FINAL
Site Inspection Report
Lakehurst Army Aviation Support Facility
Jackson Township, New Jersey

Perfluorooctanesulfonic Acid (PFOS) and
Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

February 2021
Revision 1

Prepared for:

Army National Guard Bureau
111 S. George Mason Drive
Arlington, VA 22204

UNCLASSIFIED

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
6:2 FTS	6:2 Fluorotelomer sulfonic acid
8:2 FTS	8:2 Fluorotelomer sulfonic acid
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFCEC/CZOE	Air Force Civil Engineer Center/ Environmental Operations Division
AFFF	aqueous film forming foam
amsl	above mean sea level
AOI	area of interest
ARNG	Army National Guard
bgs	below ground surface
btoc	below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
DVR	data validation report
EIS	extraction internal standards
ELAP	Environmental Laboratory Approval Program
EM	Engineering Manual
ERB	equipment rinsate blank
FedEx	Federal Express
ft	feet
FRB	field reagent blank
HA	Health Advisory
HDPE	high-density polyethylene
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
JBMDL	Joint Base McGuire-Dix-Lakehurst
LC/MS/MS	liquid chromatography tandem mass spectrometry
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection

LOQ	limit of quantitation
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NAES	Naval Air Engineering Station
NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	N-ethyl perfluorooctanesulfonamidoacetic acid
ng/L	nanograms per liter
NJARNG	New Jersey Army National Guard
NJDEP	New Jersey Department of Environmental Protection
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
NSA	Naval Support Activity
ORP	oxidation reduction potential
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutyrate
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluoroheptanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUdA	perfluoroundecanoic acid
PID	photoionization detector
PPE	personal protective equipment
PQAPP	Programmatic UFP-QAPP
PVC	polyvinyl chloride
PWS	public water supplies
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPD	relative percent differences
SI	Site Inspection
SL	screening level
SOP	Standard Operating Procedure
TOC	total organic carbon

TPP	Technical Project Planning
US	United States
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UCMR	Unregulated Contaminant Monitoring Rule

Executive Summary

The Army National Guard (ARNG) is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at per- and polyfluoroalkyl substances (PFAS)-impacted sites at ARNG facilities nationwide. The objective of the SI at each facility is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS) at or above screening levels (SLs). A SI was completed at the Lakehurst Army Aviation Support Facility (AASF) in Jackson Township, New Jersey. The Lakehurst AASF will be referred to as the "facility" throughout this document.

The Lakehurst AASF comprises 50 acres and is located in the northeastern portion of the 42,000-acre Joint Base McGuire-Dix-Lakehurst (JBMDL) in Jackson Township, Ocean County, New Jersey. The facility includes two hangers and a small. The Lakehurst AASF is a tenant activity at the JBMDL in accordance with a Host-Tenant Real Estate Agreement, Navy Contract no. N40085-09-RP-00221 and associated License# DACA51-3-09-139. The PA Report identified four potential PFAS releases associated with Building 790 and 780. Two releases occurred from the Building 790 fire suppression system, one release occurred from the Building 780 fire suppression system, and one secondary release occurred from a storm drainage outfall south of the helipad as a result of a release from Building 790 (AECOM, 2019). The release areas were grouped into one AOI (AOI 1), which was investigated during the SI. The SI field activities were conducted from 26 to 27 February 2020 and included the collection of soil and groundwater samples.

To fulfill the project Data Quality Objectives (DQOs) set forth in the approved SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2020b), samples were collected and analyzed for a subset of 18 PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.1 Table B-15. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** of this Report.

The Department of Defense (DoD) has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). The ARNG PFAS SIs follow this DoD policy and, when the maximum site concentration for sampled media exceed the SLs, the AOI will proceed to a Remedial Investigation (RI), the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table ES-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, sediment, and surface water contain or do not contain the 18 PFAS analyzed within the boundaries of the Site.

Sample chemical analytical concentrations were compared against project SLs as described in **Table ES-1**. A summary of the results of the SI data relative to the SLs is as follows:

- The detected concentrations of PFOA, PFOS, and PFBS in soil from AOI 1 were below SLs.
- PFOA and PFBS in groundwater were detected in all samples but did not exceed SLs. PFOS in groundwater exceeded the individual SL of 40 nanograms per liter (ng/L), with a maximum concentration of 75.6 ng/L at AOI01-06. Based on the results of the SI, further investigation of AOI 1 is warranted in the RI.

Table ES-2 summarizes the SI results for soil and groundwater. Based on the conceptual site model (CSM) developed and revised in light of the SI findings, there is a potential for exposure to residential drinking water receptors caused by DoD activities at or adjacent to the facility.

Table ES-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOI 1: Lakehurst AASF.

Table ES-1 Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[a,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b]	Tap Water (Groundwater) (ng/L)[a,b]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	130,000	1,600,000	40,000

Notes:
New Jersey Department of Environmental Protection regulations are not considered in this SI in lieu of Federal regulations.
a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. HQ=0.1. 15 October 2019.
b.) If only one PFAS is present, a Hazard Quotient (HQ) of 1 applies and the values presented would increase by a factor of x10.

Table ES-2: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Soil – Facility Boundary	Groundwater – Source Area	Groundwater – Facility Boundary
1	Lakehurst AASF	◐	◐	◐	●

Legend:
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

Table ES-3: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Lakehurst AASF	Exceedances of SLs in groundwater at the facility boundary. No exceedances of SLs in soil.	Proceed to RI

1.0 Introduction

1.1 Project Authorization

The Army National Guard (ARNG) G9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) at Impacted Sites, ARNG Installations, Nationwide. This work is supported by the United States (US) Army Corps of Engineers (USACE) Baltimore District and their contractor, AECOM Technical Services, Inc. (AECOM), under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017. The ARNG performed this SI at the Lakehurst Army Aviation Support Facility (AASF) in Jackson Township, New Jersey. The Lakehurst AASF will be referred to as the "facility" throughout this document.

The SI project elements were performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; US Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations including specific requirements for sampling for PFOA, PFOS, and perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as per- and polyfluoroalkyl substances (PFAS). The term PFAS is used throughout this report to encompass all PFAS chemicals being evaluated, including PFOA, PFOS, and PFBS, which are the key components of the suspected releases being evaluated, and the other 15 related compounds listed in the task order.

1.2 SI Purpose

A PA was performed at the facility (AECOM, 2019) that identified four potential PFAS release areas, which were grouped into one Area of Interest (AOI). The objective of the SI is to identify whether there has been a release to the environment from the AOI and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs).

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA, 2005), a SI has five goals:

1. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.
2. Determine the potential need for a removal action.
3. Collect or develop data to evaluate potential release.
4. Collect data to better characterize the release for more effective and rapid initiation of a Remedial Investigation (RI).
5. Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD)

In addition to the USEPA-identified goals of an SI, the ARNG SI also identifies whether there are potential off-facility PFAS sources.

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2.0 Facility Background

2.1 Facility Location and Description

The Lakehurst AASF is located in the northeastern portion of Joint Base McGuire-Dix-Lakehurst (JBMDL) in Jackson Township, Ocean County, New Jersey (**Figure 2-1**). The facility is approximately 2 miles north-northwest of the Borough of Lakehurst and 18 miles southeast of the city of Trenton, New Jersey. The approximate center of the facility is located at geographic coordinates 40°1'59.45''N; 74°20'23.98"W, at 76 feet (ft) above mean sea level (amsl).

The facility was established in 1991 on the Lakehurst portion of JBMDL. JBMDL is a 42,000-acre military installation that resulted from the merger of the McGuire Air Force Base, Fort Dix, and Naval Air Engineering Station (NAES) Lakehurst in 2009 (now Naval Support Activity [NSA] Lakehurst). Lease information obtained during the PA confirmed rightful leasing by ARNG of Parcel 29 from the Naval Facilities Engineering Command, Mid-Atlantic. The terms of the lease include all 50 acres of Parcel 29 for a 50-year period from 30 September 2009 to 29 September 2059 under Real Estate Agreement, Navy Contract no. N40085-09-RP-00221 and associated License# DACA51-3-09-139 (AECOM, 2019).

The AASF includes two hangers and a small helipad. Building 790 is approximately 37,624 square ft, and Building 780 is approximately 98,757 square ft of which approximately 47,757 square ft are office space. The hangar portions of Buildings 790 and 780 are used for cold and warm storage, respectively. Prior to 2014, the facility was an extension of the Hangar 5 and Hangar 6 helipad (located 0.25 miles south of the facility). Both hangars have dedicated centralized AFFF systems.

2.2 Facility Environmental Setting

The facility is located in the Pine Barrens of Ocean County, which is part of the Atlantic Coastal Plain Physiographic Province of southeastern New Jersey. The terrain of the Atlantic Coastal Plain is characterized by low relief coastal environment with many beaches. The Pine Barrens are a protected National Reserve subject to regulatory land use restrictions to preserve the ecosystem. Ocean County is 628.78 square miles, of which 31 percent is covered by water (US Census, 2018). Approximately 1.5 miles to the south-southeast of the facility is Lake Horicon, a 63-acre stream-fed lake used for recreational activities.

The following sections include information on geology, hydrogeology, hydrology, climate, and current and future land use. The facility geology and groundwater features are presented on **Figure 2-2**, groundwater elevations and contours are presented on **Figure 2-3**, and surface water features are presented on **Figure 2-4**.

2.2.1 Geology

The geology of the Coastal Plain around the facility is made up of unconsolidated gravel, sand, and clay deposits dipping gently to the southeast over Paleozoic crystalline bedrock. Sediments range in age from the upper Lower Cretaceous to the Miocene (90 to 10 million years old). The facility lies on the southern edge of the last glacial maximum. As a result, the majority of the surface and underlying unconsolidated materials are sequences of Pleistocene and Pliocene age sand, marginal-marine sediments, gravel, and clay. The most surficial of these units underlying the Lakehurst AASF is the Kirkwood-Cohansey Formation (**Figure 2-2**). The Formation consist of unconsolidated fine to coarse-grained sand with interbedded lenses of clay-silt reworked during the last glacial maximum. Underlying the facility, the Kirkwood-Cohansey Formation ranges in thickness from 100 to 150 ft (Fiore, 2019). Within this unit are low-permeability layers (predominantly clay and silt) which create semi-confining conditions within the Kirkwood-

Cohansey Formation. Below the Kirkwood-Cohansey Formation is the Manasquan and Shark River Formation which consists of calcareous clay-silt with varying amounts of glauconite sand (Fiore, 2019). This unit is approximately 250-300 ft thick.

The deposition of these sediments was controlled by global sea level changes; they contain repetitive transgressive-regressive facies changes (HydroGeoLogic, 2015). These changes in depositional environment created a unique, repetitive accumulation of sediments followed by interstitial confining units. This accumulation of sediments and interstitial confining units led to the formation of nine aquifer systems and eight confining units that span the Coastal Plain and underlie the Lakehurst AASF (US Geological Survey [USGS], 1989; USGS, 1998).

2.2.2 Hydrogeology

The most superficial aquifer system is the Kirkwood-Cohansey aquifer system. The surficial aquifer generally exists under unconfined conditions, and recharge occurs primarily from direct precipitation on exposed portions of the formation. Depth to groundwater at the facility typically ranges between 5 and 30 ft bgs (AECOM, 2010). During the SI, depth to water ranged from 7.37 ft below top of casing (btoc) to 9.67 ft btoc across the facility. Groundwater flow direction in the shallow aquifer is generally directed by topography and drainage conditions. Groundwater elevations calculated using depth to groundwater measurements and survey data collected during the SI indicated groundwater flows primarily east-southeast (**Figure 2-3**). The regional groundwater direction is generally east-southeast, towards the Atlantic Ocean. Multiple other aquifer systems exist beneath the Kirkwood-Cohansey as indicated in the geology discussion above, but these were not subject to the investigation.

JBMDL operates multiple public water systems (PWS) that supply drinking water to all airmen, families, civilians, and tenants on JBMDL. The supplied drinking water meets the Safe Drinking Water Act requirements in addition to the USEPA Health Advisory (HA) for PFOS and PFOA. The closest PWS to the Lakehurst AASF are the Hill, Helo, and Test PWS. The Hill system has four wells screened in the Kirkwood-Cohansey aquifer system, and one well screened in the Potomac-Raritan-Magothy aquifer. The Helo system has one well screened in the Kirkwood-Cohansey aquifer system. The Test system has two wells screened in the Potomac-Raritan-Magothy aquifer (HydroGeoLogic, 2015). It is likely PFAS have not impacted those wells screened in the deeper Potomac-Raritan-Magothy aquifer system given the depth; however, the surficial Kirkwood-Cohansey aquifer system could be subject to potential contamination. Information obtained from the New Jersey Department of Environmental Protection (NJDEP) indicated PFAS were detected from shallow (Kirkwood-Cohansey aquifer system) back-up wells in the Hill PWS. Water pumped from shallow wells associated with the back-up system to the Hill PWS are currently treated for PFOS and PFOA using ion exchange. It is worth noting that the facility is located within two wellhead protection areas, and more than two dozen wellhead protection areas exist within a 4-mile radius of the facility (NJDEP, 2019).

2.2.3 Hydrology

The facility is in the north portion of the Union Branch Watershed. The general surface water flow is to the east-southeast, as seen in **Figure 2-4**. The nearest surface water bodies are an unnamed drainage ditch, located approximately 0.15 miles southwest of the facility, and the Manapaqua Branch, located approximately 0.75 miles to the southwest. Additionally, an unlined stormwater basin is located immediately adjacent to the helipad.

2.2.4 Climate

The climate in the area of the facility is characterized by moderately cold and occasionally snowy winters and warm, humid summers. The monthly average temperature ranges from a

high of 86 degrees Fahrenheit (°F) in July to 40 °F in January. Average annual precipitation is 43.43 inches (US Climate Data, 2019).

