lower NTUs, then the sample will be collected, and the laboratory will be notified on the CoC. The lab will centrifuge the sample and decant off the water portion for subsequent extraction (i.e., only analyze the supernatant for PFAS).*" This is not something that has been done during other Region 2 PFAS investigations. In general, turbidity concerns are often addressed through careful well construction and sampling techniques. Also, please see NYSDEC 12/14/22 comment regarding this issue.

Army Response to Comment 8: Careful well construction and sampling techniques have and will be used during the investigation; however, the bedrock formation at Seneca is naturally silty and turbidity in the bedrock wells is difficult to control. The text was revised to address this concern.

> Every reasonable attempt to minimize the presence of suspended particulates will be taken during well installation, well development and while groundwater sampling. There is a potential for suspended solids to accumulate PFAS, specifically some long-chain PFAS constituents, if not prepared thoroughly at the laboratory (ITRC, 2022). It is the goal of the project team to collect groundwater samples with turbidity values less than 10 nephelometric turbidity units (NTUs). However, should the sample turbidity be greater than 10 NTUs with no means of collecting an aliquot at a lower turbidity, then the sample will be collected, and the laboratory will be notified of the potential for high total suspended solids (TSS) on the CoC. According to Draft Method 1633, aqueous samples containing less than 50mg of suspended solids per 500mL sample may be processed without modification to the preparation protocol. Through the regular course of Draft Method 1633, the laboratory will determine if an aqueous sample contains more than 50mg/500mL of TSS and should a groundwater sample produce a TSS concentration greater than 50mg/500mL, the project team will be notified immediately for direction on how to proceed. If resampling is not an option and at the concurrence of the USACE chemist, the lab may be instructed to centrifuge the sample and decant the aqueous portion for processing separately from the solid pellet. The aqueous and solid phases will be extracted and analyzed according to the appropriate matrix protocol specified within Draft Method 1633, with the aqueous phase results considered as the dissolved PFAS concentrations and the PFAS results from the solids pellet completing the measurement for each groundwater sample to yield "total" PFAS concentrations.

Comment 9: Section 3.1.4, and throughout: For all sites, it is recommended that all of the wells sampled in the first round of RI groundwater sampling also be included in the second round.

Army Response to Comment 9: The existing wells proposed to be sampled during the first round were previously sampled twice during the PFAS ESI and either define source areas or lateral extents of PFAS contamination. Resampling of a subset of the existing wells is proposed to gain additional information at source areas regarding the PFAS signature by using Draft Method 1633 or to provide temporally similar plume data that is upgradient of newly proposed wells that will be installed and sampled during the RI. In general, the existing wells have known trends of elevated PFAS concentrations and additional sampling (a fourth round) will not be filling any data gaps at this time. No changes made to the workplan.

Comment 10: Section 3.1.4: Is it anticipated that the proposed downgradient bedrock well MWFH-15D will be screened within the same hydro-stratigraphic unit as the bedrock wells in/near the source area? Is it anticipated that contaminant transport through bedrock may be affected by significant changes in rock properties moving downgradient? Please confirm that these factors have been considered in the process of evaluating the vertical positioning of bedrock wells.

Army Response to Comment 10: Well MWFH-15D is expected to be screened within the same hydro-stratigraphic unit as near the Firehouse source area. Based on the bedrock borings

conducted during the ESI and previous RIs conducted at SEDA, the bedrock geology and structure is consistent across the Firehouse, SEAD-25, and SEAD-26 AOCs and transport properties within bedrock are expected to be similar at all three sites. The onsite geologist will coordinate with the project lead during drilling to ensure correct vertical placement of the bedrock wells. No changes made to the workplan.

Comment 11: Section 3.1.6, and throughout: The proposed soil sampling does not address the data gap identified in section 3.1.2 (and other CSM descriptions) to delineate the extent of contamination in subsurface soils. Impacts were identified at the greatest sampling depth (3 ft bgs) during the ESI at the sites being investigated, and RI sampling is proposed to a maximum depth of 2 ft at all sites. This may not provide the data necessary for understanding the distribution of PFAS in soils which are impacting groundwater quality.

