FINAL
Site Inspection Report Morrisville Army Aviation Support Facility #1, North Carolina

Site Inspection for Perfluorooctanoic acid (PFOA), Perfluorooctanesulfonic acid (PFOS), Perfluorohexanesulfonic acid (PFHxS), Perfluorononanoic acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA), and Perfluorobutanesulfonic acid (PFBS) at ARNG Installations, Nationwide

August 2023

Prepared for:

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

UNCLASSIFIED

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Acronyms and Abbreviations

%	percent
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
AOI	Area of Interest
ARNG	Army National Guard
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DoD	Department of Defense
DPS	Department of Public Safety
DQO	data quality objective
DUA	data usability assessment
EA	EA Engineering, Science, and Technology, Inc.
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
FedEx	Federal Express
FTA	Fire Training Area
GSE	ground support equipment
GPRS	Ground Penetrating Radar Systems
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography with tandem mass spectrometry
MIL-SPEC	military specification
MS	matrix spike
MSD	matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
ng/L	nanograms per liter
NCARNG	North Carolina Army National Guard
NCDEQ	North Carolina Department of Environmental Quality
NCWRF	North Cary Water Reclamation Facility
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid

PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PID	photoionization detector
PQAPP	Programmatic UFP-QAPP
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RDU	Raleigh-Durham International Airport
RI	Remedial Investigation
SDO	stormwater discharge outfall
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
TOC	total organic carbon
TPP	Technical Project Planning
UFP	Uniform Federal Policy
US	United States
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

Executive Summary

The Army National Guard (ARNG) G-9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS). These compounds are collectively referred to as "relevant compounds" throughout the document and the applicable screening levels (SLs) are provided in **Table ES-1**.

The PA identified five Areas of Interest (AOIs) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2** for AOI locations). The objective of the SI is to identify whether there has been a release to the environment from the AOIs identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on SLs for relevant compounds. This SI was completed at the Morrisville Army Aviation Support Facility (AASF) #1 in North Carolina and determined further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted for AOI 1, AOI 2, AOI 3, AOI 4, and AOI 5. The Morrisville AASF #1 will also be referred to as the "facility" throughout this document.

Morrisville AASF #1 is adjacent to Raleigh-Durham International Airport in Morrisville, North Carolina. The facility is approximately 34 acres located in in Wake County, North Carolina, approximately 10 miles northwest from Raleigh and 10 miles southeast of Durham. The facility supports aircraft operations for the North Carolina ARNG (NCARNG). The facility is on North Carolina state property, which is controlled and operated by the Department of Public Safety (DPS); the NCARNG is a division within the DPS, and the facility is accessible from the main gate located along National Guard Drive.

The PA identified five AOIs for investigation during the SI phase. SI sampling results from the five AOIs were compared to OSD SLs. **Table ES-2** summarizes the SI results for each AOI. Based on the results of this SI, further evaluation under CERCLA is warranted in a Remedial Investigation (RI) for AOI 1, AOI 2, AOI 3, AOI 4, and AOI 5.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

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

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

a.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table ES-2: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Wash Rack Area and GSE Building	◐	●	●	Proceed to RI
2	Delta Row FTA	●	●	◐	Proceed to RI
3	Firehouse Storage and Flush Area	◐	●	●	Proceed to RI
4	Hangar Leak Area	◐	N/A	●	Proceed to RI
5	Long-Term Tri-Max 30™ Storage Area	◐	N/A	●	Proceed to RI

Legend:
N/A = not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

1

1. Introduction

1.1 Project Authorization

The Army National Guard (ARNG) G-9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS) at ARNG facilities nationwide. The ARNG performed this SI at the Morrisville Army Aviation Support Facility (AASF) #1 in North Carolina. The Morrisville AASF #1 is also referred to as the "facility" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States [US] Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations.

1.2 SI Purpose

A PA was performed at Morrisville AASF #1 (AECOM Technical Services, Inc. [AECOM], 2020) that identified five Areas of Interest (AOIs) where PFAS-containing materials may have been used, stored, disposed, or released historically. The objective of the SI is to identify whether there has been a release to the environment from the AOIs identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on screening levels (SLs) for the relevant compounds.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

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2. Facility Background

2.1 Facility Location and Description

Morrisville AASF #1 is adjacent to Raleigh-Durham International Airport (RDU) in Morrisville, North Carolina. The facility is approximately 34 acres and resides in Wake County, North Carolina, approximately 10 miles northwest from Raleigh and 10 miles southeast of Durham (**Figure 2-1**). The facility was opened in 1988 for the purpose of supporting rotary aircraft operations for the North Carolina ARNG (NCARNG). The facility is on North Carolina state property, which is controlled and operated by the Department of Public Safety (DPS); the NCARNG is a division within the DPS, and the facility is accessible from the main gate located along National Guard Drive. The Airport Joint Services Agreement establishes that the RDU Crash Rescue Unit is responsible for all fire protection of tenants and users of the airport. The Morrisville AASF #1 fire department, known as the 677th Engineer Firefighting Team, is only responsible for the parcel of land leased to the NCARNG, and they have a direct line to the RDU Crash Rescue Unit to call for emergency aid if needed.