2.2.5 Current and Future Land Use

The facility is a private ARNG property that is accessible only through a guarded security gate. The property is a New Jersey ARNG (NJARNG) installation that supports the NJARNG mission. As previously mentioned, the facility is located within NSA Lakehurst, which is the Navy portion of the Air Force controlled JBMDL. The Lakehurst AASF is a tenant activity at the JBMDL in accordance with a Host-Tenant Real Estate Agreement, Navy Contract no. N40085-09-RP-00221 and associated License# DACA51-3-09-139. Outside the boundaries of JBMDL, the surrounding area is generally used for residential and commercial space. There are no large-scale agricultural areas near the facility. Currently, the ARNG has a planned Aviation Readiness Center (MILCON 340100) to be constructed on the property.

2.2.6 Critical Habitat and Threatened/Endangered Species

The following species are listed as federally endangered, threatened, proposed, and/or candidate species in Ocean County, New Jersey (US Fish and Wildlife Service [USFWS], 2020):

- **Amphibians**: Bog Turtle, *Clemmys [Glyptemys] muhlenbergii* (threatened)
- **Bird**: Piping Plover, *Charadrius melodus* (threatened)
- **Bird**: Rufa Red Knot, *Calidris canutus rufa* (threatened)
- **Bird**: Roseate Tern, *Sterna dougallii* (endangered)

2.3 History of PFAS Use

The primary source of PFAS at the facility is related to the two fire suppression systems located in Buildings 790 and 780. Several releases occurred over a 4-month period in 2017 that resulted in aqueous film forming foam (AFFF) being released to the environment. The most significant of these releases occurred in June 2017, when approximately 1,000 gallons of C8 3% AFFF were released from the fire suppression system in Building 790. The release resulted in AFFF spilling out of the maintenance room and onto a grassy area between Building 790 and 780. The AFFF also entered a storm drain and resulted in a secondary release to the storm water basin south of the helipad. No other history and use of AFFF or PFAS-containing material use were documented.

2.4 Other PFAS Investigations

As described above, the Lakehurst AASF is a private ARNG property within the boundaries of JBMDL. Due to a history of AFFF use, storage, and release JBMDL has been the subject of a PFAS PA (HydroGeoLogic, 2015) and SI (Aerostar SES LLC, 2018). Results of the PA identified 51 specific sites where potential AFFF releases may have occurred (HydroGeoLogic, 2015). These sites included fire training areas, non-fire training areas, fire stations, emergency response areas, and other spill or release areas. Of the 51 identified sites, seven sites are located within 0.5 miles of the Lakehurst AASF and are shown in **Figure 2-5**. A brief description of each site SI result are provided below:

- Historical Fire Training Area #1 and #2: FTA #1 was in operation from 1985 to 1997. During this time, approximately 3 to 4 gallons of AFFF per test per truck (unknown number) were discharged monthly for fire training activities at Historical FTA # 1 from 1985 to 1997. FTA #2 used a mock aircraft for training from 1997 to 2010. Currently, a 400 square foot

dumpster with concrete secondary containment is used for training with AFFF. It is estimated that 1,944-2,592 gallons of AFFF have been released.

Six soil borings were advanced at both FTA #1 and FTA #2 during the JBMDL SI. Surface soil, subsurface soil, and groundwater samples were collected from each of the six borings. The analytical results indicated PFOS was present in one surface soil sample at a concentration exceeding the screening level (calculated using USEPA Risk Screening Level calculator). PFOA and PFOS were in groundwater samples at concentrations exceeding screening levels for water (USEPA HA). The combined concentrations of PFOA and PFOS also exceeded the screening levels in groundwater.

- Old Firefighting School (AT014): AT014 is a former firefighting school that was in operation from the 1920s to 1980. During this time, AFFF was used during fire training activities; however, it is unknown what volume or type of AFFF was used at the site.

  Two soil borings were advanced at AT014 for the collection of surface soil, subsurface soil and groundwater sample during the JBMDL SI. An additional four existing monitoring wells were sampled. The results of the surface and subsurface soils analyses indicated that the target compounds (PFOS, PFOA, and PFBS) were not present in soil. Groundwater sample analyses indicated PFBS was not present in the groundwater at concentrations above the screening level for water. However, PFOA and PFOS were in groundwater samples at concentrations exceeding screening levels for water. The combined concentrations of PFOA and PFOS exceeded the screening levels in groundwater.

- Firetruck Vehicle Accident: A firetruck crashed and spilled 130 gallons of AFFF concentrate in 1991 after overturning due to icy road conditions. Groundwater testing during the SI confirmed the presence of PFAS in exceedance of the USEPA LHA for groundwater.

  Two borings were advanced at the Firetruck Vehicle Accident site for the collection of surface soil, subsurface soil, and groundwater samples during the JBMDL SI. Two additional borings were advanced for groundwater collection and one surface water and sediment samples was collected approximately 500 feet east of the site of the accident. The results of the subsurface soil and surface soil analyses indicated that the target compounds were not present in soil at concentrations above the screening levels for soil. Groundwater sample analyses indicated PFBS was not present in the groundwater at concentrations above the screening level for water. However, PFOA and PFOS were in groundwater samples at concentrations exceeding screening levels for water.

- Fire House (Building 687): Building 687 is a currently active fire station for NAES Lakehurst that houses seven trucks which all store AFFF (15-500 gallons). To date, there have been no documented releases or spills. The 2015 PFAS PA closed out this building with no additional investigation recommended.

- Hangar 6 plane crash: Approximately 100 gallons of AFFF were used to extinguish an 8 July 1994 plane crash near Hangar 6. Three borings were advanced within the plane crash site for collection of subsurface soil and groundwater samples during the JBMDL SI. Additionally, an existing monitoring well was sampled for groundwater. The results of the subsurface soil analyses indicated that the target compounds were not present in soil at concentrations above the screening levels for soil. Groundwater sample analyses indicated PFBS was not present in the groundwater at concentrations above the screening level for water. However, PFOA and PFOS were detected in groundwater samples at concentrations exceeding screening levels for water. The combined concentrations of PFOA and PFOS exceeded the screening levels in groundwater.

- Helistat crash: Approximately 200 gallons of AFFF were used to extinguish a Helistat crash on 1 July 1986 near Hangar 5. Five borings were advanced within and around the Helistat crash site for collection of subsurface soil and groundwater samples during the JBMDL SI. Additionally, existing monitoring well was sampled for groundwater. The results of the subsurface soil analyses indicated that the target compounds were not present in soil at concentrations above the screening levels for soil. Groundwater sample analyses indicated PFBS was not present in the groundwater at concentrations above the screening level for water. However, PFOA and PFOS were detected in groundwater samples at concentrations exceeding screening levels for water. The combined concentrations of PFOA and PFOS exceeded the screening levels in groundwater.

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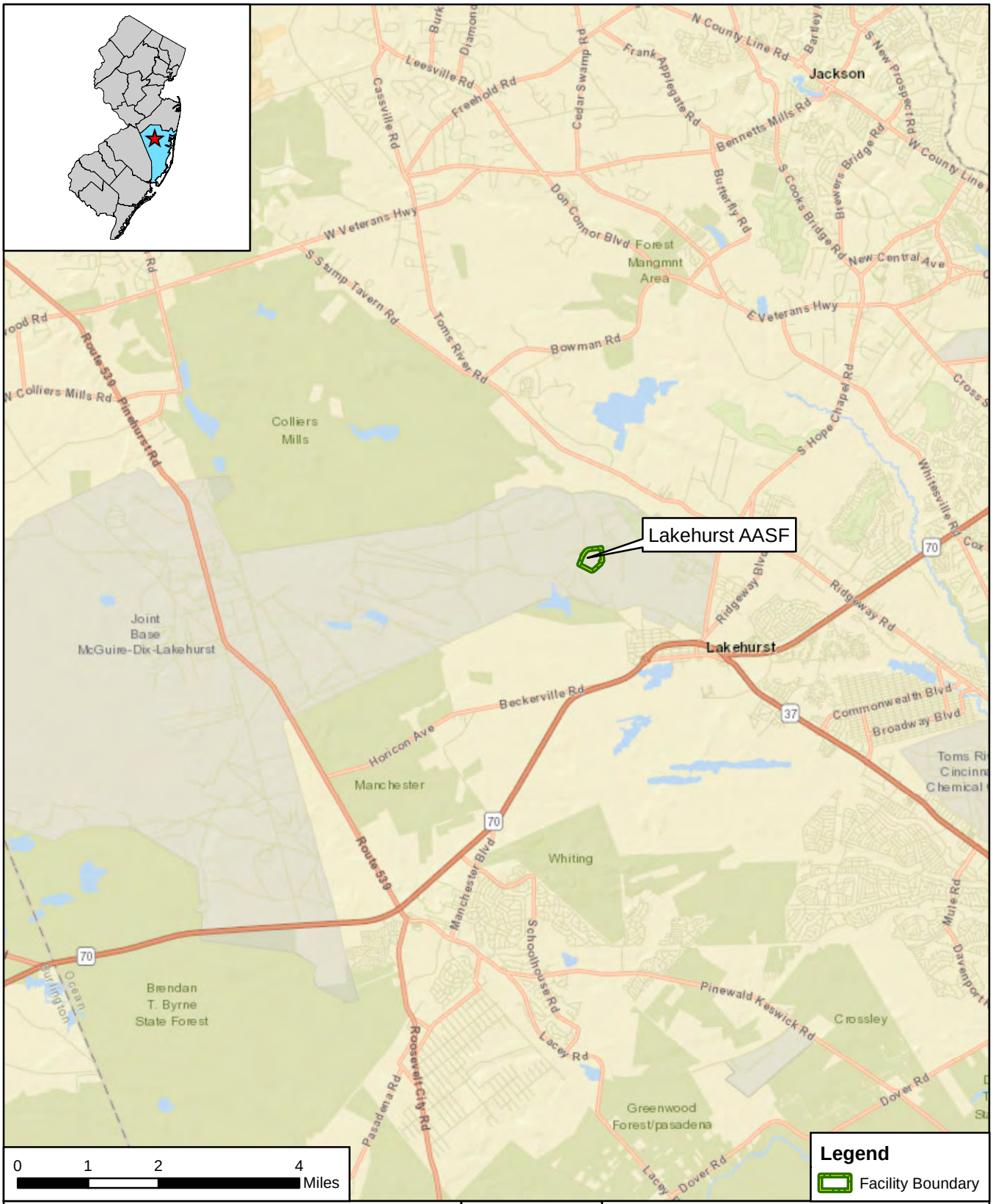

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Lakehurst AASF, NJ			
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SCALE	1:126,720	CHK BY	AB	8/10/2020
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	8/10/2020

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

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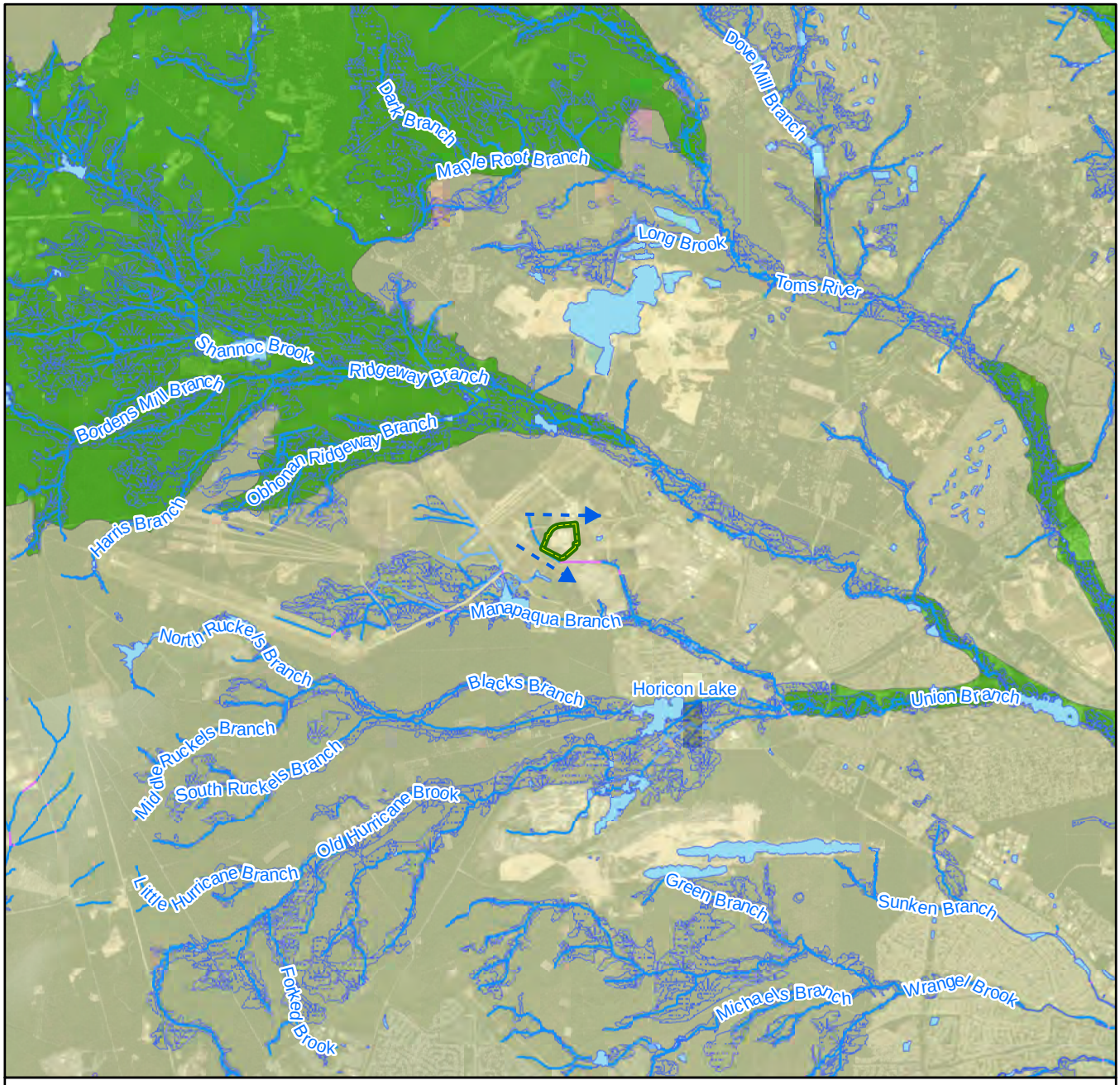