Army Response to Comment 11: To account for contamination in site soils detected to a depth of 3ft bgs during the ESI, the subsurface soil interval was adjusted from 1.5-2ft bgs to 2-4ft bgs. In some cases, the 2-4ft bgs interval will be the soil interval that is above the water table. RI analytical results from surface (0-0.5ft bgs) and subsurface (2-4ft bgs) soil sampling will be reviewed by the project team prior to proposing additional subsurface soil samples.

Comment 12: Section 3.1.6: Given the limited available information regarding the historical activities at firehouse building 103, soil sample collection is recommended at the residential property just southeast of the firehouse lot.

Army Response to Comment 12: If necessary, step-out sampling will be performed after the initial soil sampling data are reviewed. No changes made to the workplan.

Comment 13: Section 3.3: Have any groundwater seeps been observed downgradient of the SEAD-26 source areas?

Army Response to Comment 13: No groundwater seeps have been observed downgradient of SEAD-26. The terrain gently slopes west into a pond and wetland area into which groundwater is expected to discharge for most of the year except in times of drought. No changes made to the workplan.

Comment 14: Section 3.3.2: The CSM identifies a data gap regarding the downgradient extent of PFAS impacts to surface water west of SW26-06, but there does not appear to be any additional sampling proposed west of SW26-06 on Figure 6.

Army Response to Comment 14: If necessary, step-out sampling downgradient of SW26-06 will be performed, if warranted, after review of the initial surface water analytical dataset. No changes made to the workplan.

Comment 15: Section 3.3.5: To fully delineate soil impacts, it may be beneficial to add several additional sampling locations along the length of the N-S road/track area just west of SEAD-26.

Army Response to Comment 15: There is no evidence that fire training was performed in the area west of SEAD-26. There are soil samples proposed for the area just west of the main source area to account for any potential migration of AFFF related to overland flow (Figure 6). Step-out sampling may be warranted after initial review of the soil sampling dataset. No changes made to the workplan.

Comment 16: Section 3.3.6: Although precise locations for samples SWSD26-11 through SWSD26-13 will be determined based upon field conditions, the general area (wetland west of the pond) should be indicated on Figure 6.

Army Response to Comment 16: The wetland area was added to Figure 6.

Comment 17: Section 3.4.3: EPA recommends additional monitoring wells in the vicinity of SB122E-06, SB122E-16, and near the northern boundary of the southernmost subarea of SEAD- 122E in order to better characterize groundwater flow direction, potential contaminant transport, and possible comingling of plumes from adjacent SEADs. An additional shallow well in the field southwest of proposed well MW122E-07 would be useful for understanding groundwater flow in an area with multiple potential sources, including non-SEAD sources (fire house and fire training area).

Army Response to Comment 17: Northern-most SEAD-122E pad: one proposed well (MW122E-05) will be moved to the southeastern edge of the pad near soil boring (SB122E-06) (see below). The soil sample (SB122E-27) will remain along the western edge of the pad. Topography of the airfield indicates that surface topography at this pad slopes towards the western corner therefore proposed well MW122E-04 will remain in the western corner.

Central SEAD-122E pad: In the vicinity of SB122E-16, one shallow monitoring well will be added in a drainage ditch that may have received discharge from the county fire training area and would migrate down the ditch towards the northwest. An additional shallow well will be installed downgradient (southwest) of proposed location MW122E-07 to assist in delineating potentially multiple source plumes.

Southern SEAD-122E pad: Proposed well (MW122E-11) will move northwest to be centrally located downgradient of the pad. As requested, proposed well (MW122E-32) will move north to better capture potential comingling plumes between SEAD-122E and SEAD-122D.