Legend

- Facility Boundary
- Water Body
- Wetland
- River/Stream
- Canal/Ditch
- Piped Stream
- Inferred Groundwater Flow Direction

Geology

- Lower Member of the Kirkwood Formation
- Cohansey Formation

0 0.75 1.5 3 Miles

The PWS are not depicted due to security concerns, but are located in areas of JBMDL-Lakehurst that surround the Lakehurst AASF

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Lakehurst AASF, NJ			
REVISED	10/16/2020	GIS BY	MS	10/16/2020
SCALE	1:95,040	CHK BY	AB	10/16/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	10/16/2020

N

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2

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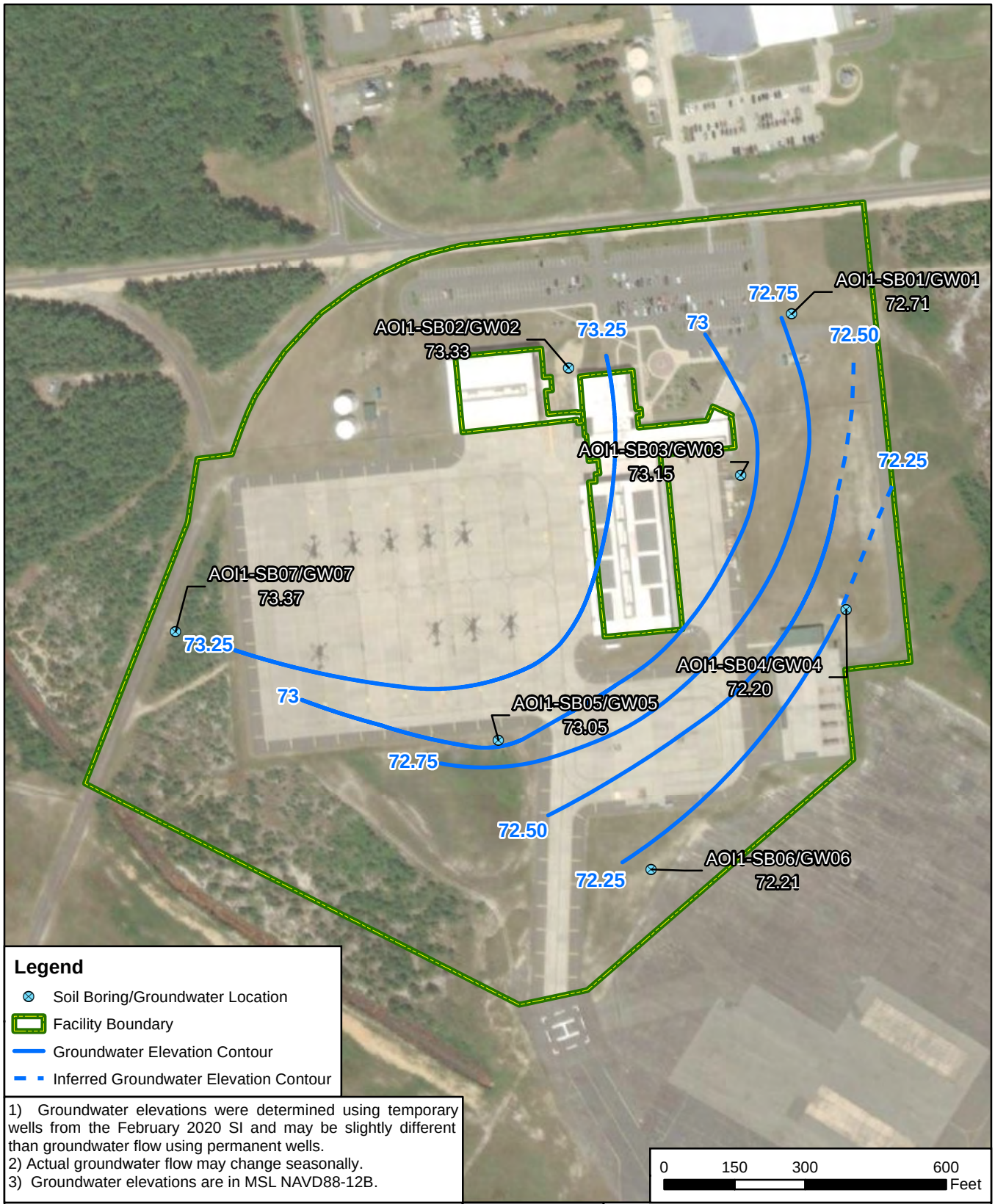

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Lakehurst AASF, NJ			
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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	10/8/2020

Groundwater Elevation February 2020

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

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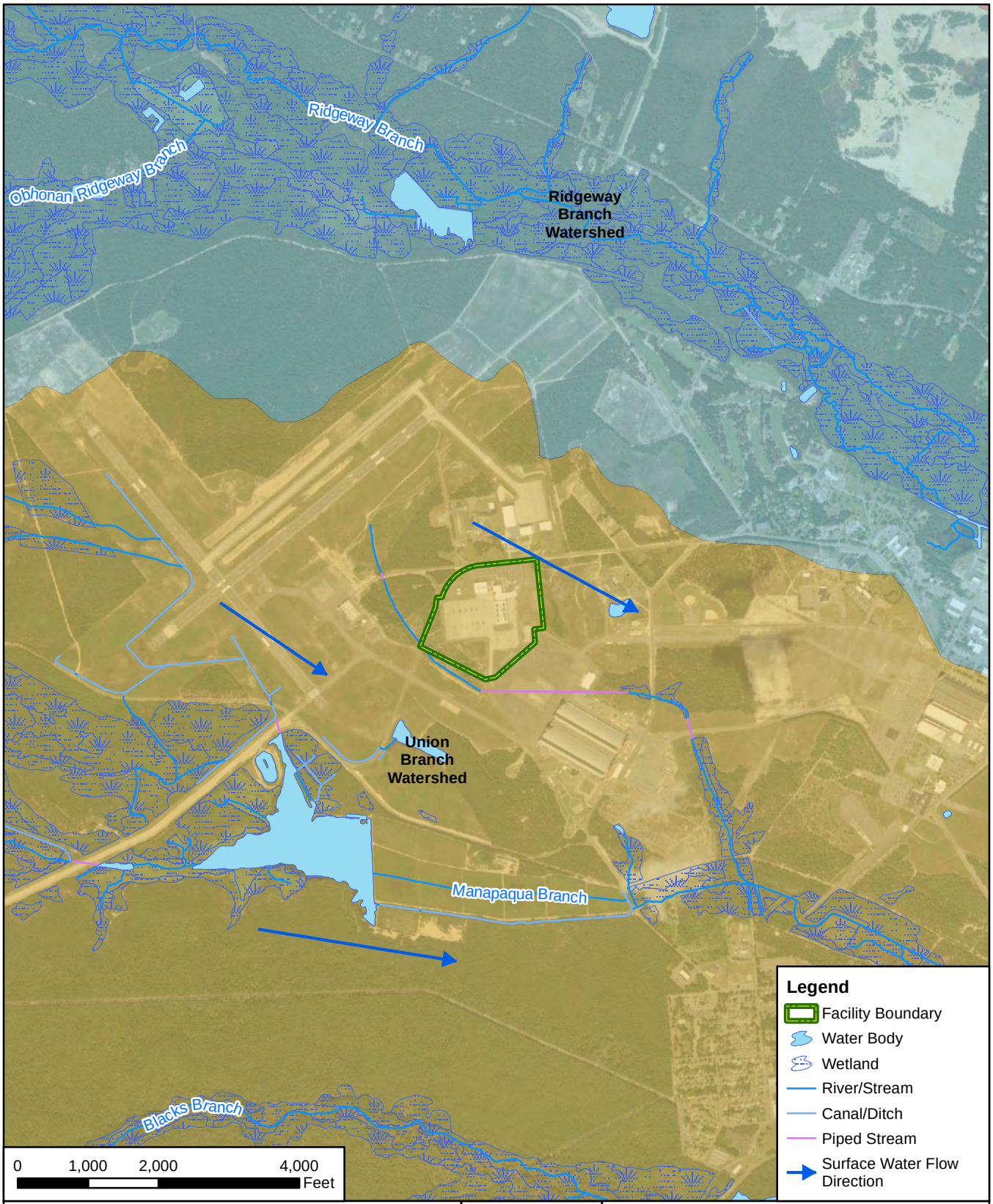

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SCALE	1:24,000	CHK BY	AB	10/16/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	10/16/2020

Surface Water Features

AECOM
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Figure 2-4

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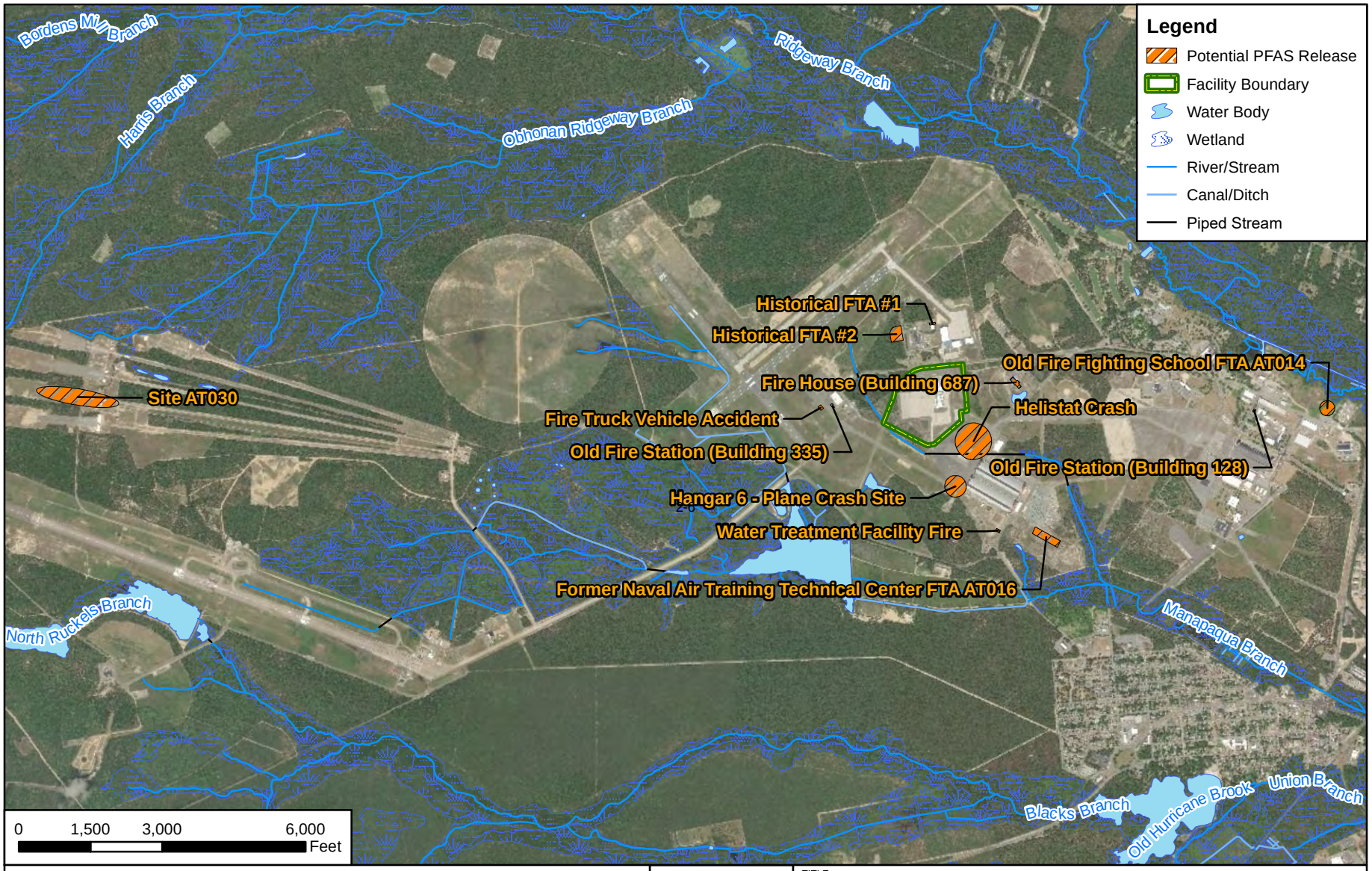

CLIENT	ARNG			
PROJECT	Preliminary Assessment for PFAS at Lakehurst AASF, NJ			
REVISED	9/10/2019	GIS BY	MS	9/10/2019
SCALE	1:36,000	CHK BY	AB	9/10/2019
Base Map: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	9/10/2019

TITLE

Non-ARNG Adjacent Sources

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Figure 2-5

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3.0 Summary of Areas of Interest

This section presents a summary of each potential PFAS release area by AOI. Based on the PA findings, one AOI was identified at the Lakehurst AASF, which includes the fire suppression system releases at Buildings 790 and 780, as well as the secondary release from storm drain outfall south of the helipad (**Figure 3-1**). A summary of the AOI is presented below.

3.1 AOI 1 – Lakehurst AASF

AOI 1 includes four potential release areas: two releases from the fire suppression system in Building 790, one release from the fire suppression system at Building 780, and one secondary release from a storm drain outfall (result from one of the releases at Building 790). The AFFF released during these events is the potential PFAS source.

3.1.1 Building 790

Building 790 is equipped with an AFFF fire suppression system. Two releases have occurred at Building 790 since it was constructed between 2014 and 2015. On 12 June 2017, an incorrectly installed cap blew off the AFFF storage tank manifold system due to a buildup of pressure. As a result, AFFF was released from the maintenance closet into the interior of the Building 790 hangar bay and outside Building 790 into a grassy area between Buildings 790 and 780. It was documented that 1,000 gallons of C8 3% AFFF were released. A large amount of the AFFF spilled in the grassy area and entered a storm drain located between Buildings 790 and 780. The AFFF exited the storm drain from the outfall located approximately 100 feet south of the southern end of the helipad and a drain located on the west side of Building 780.

The floor drain on the west side of Building 780 runs approximately the entire length of the hangar bay from north to south and leads to the sanitary sewer system. During the spill, the floor drain acted as a conduit transporting a large amount of the AFFF inside the hangar bay. The AFFF that flowed west into the Building 790 hangar bay was pushed into the floor drain with brooms. Water containing AFFF was pulled from the lift station and put into a frac tank before eventual transport and disposal. In total, approximately 10,000 square feet of area were contaminated.

All-State Power Vac contractors (now ACV) performed the clean-up on 13 June 2017. The pump station that serviced the ARNG facility was emptied and cleaned to prevent any residual AFFF from entering the sanitary sewer system, and the floor drain in the hangar bay was backfilled with cement. The storm water system was flushed and cleaned, and 9,000 gallons of contaminated water were containerized in a frac tank. The C8 3% AFFF containment tank in the maintenance room was emptied, and the system/tank was cleaned. No cement that had AFFF spilled on it was removed. Contaminated soil was excavated from the outfall south of the helipad and from between Buildings 790 and 780. Approximately of 6 – 8 inches of soil was excavated based on the results of soil and water shake tests. No confirmatory samples were collected for analysis; however, a real-time ‘shake test’ was performed with the excavated soil and water. No foaming was observed in the sample jar. The soil was containerized into sixteen lined and covered 20-cubic yard roll-offs totaling 294 tons (588,000 pounds) and taken to an area east of Building 780. No contaminated soil/water is thought to have been accidentally released during this clean-up event.

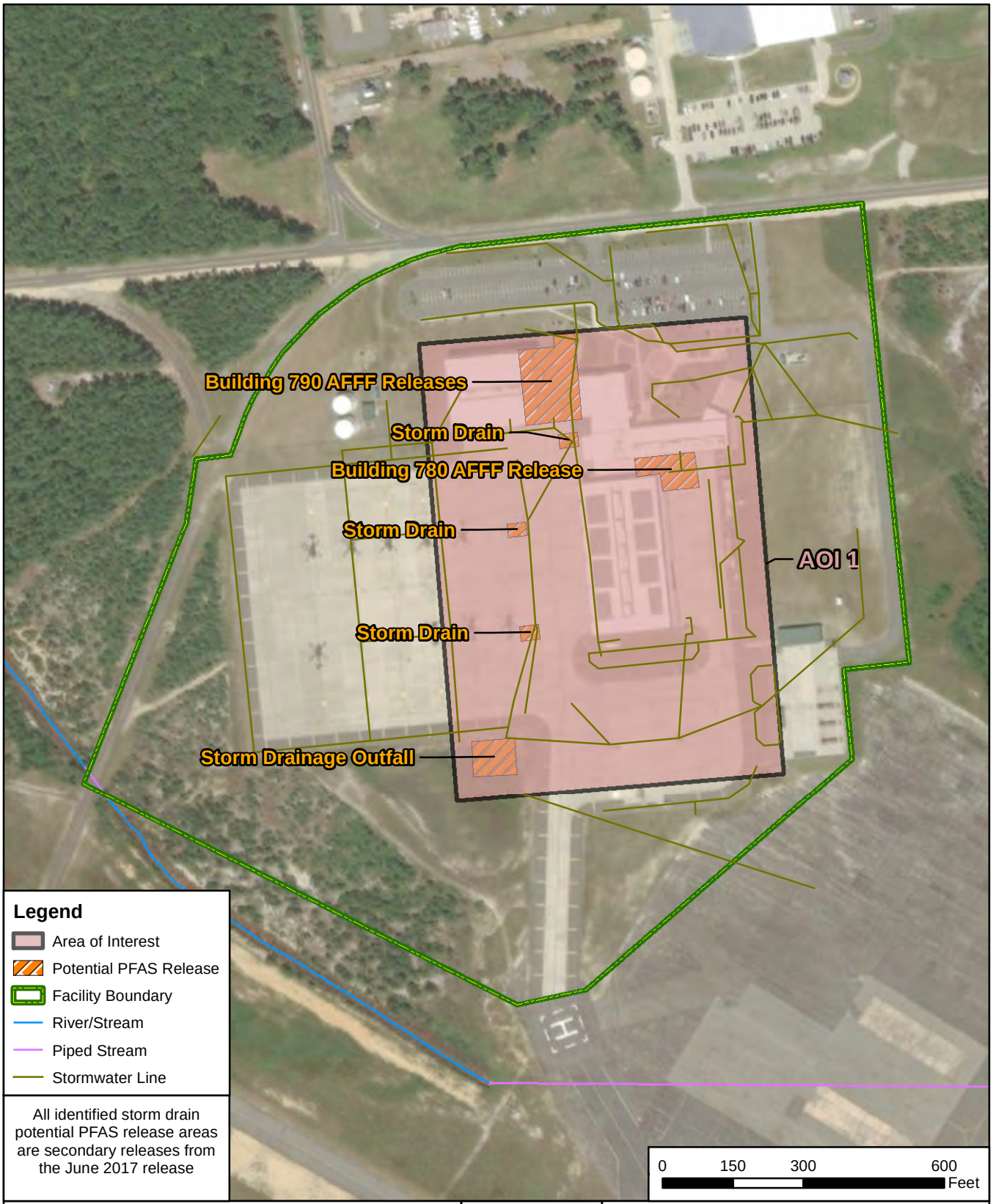
The second release at Building 790 occurred on 26 October 2017. During maintenance activities, less than 25 gallons of C8 3% AFFF were released from a leak in a pipe that leads to a down spout valve located outside Building 790. As a result, the AFFF spilled west, into the grassy area between Buildings 790 and 780, within the bounds of the spill event from 12 June 2017. The contaminated soil was excavated to a depth of 10 inches at the down spout and 3 inches in the area, between Buildings 790 and 780. Similar to the other spill, the depth of the excavation was

determined by performing soil and water shake test results. No foaming was observed in the sample jar. No confirmatory samples were collected for analysis. Excavated soil was placed in one 20-cubic yard roll-off and temporarily stored in the same area as the previous roll-offs from the 12 June 2017 spill event. The maintenance room was cleaned by the Joint Base Response team, and no contaminated soil or liquid were spilled during the clean-up event.

The excavated soil from the June 2017 and October 2017 spill event was sent to WHI Heritage facility for incineration, and the ashes were sent to a Class-C landfill. The water was also incinerated at temperatures greater than 1,100°F.

3.1.2 Building 780

The third release occurred in Building 780 on 28 August 2017. During the installation of a new bladder to the fire suppression system tank, a small amount of AFFF leaked from the valve of the 900-gallon AFFF storage tank, creating a stain on the concrete floor. Additionally, during the exchange, the hose connector for the vacuum system on the truck leaked, spilling C8 3% AFFF onto the concrete just east of Building 780. No subsequent clean-up event was performed because of the small volume released and confirmation from the facility personnel that no AFFF contacted the surrounding soil.



CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Lakehurst AASF, NJ			
REVISED	10/16/2020	GIS BY	MS	10/16/2020
SCALE	1:3,600	CHK BY	AB	10/16/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	10/16/2020

Area of Interest

AECOM
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Germantown, MD 20876

Figure 3-1

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4.0 Project Data Quality Objectives

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data and define the level of certainty required to support the project decision-making process. The specific DQOs established for this facility are described below. These DQOs were developed in accordance with the USEPA's seven-step iterative process (USEPA, 2006).

4.1 Problem Statement

The following problem statement was developed during project planning:

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the site will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS. The SLs are presented in **Section 6.1** of this Report.

The following quotes from Army policy documents form the basis for this project (DA, 2016b; DA, 2018):

- "The Army will research and identify locations where PFOS- and/or PFOA-containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider FTAs, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."
- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."
- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels" (USEPA, 2016a; USEPA, 2016b).

4.2 Goals of the Study

The following goals were established for this SI:

1. Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.
2. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3. Determine the potential need for a removal action.
4. Collect data to better characterize the release areas for more effective and rapid initiation of a RI.
5. Identify, within 4 miles of the installation, other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS, or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).
6. Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.

4.3 Information Inputs:

Primary information inputs for the SI included the following:

- The PA for the Lakehurst AASF (AECOM, 2019);
- Analytical data from groundwater and soil collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2020b); and
- Field data including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter.

4.4 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-1**). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s).

4.5 Analytical Approach

All samples were analyzed by Pace Analytical Gulf Coast, accredited under the DoD Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs and decision rules as defined in the SI QAPP Addendum (AECOM, 2020b). Decision rules were developed for groundwater and soil, and they applied to all data collected. These rules governed response actions based on the results of the SI sampling effort.

The decision rules described in the **Worksheet #11** of the QAPP Addendum identify actions based on the following:

Groundwater

- Is there a human receptor within 4-miles of the facility?
- What is the concentration of PFOA, PFOS, and PFBS at the potential PFAS release area?
- What is the concentration of PFOA, PFOS, and PFBS at the facility boundary upgradient and downgradient of the potential release areas?

- What does the conceptual site model (CSM) suggest in terms of source, pathway and receptor?

Soil

- What is the concentration of PFOA, PFOS, and PFBS in shallow surface soil (0 - 2 ft bgs)?
- What is the concentration of PFOA, PFOS, and PFBS in deep soil (i.e., capillary fringe)?
- What does the CSM suggest in terms of source, pathway, and receptor?

Soil and groundwater samples were collected from each of the potential PFAS release areas within AOI 1. Depth to groundwater was observed to range from 7.37 to 9.67 ft bgs in February 2020.

4.6 Data Usability Assessment

The Data Usability Assessment (DUA) is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution, and the resulting data have met installation-specific DQOs. Both sampling and analytical activities are considered to assess whether the collected data are of the right type, quality, and quantity to support the decision-making (DoD, 2018a; DoD, 2018b; USEPA, 2017).

Data Quality Indicators (DQIs) (Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity) are important components in assessing data usability. These DQIs were evaluated in the subsequent sections and demonstrate that the data presented in this SI report are of high quality. Although the SI data are considered reliable, some degree of uncertainty can be associated with the data collected. Specific factors that may contribute to the uncertainty of the data evaluation are described below. The Data Validation Report (DVR) (**Appendix A**) presents explanations for all qualified data in greater detail.

4.6.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences (RPD); laboratory precision is measured with calibration verification, internal standard recoveries, laboratory control spike (LCS), and matrix spike (MS) duplicate RPD.

Extraction internal standards (EIS) were added by the laboratory during sample extraction to measure relative responses of target analytes and used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, mass spectrometry ionization efficiencies, and other associated preparation and analytical anomalies. All field samples displayed EIS area counts within the quality control (QC) limits of 50-150%.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. All calibration verifications were within the project established precision limits presented in the QAPP Addendum (AECOM, 2020b).

LCS/LCS duplicate (LCS/LCSD) pairs were prepared by addition of known concentrations of each analyte in a matrix-free media known to be free of target analytes. LCS/LCSD pairs were analyzed for every analytical batch to demonstrate the ability of the laboratory to detect similar concentrations of a known quantity in matrix-free media. The LCS/LCSD samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2020b).

MS/MS duplicate (MS/MSD) samples were prepared, analyzed, and reported for all preparation batches. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested. MS/MSD samples were submitted to the laboratory for analysis at a rate of 5%. The MS/MSD samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2020b).

Field duplicate samples were collected at a rate of 10% to assess the overall sampling and measurement precision for this sampling effort. The field duplicate samples were analyzed for PFAS and general chemistry parameters. The field duplicate samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2020b).

4.6.2 Accuracy

Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in the LCS/LCSD, MS/MSD, and surrogates.

LCS/LCSD samples were prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS/LCSD samples were analyzed for every analytical batch and demonstrated that the analytical system was in control during sample preparation and analysis.

MS/MSD samples were prepared, analyzed, and reported at a rate of 5%. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested, with a limited number of exceptions. The MS/MSD performed on parent sample AOI01-01-GW displayed a recovery outside the QC limits of 70-130% for Perfluorohexanesulfonic acid **(**PFHxS) at 64%. The parent sample result associated with the negative bias was positive and was qualified “J-“.

4.6.3 Representativeness

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

Relating to the use of standard analytical methods, the laboratory followed the method as established in PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) Compliant with Quality Systems Manual (QSM) 5.1 Table B-15, including the specific preparation requirements (i.e. ENVI-Carb or equivalent used), mass calibration, spectra, all the ion transitions identified in Table B-15 were monitored, standards that contained both branched and linear isomers when available were used, and isotopically labeled standards were used for quantitation.

Field QC samples were collected to assess the representativeness of the data collected. Field duplicates were collected at a rate of 10% for all field samples, while MS/MSD samples were collected at a rate of 5%. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods in accordance with the QAPP Addendum (AECOM, 2020b) for all analyses.

Instrument blanks and method blanks were prepared by the laboratory in each batch as a negative control. A limited number of PFAS instrument blanks and method blanks displayed detections greater than the detection limit for multiple target analytes. In total, one field sample result for PFOS and one field sample result for PFBA were qualified “U” during data validation due to a detection in the associated method blanks. The reported field sample result values were adjusted

to be equal to the limit of detection (LOD). The results are usable as qualified but should be considered false positives and treated as non-detect. All the detections were less than the detection limits and less than SLs.

Field blanks and equipment rinsate blanks were also collected for groundwater and soil samples. All equipment rinsate blanks and field blanks were non-detect for all target analytes. A sample of the water used for decontamination of the drill rig was collected in advance of the field effort. The decontamination sample, LH-PW-01, displayed a detection for PFOA greater than the detection limit. The positive associated field sample results were greater than five times the concentration found in the decontamination sample; therefore, no data qualifying action was required. Based on the sample results, the potable water source was deemed acceptable for use during the investigation for decontamination of drilling equipment and during well installation.

Overall, the data are usable for evaluating the presence or absence of PFAS at the facility. Sufficient usable data were obtained to meet the objectives of the SI.

4.6.4 Comparability

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures help ensure comparability. Standard field sampling and typical laboratory protocols were used during the SI and are considered comparable to ongoing investigations.