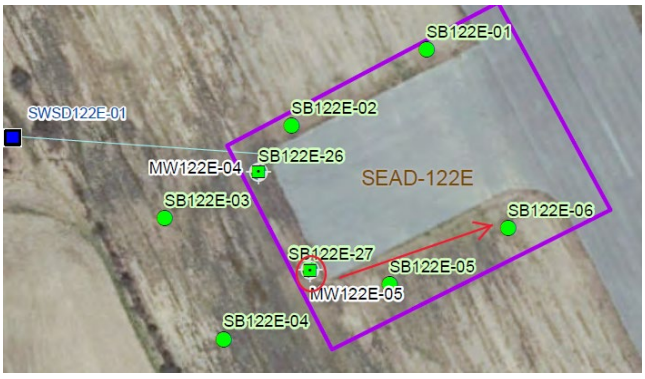

Figure 1: Northern SEAD-122E pad area.

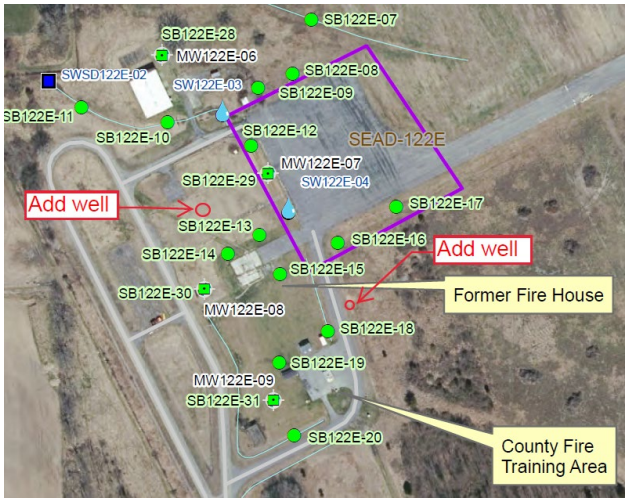

Figure 2: Central SEAD-122E pad area

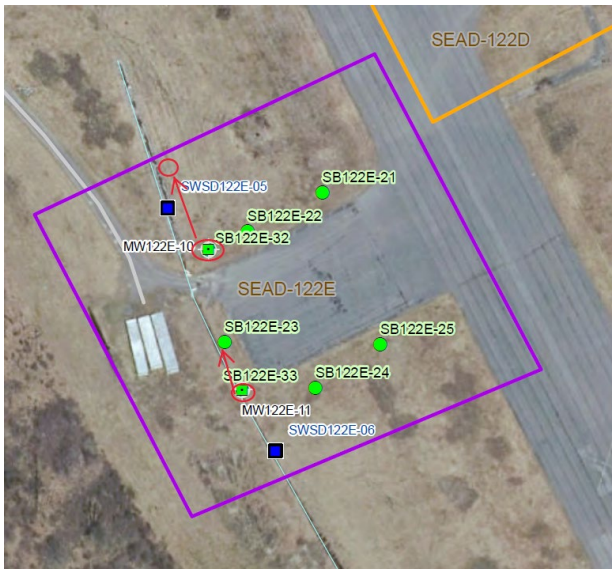

Figure 3: Southern SEAD-122E pad area and SEAD-122D to the northeast.

Comment 18: Section 3.4.3: Given the state MCLs, and the position of the SEAD-122 areas with respect to the depot boundary and homes with private wells, additional monitoring may be required farther downgradient of these sites in order to delineate areas with contamination above the relevant groundwater standards. It may be wise to designate contingency locations, although the network can also be reassessed following the receipt of initial data.

Army Response to Comment 18: The Army will evaluate the initial datasets before proposing contingency locations. Stakeholders will be engaged in decision-making if additional sampling locations are necessary. No changes made to the workplan.

Comment 19: Section 3.4.3: EPA concurs with the approach suggested for designating locations for bedrock monitoring wells.

Army Response to Comment 19: Comment noted. No response required.

Comment 20: Section 3.4.3: The addition of a monitoring well upgradient of SEAD-122D and the northernmost SEAD-122E site is suggested in order to capture any PFAS migrating onto the sites being investigated.

Army Response to Comment 20: Based on SI results at the Airfield, limited PFAS impacts are expected at SEAD-122D and the northern most SEAD-122E site. Upgradient areas are generally undeveloped and the nearest upgradient SEADs (SEAD-11 and SEAD-64D) will be investigated during the PFAS SI. No changes made to the workplan.