4.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. The laboratory provided data meeting system QC acceptance criteria for all samples tested. Project completeness was determined by evaluating the planned versus actual quantities of data. Percent completeness per parameter is as follows:

- PFAS in groundwater by LC/MS/MS compliant with QSM 5.1 Table B-15 at 100%;
- PFAS in soil by LC/MS/MS compliant with QSM 5.1 Table B-15 at 100%;
- pH in soil by USEPA Method 9045D at 100%; and,
- Total organic carbon (TOC) by USEPA Method 9060 at 100%.

4.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a method detection limit (MDL) study, and calibration standards at the limit of quantitation (LOQ). In order to meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project LOQs specified in the QAPP Addendum (AECOM, 2020b). The laboratory provided the requested MDL studies and provided applicable calibration standards at the LOQ. In order to achieve the DQOs for sensitivity outlined in the QAPP Addendum (AECOM, 2020b), the laboratory reported all field sample results at the lowest possible dilution. Additionally, any analytes detected below the LOQ and above the DL were reported and qualified “J” as estimated values by the laboratory.

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5.0 Site Inspection Activities

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and was implemented in accordance with the following approved documents:

- *Final Preliminary Assessment Report, Joint Base McGuire-Dix-Lakehurst, Lakehurst, New Jersey* dated October 2019 (AECOM, 2019);
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan* dated March 2018 (AECOM, 2018a);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Lakehurst Army Aviation Support Facility* dated March 2020 (AECOM, 2020b);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b); and
- *Final Site Safety and Health Plan, Lakehurst AASF, Lakehurst, New Jersey* dated February 2020 (AECOM, 2020a)

The SI field activities were conducted from 26 to 27 February 2020 and consisted of direct push boring and soil sample collection, temporary monitoring well installation, and grab groundwater sample collection. Field activities were conducted in accordance with the QAPP Addendum (AECOM, 2020b), except as noted in **Section 5.8**.

The following samples were collected during the SI and analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.1 Table B-15 to fulfill the project DQOs:

- 22 soil samples from eight locations (seven soil borings and one surface hand auger location); and
- Seven grab groundwater samples from temporary well locations

Figure 5-1 provides the sample locations for all media across the facility. **Table 5-1** presents the list of samples collected for each media. Field documentation is provided in **Appendix B**. A Log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Field forms are provided in **Appendix B2**, and survey data are available is **Appendix B3**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 Pre-Investigation Activities

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details of these activities are presented below.

5.1.1 Technical Project Planning

The USACE TPP Process, Engineering Manual (EM) 200-1-2 (DA, 2016a) defines four phases to project planning: 1) defining the project phase; 2) determining data needs; 3) developing data collection strategies; and 4) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including quantitative and qualitative DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 16 January 2020, prior to SI field activities. Meeting minutes are provided in **Appendix D**. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2.

The stakeholders for this SI include ARNG, NJARNG, USACE, the United States Air Force Civil Engineer Center (AFCEC/CZOE) on behalf of the JBMDL Environmental Restoration Program, and NJDEP representatives familiar with the facility, the regulations, and the community. Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the SI QAPP Addendum (AECOM, 2020b). Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

New Jersey One Call was contacted by AECOM's drilling subcontractor Cascade Drilling Services to notify them of intrusive work at the Lakehurst AASF. However, because the Lakehurst AASF is on a private facility (JBMDL), Dig Safe® contractors did not enter to perform mark-outs. Therefore, AECOM submitted a JBMDL work clearance request to have all utilities at the Lakehurst AASF be marked by the appropriate JBMDL utility departments. Mark-outs were performed between 21-25 February, with final approval to begin work on 25 February. As an added measure, the first 5 ft of each boring were pre-cleared using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

A potable water sample (LH-PW-01) was collected from a spigot at Building 790 on 16 January 2020, prior to mobilization, and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15. The results of the potable well sample are provided in **Appendix F**. A discussion of the results is presented in **Section 4.6.3**.

All materials that were used within the sampling zone were confirmed as acceptable for use in the PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the QAPP Addendum (AECOM, 2020b). Prior to the start of field work each day, a PFAS Sampling Checklist was completed as an additional layer of control. The checklist served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Soil Borings and Soil Sampling

Soil samples were collected via direct push technology (DPT), in accordance with *Standard Operating Procedure (SOP) 3-17 Direct Push Sampling Techniques*. A GeoProbe® 7822DT dual-tube sampling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top 5 ft of the boring to be compliant with utility clearance procedures.

Three discrete soil samples were collected for chemical analysis from each soil boring. One surface soil sample (0 to 2 ft bgs) and two subsurface soil samples (one approximately 1 ft above the groundwater table and one at the mid-point between the surface and the groundwater table) were collected from each boring. Additionally, one surface soil location (AOI1-SB08) was completed to 2 ft bgs using a hand auger. The soil boring locations are shown on **Figure 5-1**, and boring and sample depths are provided in **Table 5-1**. The soil boring locations were selected based on the AOI information as agreed on through TPP and QAPP Addendum review.

The soil cores were continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS). A photoionization detector (PID) was used to screen the breathing zone during boring activities as part of personal safety requirements. Observations and measurements were recorded on sampling forms (**Appendix B2**) and in a non-treated field logbook (i.e., composition notebook). Depth interval, recovery thickness, PID concentrations,

moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) were recorded. The boring logs are provided in **Appendix E**.

Each sample was collected into laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain of custody (CoC) procedures to the laboratory and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15, TOC (USEPA Method 9060A), and pH (USEPA Method 9045D) in accordance with the QAPP Addendum (AECOM, 2020b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, equipment rinsate blanks (ERBs) were collected at a rate of 5% and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 4 degrees Celsius (°C) during shipment.

DPT borings were converted to temporary wells, which were subsequently abandoned in accordance with the QAPP Addendum (AECOM, 2020b) using bentonite chips at completion of sampling activities. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.3 Temporary Well Installation and Groundwater Grab Sampling

Temporary wells were installed using a GeoProbe® 7822DT dual-tube sampling system. Temporary wells were installed at seven boring locations (AOI1-01 – AOI1-07). A temporary well was not installed at surface soil location AOI1-08 (drill rig unable to traverse the retention basin slope). Once the boring locations (AOI01-01 – AOI01-07)were advanced to the desired depth, a temporary well was constructed of a 5-foot section of 1-inch Schedule 40 poly-vinyl chloride (PVC) screen with sufficient casing to reach ground surface. The screen intervals for the temporary wells are provided on **Table 5-2**. New PVC pipe and screen were used at each location to avoid cross contamination.

The temporary wells were allowed to recharge for a minimum of 24 hours after installation before collection of groundwater samples. Groundwater samples were collected using a peristaltic pump with PFAS-free HDPE dedicated tubing. Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. The temporary wells were purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) after each grab sample was collected. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to identify if there was any foaming. No foaming was noted in any of the groundwater samples.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15 in accordance with the QAPP Addendum (AECOM, 2020b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One field reagent blank (FRB) was collected in accordance with the Programmatic UFP-QAPP (PQAPP) (AECOM, 2018a). A temperature blank

was placed in each cooler to ensure that samples were preserved at or below 4°C during shipment.

Temporary wells were abandoned in accordance with the QAPP Addendum (AECOM, 2020b) by removing the PVC and backfilling the hole with bentonite chips. Temporary wells were installed in grass areas to avoid disturbing concrete or asphalt.

5.4 Synoptic Water Level Measurement

A synoptic groundwater gauging event was performed on 26 February 2020. Groundwater elevation measurements were collected from the 7 temporary monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-3**. Groundwater elevation data is provided in **Table 5-3**.

5.5 Surveying

The northern side of each well casing was surveyed by New Jersey licensed land surveyors following guidelines provided in *SOP 3-07 Land Surveying*. Survey data from the temporary monitoring wells were collected on 3 March 2020 in the Universal Transverse Mercator Zone 18N projection with World Geodetic System 84 datum. The surveyed well data are provided in **Appendix B3**.

5.6 Investigation-Derived Waste

As of the date of this report, the disposal of PFAS investigation-derived waste (IDW) is not regulated federally. Per the request of JBMDL and the NJARNG, all IDW generated was containerized and labeled per the United States Air Force *Memorandum Establishing Aqueous Film Forming Foam (AFFF)-Related Waste Management Implementation Guidance* (US Air Force, 2019).

Soil IDW (i.e., soil cuttings) and liquid IDW (purge and decontamination water) generated during the SI activities were containerized in two, separate 55-gallon drums and stored inside Building 780. The soil and liquid IDW was not sampled and assumes the PFAS characteristics of the associated soil samples collected from that source location.

Other solids such as spent personal protective equipment (PPE), plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities were disposed of at a licensed solid waste landfill.

5.7 Laboratory Analytical Methods

Samples were analyzed for a subset of 18 PFAS by LC/MS/MS compliant with QSM 5.1 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP-certified laboratory. The 18 PFAS analyzed as part of the ARNG SI program include the following:

- 6:2 fluorotelomer sulfonic acid (6:2 FTS)
- 8:2 fluorotelomer sulfonic acid (8:2 FTS)
- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanoic acid (PFHxA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)

- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutyrate (PFBA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUdA)

Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.8 Deviations from QAPP Addendum

One deviation was identified after completion of the field work during the reporting stage and therefore a Nonconformance and Corrective Action Report was not completed. The deviation from the SI QAPP Addendum is noted below:

- At the request of NJDEP, the Final SI QAPP was updated to indicated that surface soil samples would be collected from the 0.5-1 foot bgs interval. However, during the SI fieldwork, surface soil samples were inadvertently collected from the ARNG programmatic surface soil samples interval of 0-2 feet bgs.

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Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Lakehurst AASF

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS by LC/MS/MS compliant with QSM 5.1 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples						
AOI01-01-SB-0-2	2/26/2020	0-2	x			
AOI01-01-SB-0-2-D	2/26/2020	0-2	x			Field Duplicate
AOI01-01-SB-7-8	2/26/2020	7-8	x			
AOI01-01-SB-8-9	2/26/2020	8-9	x			
AOI01-02-SB-0-2	2/26/2020	0-2	x			
AOI01-02-SB-4-5	2/26/2020	4-5	x	x	x	
AOI01-02-SB-8-9	2/26/2020	8-9	x			
AOI01-03-SB-0-2	2/26/2020	0-2	x			
AOI01-03-SB-4-5	2/26/2020	4-5	x			
AOI01-03-SB-4-5-D	2/26/2020	4-5	x			Field Duplicate
AOI01-03-SB-8-9	2/26/2020	8-9	x			
AOI01-04-SB-0-2	2/26/2020	0-2	x			
AOI01-04-SB-4-5	2/26/2020	4-5	x			
AOI01-04-SB-8-9	2/26/2020	8-9	x			
AOI01-05-SB-0-2	2/26/2020	0-2	x			
AOI01-05-SB-3-4	2/26/2020	3-4	x			
AOI01-05-SB-4-5	2/26/2020	4-5	x			
AOI01-06-SB-0-2	2/26/2020	0-2	x			
AOI01-06-SB-4-5	2/26/2020	4-5	x			
AOI01-06-SB-9-10	2/26/2020	9-10	x			
AOI01-07-SB-0-2	2/26/2020	0-2	x			
AOI01-07-SB-4-5	2/26/2020	4-5	x			
AOI01-07-SB-8-9	2/26/2020	8-9	x			
AOI01-07-SB-8-9-D	2/26/2020	8-9	x			Field Duplicate
AOI01-08-SB-0-2	2/26/2020	0-2	x			
Groundwater Samples						
AOI01-01-GW	2/27/2020	8-13	x			
AOI01-02-GW	2/27/2020	4-9	x			
AOI01-02-GW-D	2/27/2020	4-9	x			Field Duplicate
AOI01-03-GW	2/27/2020	9-14	x			
AOI01-04-GW	2/27/2020	9-14	x			
AOI01-05-GW	2/27/2020	5-10	x			
AOI01-06-GW	2/27/2020	8-13	x			
AOI01-07-GW	2/27/2020	8.5-13.5	x			

Notes:
AASF = Army Aviation Support Facility
AOI = Area of Interest
bgs = below ground surface
D = duplicate
GW = groundwater
PFAS = per- and polyfluoroalkyl substances
pH = potential for hydrogen
SB = soil boring
TOC =total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Boring Depths and Temporary Well Screen Intervals
Site Inspection Report, Lakehurst AASF

Area of Interest	Soil Boring ID	Soil Boring Depth (feet bgs)	Temporary Well Screen Interval (feet bgs)
AOI 1	AOI01-01	15	8-13
	AOI01-02	15	4-9
	AOI01-03	15	9-14
	AOI01-04	15	9-14
	AOI01-05	10	5-10
	AOI01-06	15	8-13
	AOI01-07	15	8.5-13.5

Notes:
AASF = Army Aviation Support Facility
bgs = below ground surface
ID = identification

Table 5-3
Depth to Water and Groundwater Elevation
Site Inspection Report, Lakehurst AASF

Monitoring Well ID	Ground Surface Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
AOI01-01	80.90	8.19	72.71
AOI01-02	80.22	6.89	73.33
AOI01-03	80.61	7.46	73.15
AOI01-04	80.50	8.30	72.20
AOI01-05	79.65	6.60	73.05
AOI01-06	78.38	6.17	72.21
AOI01-07	80.10	6.73	73.37

Notes:

AASF = Army Aviation Support Facility

AOI = Area of Interest

amsl = above mean sea level

btoc = below top of casing

ft = feet

ID = identification

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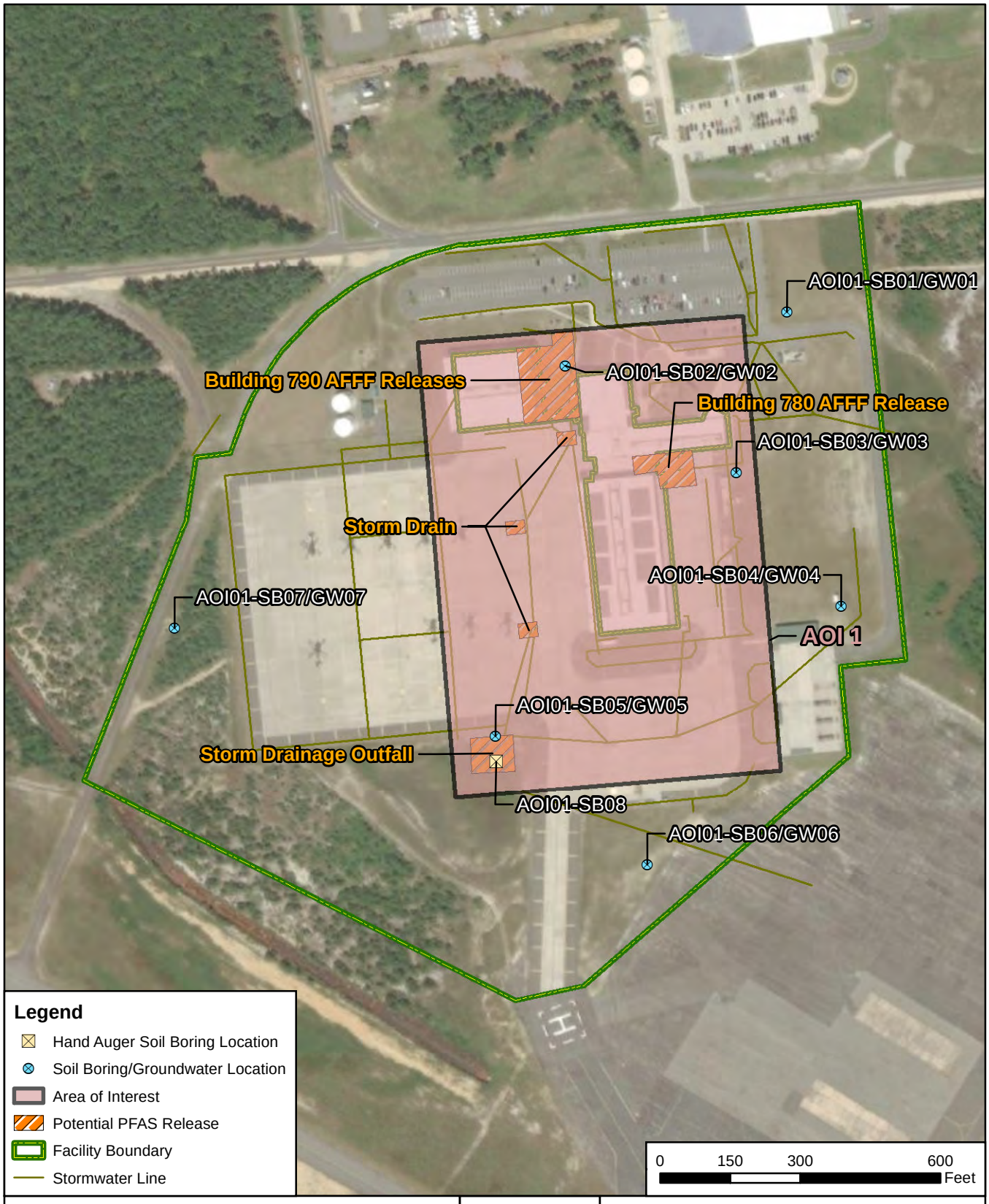

CLIENT	ARNG			
NOTES	Site Investigation for PFAS at Lakehurst AASF, NJ			
REVISED	10/16/2020	GIS BY	MS	10/16/2020
SCALE	1:3,600	CHK BY	AB	10/16/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	RG	10/16/2020

N

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

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6.0 Site Inspection Results

This section presents the analytical results of AOI 1. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for AOI 1 is provided in **Section 6.3**. **Table 6-2** through **Table 6-4** present PFAS results for samples with detections in soil and groundwater; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G.**

6.1 Screening Levels

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 15 October 2019 (Assistant Secretary of Defense, 2019). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to an RI, the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table 6-1**.

All other results presented in this report are considered informational in nature and serve as an indication as to whether soil and groundwater contain or do not contain PFAS within the boundaries of the facility. These SLs were adopted after the SI QAPP was finalized and are more stringent than the USEPA HA originally documented in the SI QAPP (AECOM, 2020b). This change did not have any impact on the interpretation of the analytical results or recommendations.

Table 6-1: Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[a,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b]	Tap Water (Groundwater) (ng/L)[a,b]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	130,000	1,600,000	40,000

Notes:
New Jersey Department of Environmental Protection regulations are not considered in this SI in lieu of Federal regulations.

a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. HQ=0.1. 15 October 2019.

b.) If only one PFAS is present, a Hazard Quotient (HQ) of 1 applies and the values presented would increase by a factor of x10.

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, soil samples were analyzed for TOC and pH, which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC and pH sampling.

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions and are therefore relatively mobile in groundwater (Xiao et al., 2015), but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins,

2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC, 2018).

6.3 AOI 1 – Lakehurst AASF

This section presents the analytical results for soil and groundwater for AOI 1, which includes four potential PFAS release areas: two releases from the fire suppression system in Building 790, one release from the fire suppression system at Building 780, and one secondary release from a storm drain outfall (result from one of the releases at Building 790). The detected compounds are summarized in **Table 6-2** through **Table 6-4** and on **Figure 6-1** through **Figure 6-3**.

6.3.1 Soil Analytical Results

PFOA, PFOS, and PFBS did not exceed the SLs in soil at the four potential PFAS release areas. **Figure 6-1** and **Figure 6-2** present detections in soil for PFOS and PFOA. The detected compounds in soil are summarized on **Table 6-2** and **Table 6-3**.

At AOI 1, soil was sampled from the shallow interval (0 to 2 ft bgs), intermediate interval (3 to 8 ft bgs), and deep interval (8 to 10 ft bgs) from boring locations AOI01-01 through AOI01-08. PFOA and PFBS were not detected in soil; PFOS was detected in soil at concentrations several orders of magnitude lower than the SLs. In the shallow intervals, PFOS was detected at five locations, with concentrations ranging from 0.267 J micrograms per kilogram (µg/Kg) to 1.55 µg/Kg. In the intermediate intervals, PFOS was detected at four locations within concentrations ranging from 0.212 J µg/Kg to 0.358 J µg/Kg. In the deep intervals, PFOS was detected at one location at a concentration of 0.368 J µg/Kg. The magnitude of concentrations in soil did not show significant variation between shallow and intermediate or intermediate and deep. A greatest number of compounds detected were observed within AOI01-02, which was advanced adjacent to the Building 790 release area.

6.3.2 Groundwater Analytical Results

PFOS in groundwater exceeded the SLs at one location in AOI 1. PFOA and PFBS did not exceed the SL at any locations in AOI 1. **Figure 6-3** presents the ranges of detections for PFOS and PFOA. The detected compounds in groundwater are summarized in **Table 6-4**.

Within AOI 1, groundwater was sampled from temporary monitoring well locations AOI01-01 through AOI01-07. The SL of 40 nanograms per liter (ng/L) for PFOS was exceeded at AOI01-06 at a concentration of 75.6 ng/L. PFOS was detected in the other six locations, all below SL, with concentrations ranging from 6.95 J ng/L to 32.1 ng/L. PFOA and PFBS were detected below the SLs of 40 ng/L and 40,000 ng/L at all seven locations with concentrations ranging from 6.92 J ng/L to 26.6 ng/L for PFOA and 2.22 J ng/L to 35.5 ng/L for PFBS.

6.3.3 Conclusions

Based on the results of the SI, PFOA and PFBS were not detected in soil at AOI 1, and PFOS was detected several orders of magnitude lower than the soil SLs. At location AOI01-06, PFOS was detected in groundwater at concentrations exceeding the individual SL of 40 ng/L. PFOA and PFBS were detected in groundwater at concentrations below the SL, including in an upgradient monitoring well, indicating a potential off-facility source. Based on the exceedance of the SL for PFOS in groundwater, further evaluation at AOI 1 is warranted.

Table 6-2
PFAS Detections in Surface Soil
Site Inspection Report, Lakehurst AASF

Area of Interest		AOI01																	
Sample ID		AOI01-01-SB-0-2		AOI01-01-SB-0-2-D		AOI01-02-SB-0-2		AOI01-03-SB-0-2		AOI01-04-SB-0-2		AOI01-05-SB-0-2		AOI01-06-SB-0-2		AOI01-07-SB-0-2		AOI01-08-SB-0-2	
Sample Date		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020	
Depth		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft		0 - 2 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (µg/Kg)																			
6:2 FTS	-	ND		ND		12.9		ND		ND		ND		ND		ND		0.325	J
PFBA	-	ND		ND		0.349	J	ND		ND		ND		ND		ND		ND	
PFHpA	-	ND		ND		0.168	J	ND		ND		ND		ND		ND		ND	
PFHxA	-	ND		ND		0.690	J	ND		ND		ND		ND		ND		ND	
PFOS	130	0.397	J	0.460	J	ND		0.564	J	1.55		ND		0.730	J	0.267	J	ND	
PFPeA	-	ND		ND		0.946	J	ND		ND		ND		ND		ND		ND	
PFTeDA	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFTrDA	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFUnDA	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
USEPA	United States Environmental Protection Agency
µg/Kg	micrograms per Kilogram
-	Not applicable

Table 6-3
PFAS Detections in Shallow Subsurface Soil
Site Inspection Report, Lakehurst AASF

Area of Interest		AOI01																	
Sample ID		AOI01-01-SB-7-8		AOI01-01-SB-8-9		AOI01-02-SB-4-5		AOI01-02-SB-8-9		AOI01-03-SB-4-5		AOI01-03-SB-4-5-D		AOI01-03-SB-8-9		AOI01-04-SB-4-5		AOI01-04-SB-8-9		AOI01-05-SB-3-4	
Sample Date		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020	
Depth		7 - 8 ft		8 - 9 ft		4 - 5 ft		8 - 9 ft		4 - 5 ft		4 - 5 ft		8 - 9 ft		4 - 5 ft		8 - 9 ft		3 - 4 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (µg/Kg)																					
6:2 FTS	-	ND		ND		13.0		6.72		ND		ND		0.406	J	ND		ND		ND	
PFBA	-	ND		ND		ND		0.387	J	ND		ND		ND		ND		ND		ND	
PFHxA	-	ND		ND		0.270	J	0.662	J	ND		ND		ND		ND		ND		ND	
PFOS	1600	0.237	J	ND		ND		ND		ND		ND		ND		0.330	J	ND		0.358	J
PFPeA	-	ND		ND		0.411	J	0.991	J	ND		ND		0.191	J	ND		ND		0.222	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFHxA	perfluorohexanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
USEPA	United States Environmental Protection Agency
µg/Kg	micrograms per Kilogram
-	Not applicable

Table 6-3
PFAS Detections in Shallow Subsurface Soil
Site Inspection Report, Lakehurst AASF

Area of Interest		AOI01											
Sample ID		AOI01-05-SB-4-5		AOI01-06-SB-4-5		AOI01-06-SB-9-10		AOI01-07-SB-4-5		AOI01-07-SB-8-9		AOI01-07-SB-8-9-D	
Sample Date		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020		02/26/2020	
Depth		4 - 5 ft		4 - 5 ft		9 - 10 ft		4 - 5 ft		8 - 9 ft		8 - 9 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ug/Kg)													
6:2 FTS	-	ND		ND		ND		ND		ND		ND	
PFBA	-	ND		ND		ND		ND		0.172	J	ND	
PFHxA	-	ND		ND		ND		ND		ND		ND	
PFOS	1600	0.368	J	0.212	J	ND		ND		ND		ND	
PFPeA	-	ND		ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFHxA	perfluorohexanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	Interpreted Qualifier
SB	Soil boring
USEPA	United States Environmental Protection Agency
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Lakehurst AASF

Area of Interest		AOI1															
Sample ID		AOI01-01-GW		AOI01-02-GW		AOI01-02-GW-D		AOI01-03-GW		AOI01-04-GW		AOI01-05-GW		AOI01-06-GW		AOI01-07-GW	
Sample Date		02/27/2020		02/27/2020		02/27/2020		02/27/2020		02/27/2020		02/27/2020		02/27/2020		02/27/2020	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)																	
6:2 FTS	-	ND		2110		2230		2270		ND		3190		4090		ND	
8:2 FTS	-	ND		ND		ND		ND		ND		7.33	J	7.88	J	ND	
PFBA	-	11.7		245		252		364		32.1		87.5		279		11.0	
PFBS	40000	2.22	J	19.2		21.1		16.6		35.5		2.31	J	10.6		5.78	J
PFDA	-	ND		ND		ND		ND		ND		5.26	J	2.52	J	ND	
PFHpA	-	10.2		97.3		101		179		19.7		51.9		160		3.67	J
PFHxA	-	23.8		700		690		1130		62.2		199		1080		10.8	
PFHxS	-	51.0	J-	125		131		28.8		114		34.9		53.9		31.4	
PFNA	-	3.87	J	ND		ND		2.81	J	ND		2.87	J	4.02	J	ND	
PFOA	40	26.4		18.5		19.2		6.92	J	25.3		19.6		26.6		14.4	
PFOS	40	12.5		32.1		35.3		19.4		6.95	J	27.3		75.6		24.5	
PFPeA	-	10.4		1050		1080		1910		39.0		336		1570		3.79	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