Comment 21: Figure 9: What is the nature of the white structure west of the 'central' SEAD-122E pad and adjacent to proposed MW122E-06? Was there known chemical storage onsite or potential discharge at areas other than the pad itself?

Army Response to Comment 21: There is no historical information regarding this building. It is newer construction and, estimating from historical aerial photos, was built between 1984 and 1994. The building style is a warehouse with three large bay doors on the northeast facing side. The Army will review historical information and the current land user will be contacted in

an attempt to determine the use of the building. Two former Depot buildings were located in this area and were used for JP-8 fuel and petroleum, oil and lubricants (POL) storage.

- Note: The original copy of EPA comments contained a typo in the numbering. The comments skipped from 2 to 4. All comments received are provided above and total 21.

HUMAN HEALTH RISK ASSESSOR COMMENTS:

Comment 1: Page 2, Section 1.2.2: "…PFOA and PFOS did not exceed the EPA lifetime health advisory level of 70 nanograms per liter (ng/L) (parts per trillion [ppt]) (EPA, 2022)." – This EPA 2022 citation (https://www.epa.gov/sdwa/drinking-water-health-advisoriespfoa-and-pfos) does not reflect the information presented in the sentence. The PFOS and PFOA lifetime drinking water health advisories of 70 ppt (combined or individually) are outdated/no longer effective, and there are now new interim drinking water health advisories, which have been updated in 2022, for PFOA and PFOS.

Army Response to Comment 1: The intent of the sentence was to note that the SI report, completed in 2018, recommended no further action for the airfield AOCs because the concentrations of PFOA and PFOS were below the health advisory of the time. The reference was removed from the sentence and the sentence was revised to indicate "…PFOA and PFOS did not exceed *the then* current EPA lifetime health advisory…".

Comment 2: Page 8, Section 1.5.1: "PFAS compounds typically found in the environment are not considered to be volatile and transport of PFAS impacts through vapor transport (e.g., impacts to indoor air related to soil gas or airborne particles) are unlikely." – It may be unlikely for certain PFAS compounds to be volatile; however, as PFAS encompasses thousands of individual compounds with a broad range of chemical properties, there may be some PFAS compounds that are relatively volatile and thus subject to vapor intrusion. Thus, the potential consideration and investigation of vapor intrusion of PFAS should not be ruled out. EPA's Office of Research and Development (ORD) has planned to conduct a PFAS vapor intrusion pilot study and is expected to issue a report on the subsurface migration potential of PFAS into buildings and residences.

Army Response to Comment 2: The sentence was revised as follows: "*PFAS compounds typically analyzed during environmental investigations are not considered to be volatile and transport of PFAS impacts through vapor transport (e.g., impacts to indoor air related to soil gas or airborne particles) cannot yet be quantitatively evaluated under CERCLA in a risk assessment because there is no SW-846 method for measuring volatile PFAS and there are no toxicity values for the volatile PFAS.*"

Comment 3: Page 9, Section 2.0: "Soil Sampling. Soil sampling will be conducted using a decontaminated hand auger. Surface soil samples (0 – 0.5ft bgs) will be collected beneath any vegetative layers. Subsurface soil will be collected from 1.5 to 2.0 ft bgs" as well as in any other section of the draft work plan that discusses soil sampling – The subsurface soil is usually defined as greater than 2ft bgs so the proposed subsurface soil sampling seems to be just at the surface level. Please consider adjusting the subsurface soil depth. In the QAPP Worksheet #18 for RI at Four Known PFAS Sites (dated October 2022), it is indicated 0.5-2 ft bgs for subsurface soil, but in this draft work plan, surface soil is indicated as only from 1.5-2 ft bgs. Please be sure to put consistent information in the draft work plan and QAPP.

Army Response to Comment 3: Surface soil will be collected from 0 to 0.5ft bgs. The depth of subsurface soil collection in the RI was revised to 2-4ft bgs. The QAPP was revised accordingly.