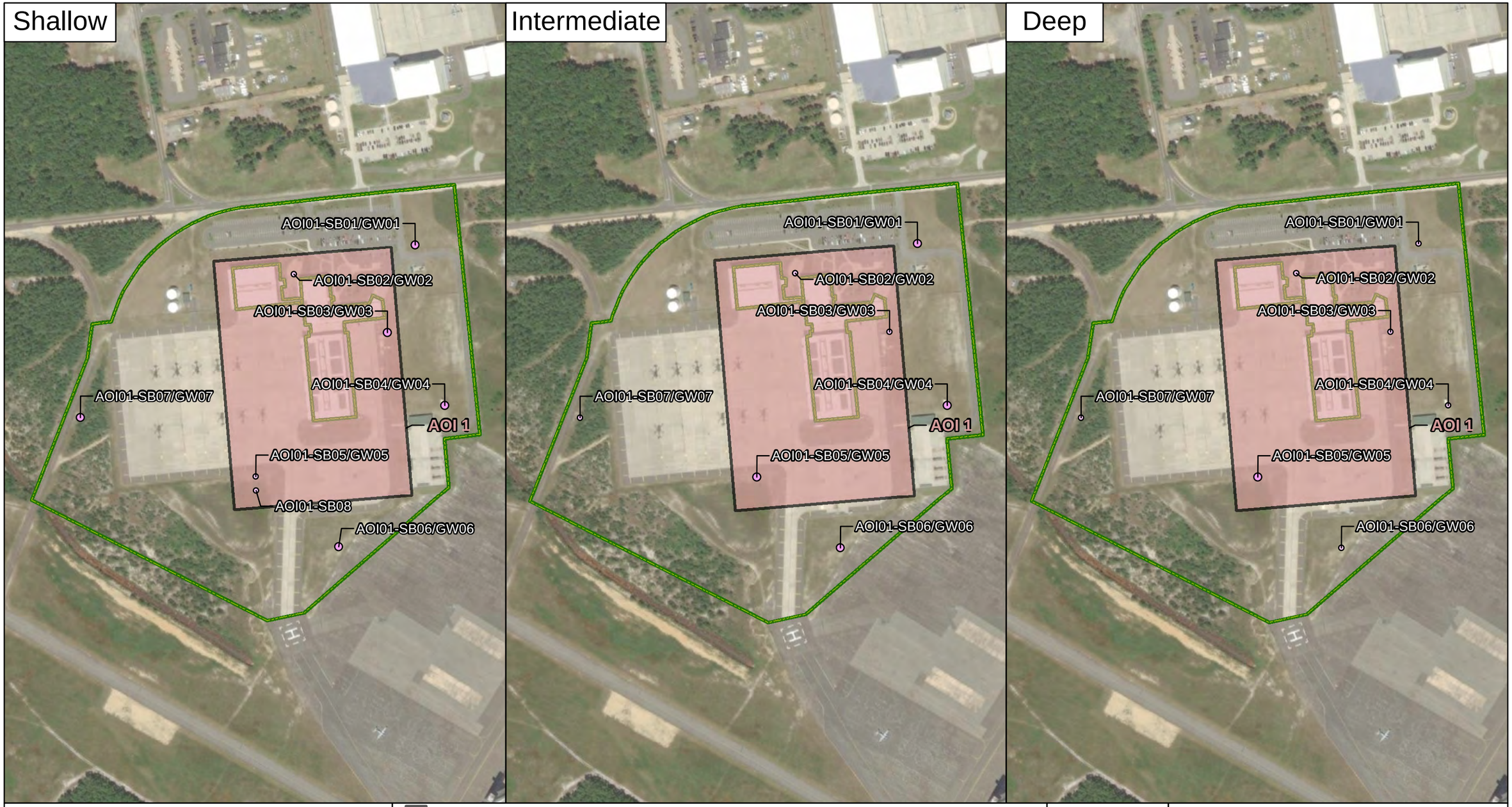
J- = Estimated concentration, biased low

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	Duplicate
GW	Groundwater
HQ	Hazard quotient
LCMSMS	Liquid Chromatography Mass Spectrometry
LOD	Limit of Detection
ND	Analyte not detected above the LOD
OSD	Office of the Secretary of Defense
Qual	Interpreted Qualifier
QSM	Quality Systems Manual
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Lakehurst AASF, NJ			
REVISED	8/10/2020	GIS BY	MS	8/10/2020
SCALE	1:4,523	CHK BY	AB	8/10/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	8/10/2020

Area of Interest
Facility Boundary

PFOS Results (µg/Kg)
- ND
- >ND - 10
- >10 - 130
- >130 - 1600
- >1600

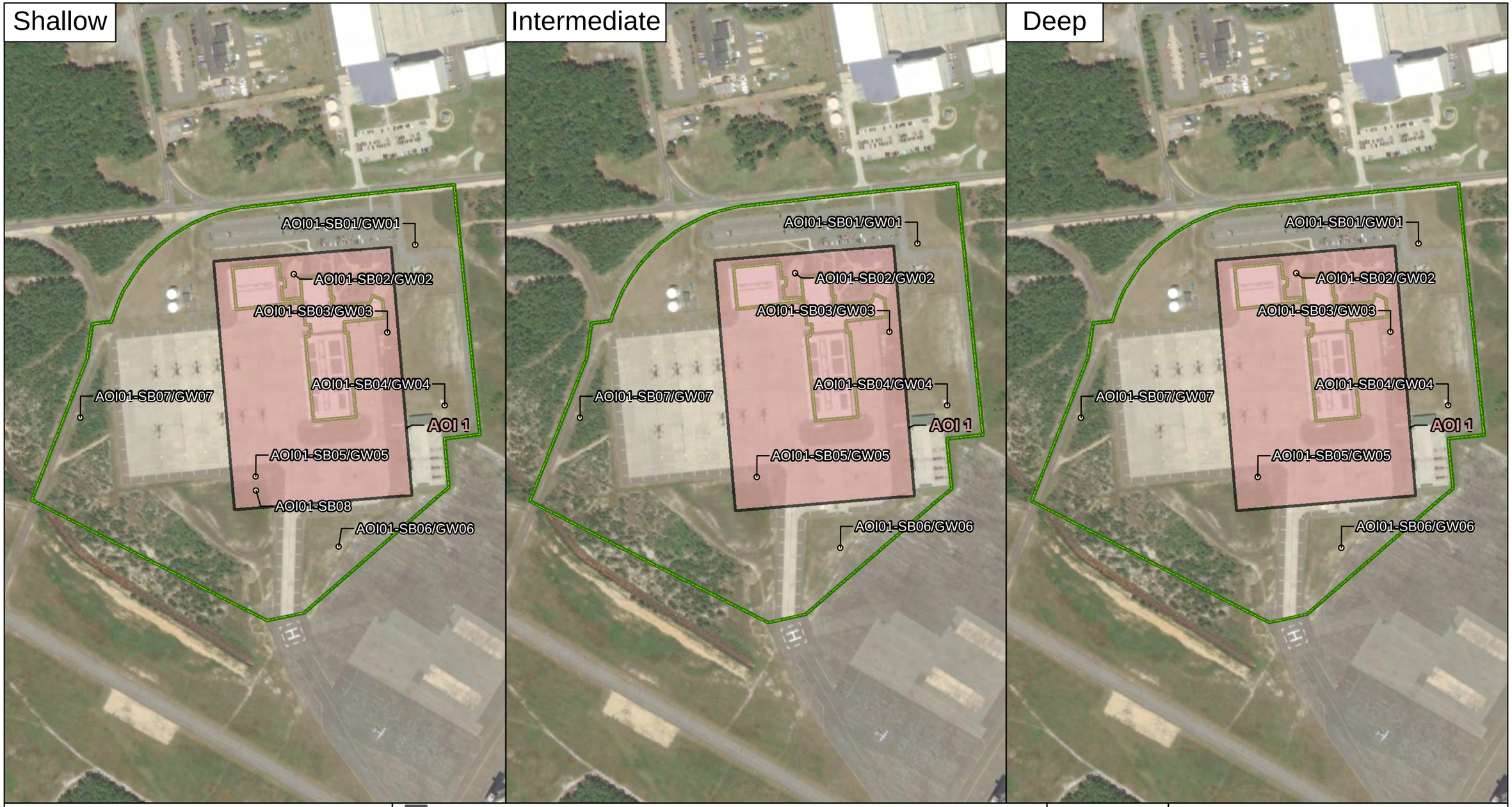
0 190 380 760 Feet

N

PFOS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Lakehurst AASF, NJ			
REVISED	8/19/2020	GIS BY	MS	8/19/2020
SCALE	1:4,523	CHK BY	AB	8/19/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	8/19/2020

Area of Interest
Facility Boundary

PFOA Results (µg/Kg)
- ND
- >ND - 10
- >10 - 130
- >130 - 1600
- >1600

0 190 380 760 Feet

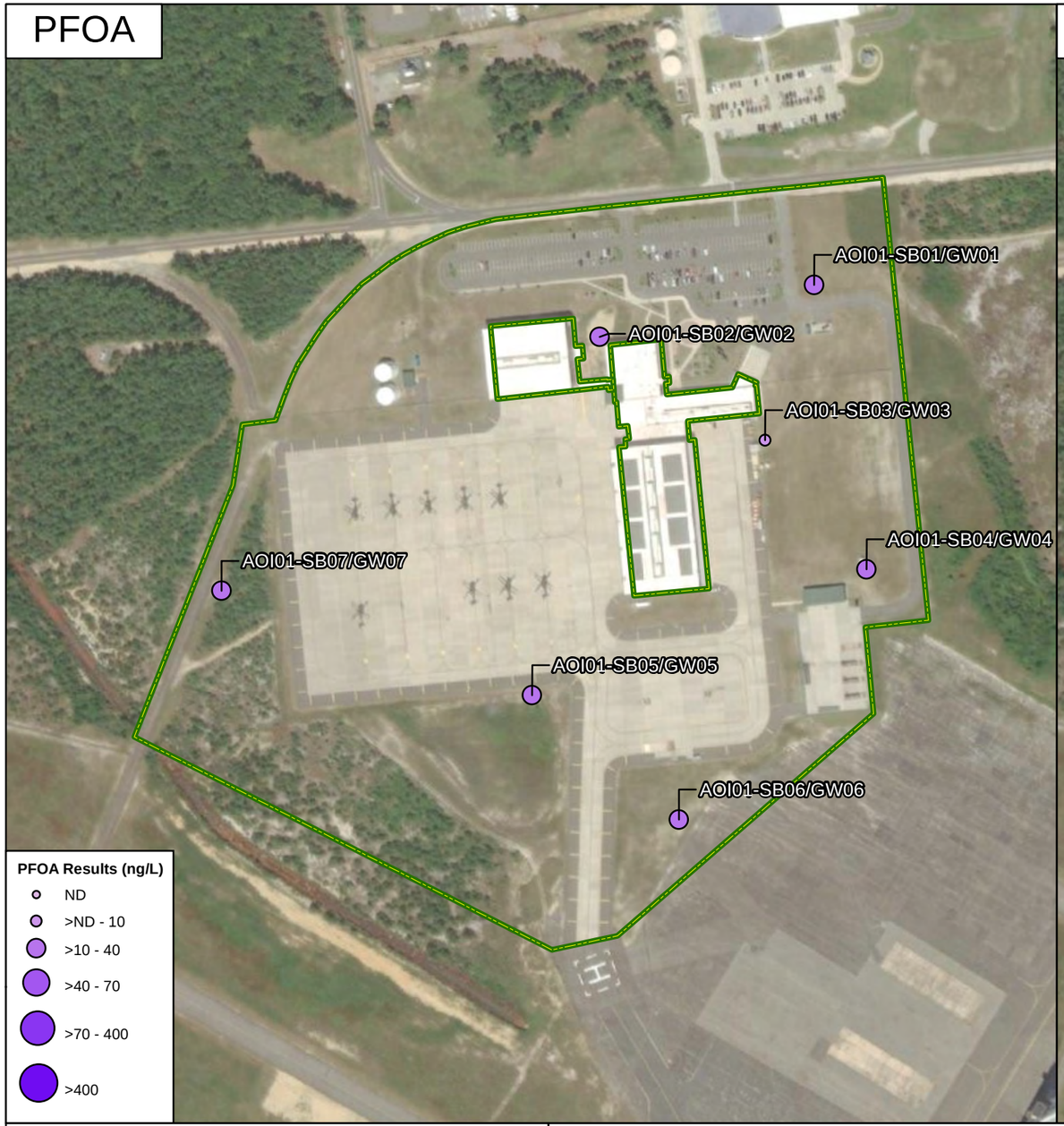
N

PFOA Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-2

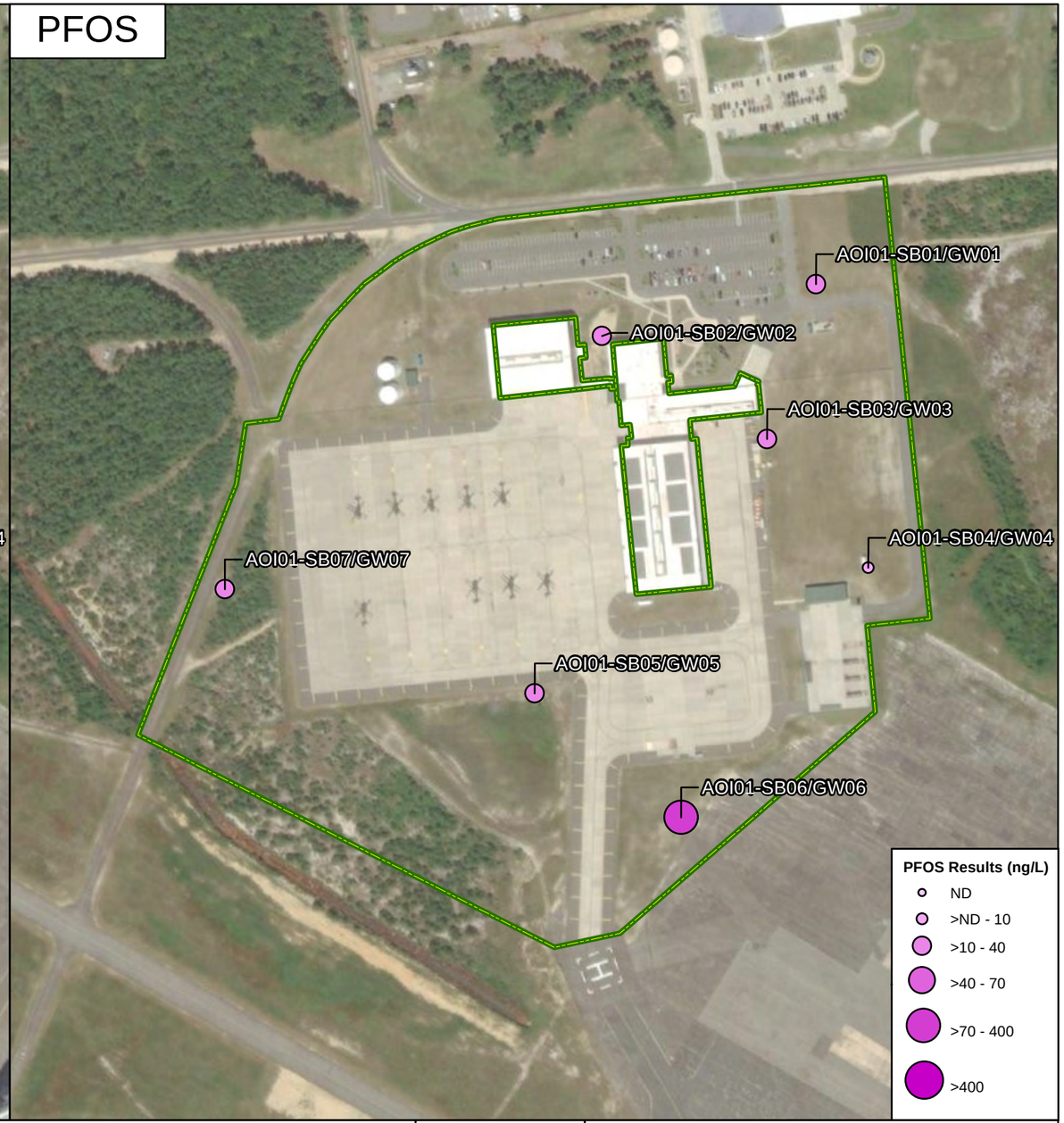
PFOA



PFOA Results (ng/L)