Comment 4: Page 10, Section 2.1: "All media will be analyzed for PFAS using EPA Method 1633 in accordance with DoD Quality Systems Manual (QSM) 5.4." – Please be sure to indicate that this EPA Method 1633 is still a DRAFT method, and there may need to be a discussion of limitations/uncertainties using the draft method.

> **Army Response to Comment 4:** The workplan text was updated to indicate EPA Draft Method 1633. Any limitations and uncertainties associated with the use of a draft method are minimized to the extent possible by use of an ELAP-accepted laboratory SOP that adheres to QSM version 5.4, Table B-24.

Comment 5: Appendix A, Page 9, Section 5.1: "…For this reason, the HHRA will not estimate potential risks for the indoor worker. Because the potential contaminants are not volatile, volatile emissions that may contribute to vapor intrusion impacts on indoor air are not identified as a potential exposure route." – The indoor worker should still be considered as a potential receptor, and the vapor intrusion pathway may also need to be considered. As indicated in the second bullet point above, it may be possible for certain PFAS compounds to be relatively volatile and thus subject to vapor intrusion investigation of potential migration from subsurface soil or groundwater into the indoor air of buildings.

> **Army Response to Comment 5:** Concur. The text in Appendix A and EPA RAGS Table 1 were revised to present potential exposure via inhalation of vapors, both from vapor intrusion and during potable water use, as potentially complete exposure routes that will be evaluated qualitatively or quantitatively depending on the state of the science at the time of HHRA preparation. An EPA RAGS Part D Table 4 was added for the indoor worker as Table 4.7.

Comment 6: Appendix A, Page 10, Section 5.1: "…To streamline the risk calculations, recreational users and site visitors/trespassers will be merged into a single receptor for the HHRA." - Please make sure to indicate in the future HHRA as to why recreational users and site visitors/trespassers were combined into a single receptor and delineate the exposure factors and activities that were considered in order to combine these potential receptors as a single receptor.

> **Army Response to Comment 6:** Concur. The requested information will be provided in the future HHRA.

Comment 7: Appendix A, Page 12, Section 5.2: "…Analytes detected in both site and background samples only will be included in the risk assessment if detected on-site samples are above background concentrations." - Do not screen contaminants out of the COPC screen (RAGS D table 2 analysis for HHRA) if they are less than state- or site-specific background concentrations. Screen all analytes against the applicable risk-based screening values. If screening values are exceeded, the contaminant will need to be retained for the quantitative portion of the HHRA. A discussion of onsite concentrations as compared with background concentrations should be included in the risk characterization and/or uncertainty section of the HHRA. Please be sure to add a discussion to the RI & FS documents that support the background evaluation.

> **Army Response to Comment 7:** Do not concur. In accordance with the US Department of Defense Manual: Defense Environmental Restoration Program (DERP) Management (Number 4715.20, March 9, 2012), the HHRA and SLERA will not quantify exposure to naturally occurring substances present at concentrations unaffected by current or past site activities. Non-site-related, or background, constituents present at concentrations greater than risk-based or ecological screening levels will be evaluated qualitatively in the HHRA and SLERA risk characterizations. The work plan was revised to clarify this approach.

Comment 8: Appendix A, RAGS Part D Tables 4, Pages 1-17 – Please make sure to use updated information from EPA's Exposure Factors Handbook Chapters (e.g., Chapter 5 - Soil and Dust Ingestion chapter was updated in 2017) and relevant EPA exposure-related guidance.

Army Response to Comment 8: Concur. EPA's 2014 Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors is the primary source of exposure assumptions in the EPA RAGS Part D Table 4s. Exposure assumptions (ingestion rates) for the wild game/deer meat consumer in EPA RAGS Part D Table 4.6 were updated per EPA's 2018 update of Chapter 11 of the Exposure Factors Handbook. Exposure assumptions relating to Chapter 7 (dermal exposure factors) and Chapter 8 (body weight studies) of the 2011 Exposure Factors Handbook have not been updated.

END OF COMMENTS