- ND
- >ND - 10
- >10 - 40
- >40 - 70
- >70 - 400
- >400

PFOS



PFOS Results (ng/L)

- ND
- >ND - 10
- >10 - 40
- >40 - 70
- >70 - 400
- >400

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Lakehurst AASF, NJ			
REVISED	8/19/2020	GIS BY	MS	8/19/2020
SCALE	1:3,600	CHK BY	AB	8/19/2020
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	8/19/2020

Legend

Facility Boundary

0 150 300 600 Feet

N

PFOA and PFOS Detections in Groundwater

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-3

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7.0 Exposure Pathways

The CSM for the AOI, revised based on the SI findings, is presented in **Figure 7-1**. A CSM presents the current understanding of the site conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

1. Contaminant source;
2. Environmental fate and transport;
3. Exposure point;
4. Exposure route; and
5. Potentially exposed populations.

If any of these elements are missing, the pathway is incomplete. The CSM figure uses an empty circle symbol to represent an incomplete exposure pathway. Areas with no identified complete pathway generally warrant no further action. However, the pathway is considered potentially complete if PFOA, PFOS, or PFBS are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of PFOA, PFOS, or PFBS above the SLs. Areas with an identified potentially complete pathway may warrant further investigation.

In general, the potential routes of exposure to PFAS are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of PFAS toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA, 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, trespassers (though unlikely due to restricted access), residents outside the JBMDL facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria.

7.1.1 AOI 1 – Lakehurst AASF

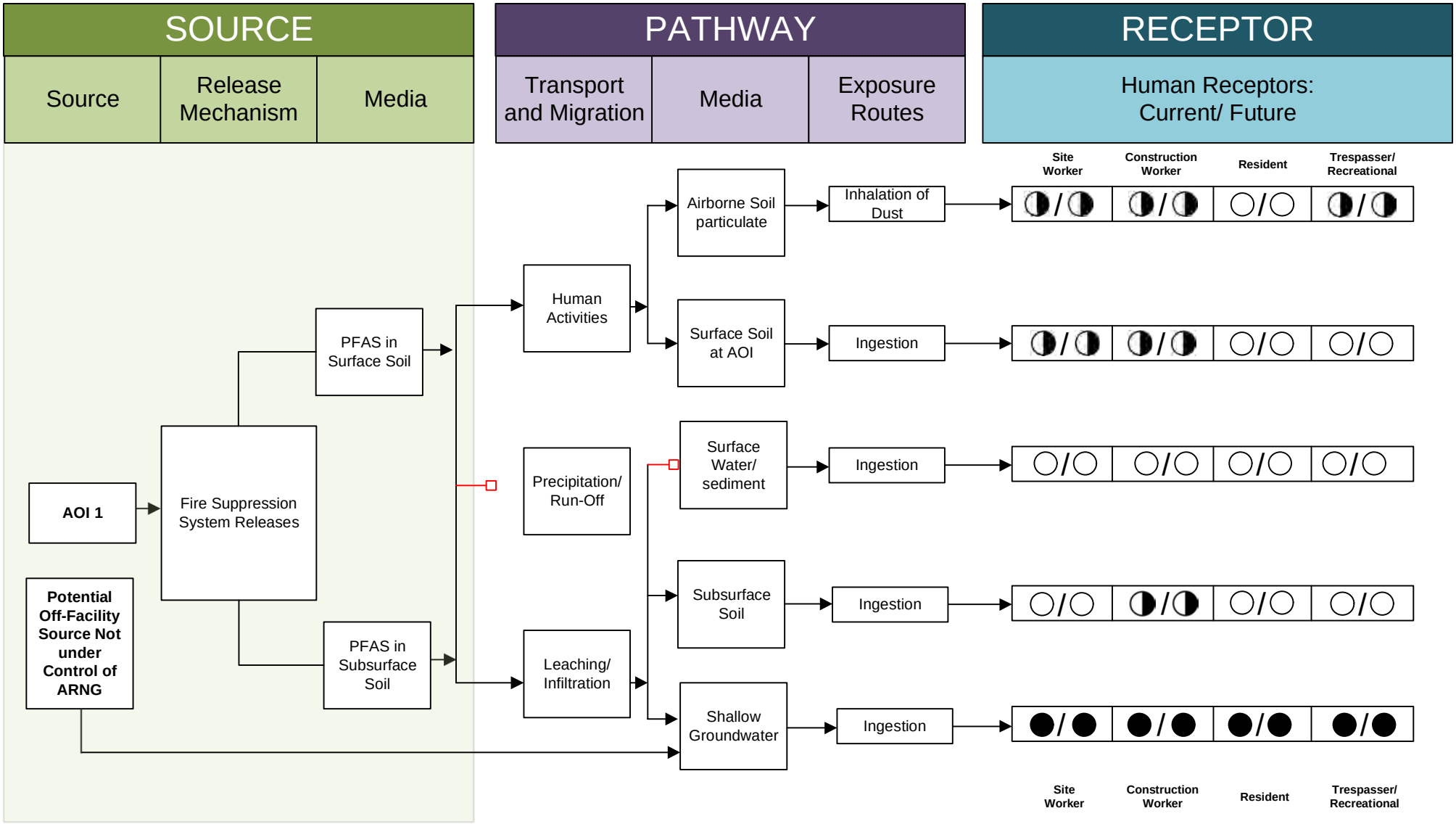
AFFF was released to soil at three of the four potential PFAS release areas within AOI 1 through accidental releases from the fire suppression systems. PFOS was detected in soil at AOI 1 and confirmed the release of PFAS to soil in AOI 1. Based on the results, ground-disturbing activities could potentially result in site worker and construction worker exposure to PFOS via inhalation of dust or ingestion of surface soil, and ground-disturbing activities could potentially result in construction worker exposure to subsurface soil. Additionally, off-facility recreational users may potentially be exposed to PFOS via inhalation of dust caused by on-facility ground disturbing activities, although this exposure is likely insignificant. The CSM is presented on **Figure 7-1**.

7.2 Groundwater Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria.

7.2.1 AOI 1 – Lakehurst AASF

PFOA, PFOS, and PFBS were detected in groundwater from all seven temporary monitoring wells at low levels at AOI 1 and exceeded the SL for PFOS in one temporary monitoring well at the downgradient facility boundary (AOI01-06). The Main and Back-up Hill PWS wells (which supplies water to the facility) are located downgradient. The Back-up system is not hydraulically connected with the AASF and is currently treated for PFOS and PFOA; however, the Main Hill PWS system includes several shallow Kirkwood-Cohansey wells that have had low-level (below USEPA HA) PFOS and PFOA detections. Based on this information, the ingestion exposure pathway is potentially complete for site workers. Due to the OSD exceedance at the ARNG facility boundary and the current understanding of off-facility potable water wells , the ingestion exposure pathway is potentially complete for off-facility residents, recreational users, and trespassers. The ingestion exposure pathway for future construction workers is considered potentially complete due to the exceedance of the SL for PFOS and the shallow depth to groundwater. The CSM is presented on **Figure 7-1**.



LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of SL

NOTES:

1. The resident and recreational user receptors refer to an off-site resident or recreational user.
2. Dermal contact exposure pathway is incomplete for PFAS.

Figure 7-1
Conceptual Site Model
AOI 1 Lakehurst AASF

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8.0 Summary and Outcome

This section summarizes SI activities and findings. The most significant findings are summarized in this section and are reproduced directly or abstracted from information contained in this report. The outcome provides general and comparative interpretations of the findings relative to the SLs.

8.1 SI Activities Summary

The SI field activities at the Lakehurst AASF were conducted from 26 to 27 February 2020. The SI field activities included soil and groundwater sampling. Field activities were conducted in accordance with the QAPP Addendum (AECOM, 2020b), except as previously noted in **Section 5.8**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2020b), samples were collected and analyzed for a subset of PFAS by LC/MS/MS compliant with QSM Table B-15 as follows. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** of this Report.

- 22 soil samples from eight locations (seven soil borings and one surface hand auger location);
- Seven grab groundwater samples from seven temporary well locations

The information gathered during this investigation was used to determine if PFOA, PFOS, and/or PFBS were present at or above SLs. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at the AOIs, which are described in **Section 7**.

8.2 SI Goals Evaluation

As described in **Section 4.2**, the SI activities were designed to achieve six main goals or DQOs. This section describes the SI goals and the conclusions that can be made for each based on the data collected during this investigation.

1. *Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.*

   Only PFOS was detected at the facility in soil; however, the detected concentrations in soil samples from AOI 1 were below the SLs. PFOA, PFOS, and PFBS were all detected in groundwater. PFOA, PFOS, and PFBS were detected both at the source areas, as well as at the facility boundary, but PFOS only exceeded SLs at the facility boundary.

2. *Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.*

   PFOA, PFOS, and PFBS were detected in groundwater and PFOS exceeded SLs at the facility boundary. The location of the exceedance is downgradient of several release areas. As a result, no release areas can be eliminated from further consideration at this point in the investigation.

3. *Determine the potential need for a removal action.*

   Based on the data collected during this SI, there are no off-facility residential wells immediately downgradient of the facility; therefore, the pathway is incomplete between source and off-facility residential receptors.

4. *Collect data to better characterize the release areas for more effective and rapid initiation of a RI.*

   The geological data collected as part of the SI indicate a highly permeable and conductive environment exists at the facility. Soil observed were dominated by poorly-graded sands with thin, interbedded layers of clays and small gravel.

   These site observations are consistent with the regional geology of sedimentary deposition from a marine environment. Given the shallow nature of the borings, it is difficult to interpret the underlying transgressive and regressive deposits; however, the shallow deposits do indicate an unconfined shallow aquifer exists as shallow as 7 to 9 feet bgs. Groundwater flow direction is to the east-southeast, and the gradient across the facility is low, which impacts groundwater velocities and contaminant transport. The observed gradient across the facility could partly be due to the large impervious area and engineering drainage features designed to move water off runways and landing areas. This imbalance in recharge likely impacts the groundwater flow direct and therefore fate and transport. These geologic and hydrogeologic observations will inform the development of the technical approach for the RI.

5. *Identify within 4 miles of the installation other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS, or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).*

   Based upon the evaluation of groundwater and soil results in comparison to SLs, in combination with the groundwater flow direction analysis, the results of the SI indicate that the source of detected concentrations of PFOA, PFOS, and PFBS at the southeast facility boundary is likely attributable to ARNG activities. However, it is important to note that the facility is within the active JBMDL facility and is in close proximity to several Navy PFAS releases. Specifically, there are two former Navy fire training areas located on JBMDL approximately 900 ft north of AOI01-01 and AOI01-02. Additionally, there is a former Navy fire station and emergency response site 1,300 ft west of AOI01-07. A summary of the site history and sampling results are included in Section 2.4. These non-ARNG sources may contribute to some of the upgradient and cross-gradient detections; however, it is likely the PFOS SL exceedance on the downgradient side of the ARNG facility is due to releases at the Lakehurst AASF. As such, one component of the RI will further evaluate areas upgradient and cross-gradient of known ARNG releases to better define the extent of impacts due to ARNG activities.

6. *Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.*

   Detections of PFOS in soil within source areas and at the facility boundary indicate there is a potentially complete pathway to site workers, construction workers, and off-facility residents, recreational users, and trespassers. The PFOS SL exceedance in groundwater indicate there is a potentially complete pathway between source and construction workers.

8.3 Outcome

Based on the CSM developed and revised in light of the SI findings, there is no potential for exposure to residential drinking water receptors caused by DoD activities at or adjacent to the facility. Sample chemical analytical concentrations collected during the SI were compared against the project SLs for PFOA, PFOS, and PFBS in soil and groundwater, as described in **Table 6-1**. The following bullets summarize the SI results:

- The detected concentrations of PFOA, PFOS, and PFBS in soil from AOI 1 were below SLs.
- PFOA and PFBS in groundwater were detected in all samples, but did not exceed SLs. PFOS in groundwater exceeded the individual SL of 40 ng/L with a maximum concentration of 75.6 ng/L at AOI01-06. Based on the results of the SI, further investigation of AOI 1 is warranted in the RI.

Table 8-1 summarizes the SI results for soil and groundwater. Based on the CSM developed and revised in light of the SI findings, there is a potential for exposure to residential drinking water receptors caused by DoD activities at or adjacent to the facility.

Table 8-2 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOI 1: Lakehurst AASF.

Table 8-1: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Soil – Facility Boundary	Groundwater – Source Area	Groundwater – Facility Boundary
1	Lakehurst AASF	◐	◐	◐	●

Legend:
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

Table 8-2: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Lakehurst AASF	Exceedances of SLs in groundwater at the facility boundary. No exceedances of SLs in soil.	Proceed to RI

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