2.2 Facility Environmental Setting

Morrisville AASF #1 is next to the southeast portion of RDU. The facility property lies within the eastern Piedmont physiographic region, which is characterized by rolling hill topography with moderately well-drained Creedmoor sandy loam soil (Cawthorn, 1970) (**Figure 2-2**). The facility borders William B. Umstead State Park, which is made up of over 5,500 acres of densely wooded land surrounding three man-made lakes (North Carolina State Parks, 2019). Outside of the state park, the land use surrounding the facility is mostly commercial.

2.2.1 Geology

The Triassic Basin underlies Morrisville AASF #1, with bedrock of mostly Precambrian and Paleozoic age comprised of igneous, metamorphosed igneous, and sedimentary rocks (Heath, 1980). The bedrock is exposed at the surface along steep hillsides, stream channels, and in roadcuts. Overlaying the bedrock is saprolite, or residuum, which ranges in thickness from 1 foot to more than 100 feet in the Piedmont (Heath, 1980). The facility is underlain by Triassic-aged, poorly sorted cobble to boulder conglomerate belonging to the Chatham Group and Newark Supergroup. The conglomerate is situated on the eastern boundary of the Triassic basin, marked by the Jonesboro Fault and located approximately 0.25 miles east of the facility (Hoffman and Gallagher, 1989; Blake and Clark, 2016). The fault is a stepped, high-angle normal fault with a northeast-southwest strike and westerly dip. The facility may also be within or close to the fault breccia zone (North Carolina Geological Survey, 1989).

Soils in the area are considered a sandy loam, weathered from Triassic age sandstone, mudstone, and shale, with an increase in clay content with depth. Depth to bedrock at the facility is estimated to be encountered at depths between 5 to 10 feet below ground surface (bgs) (Weston, 2004). Sedimentary rocks in the property vicinity are comprised of fine- to medium-grained sandstone, siltstone, and mudstone, with potential for encountering cobble to boulder conglomerate. The sandstone sequences are usually thick and are cross-bedded and interbedded with siltstone and muddy, fine-grained sandstone (DA, 2018a).

During the SI, silt, clay, and silty sand were observed as the dominant lithology of the unconsolidated sediments below Morrisville AASF #1. The borings were completed at depths between 40 and 80 feet bgs. Below the unconsolidated sediments, various rock layers were observed including conglomerate, sandstone, siltstone, granite, and felsic schist. Rock was first encountered at various depths ranging from 5 feet bgs to 30 feet bgs.

Samples for grain size analyses were collected at two locations, AOI01-01 and AOI02-01, and analyzed via American Society for Testing and Materials (ASTM) Method D-422. The results indicate that the soil samples are comprised primarily of silt (29.98 percent [%] to 42.35%), clay (22.55% to 32.33%), and fine sand (21.63% to 24.29%). These results and facility observations are consistent with the reported depositional environment of the region. Boring logs are presented in **Appendix E**, and grain size results are presented in **Appendix F**.

2.2.2 Hydrogeology

Regional groundwater flows through fractures within metamorphic, igneous, and sedimentary bedrock. There is a complex two-component groundwater system where the regolith, composed of soil residuum, saprolite, alluvium, and colluvium, provides sheet like openings along the fractures for water storage (Heath, 1980). There is also a complex and variable thickness transition zone between the regolith and bedrock that consists of weathered and altered bedrock and numerous open near-horizontal fractures near the top of the bedrock (McSwain, 2013).

The saprolite that forms in the Piedmont consists of unconsolidated granular material that contains water in the pore spaces between rock particles. When it rains, water moves laterally and downward through the saprolite layer to points of groundwater seepage on the hillsides and to the streams in the adjacent valleys. The remaining water moves downward into the fractured bedrock (Heath, 1980). Groundwater resources in the Triassic Basin underlying the facility are poor. Wells sourcing groundwater in the Triassic Basin are low yielding and often cannot supply water for minimal household purposes (Welby, 1994). Previous studies in the area indicate shallow groundwater is supplied by low-producing shallow (approximately 30 to 50 feet bgs) joints and fractures (Weston, 2004), which may be further complicated by the presence of fault breccia zones, diabase dikes, and proximity to the Jonesboro Fault. Groundwater flow dynamics through the bedrock aquifer are based on the dip of the bedding planes, orientation of joint and fault systems, permeability, and the connection of fractures, faults, dikes, and joint systems present within the formations (S&ME, 2008). Based on US Geological Survey (USGS) well logs in the vicinity, depth to water of the perched groundwater (i.e., the water table aquifer) may be encountered as deep as 80 feet bgs at the facility (USGS, 2020). Groundwater flow is inferred to generally flow with surface topography to the south. However, groundwater flow may be strongly influenced by flow paths in the saprolite and may show local variability to the southwest or southeast.

No drinking water wells exist at Morrisville AASF #1; the facility is provided drinking water from Jordan Lake by the Town of Cary, located southeast of the facility (Town of Cary, 2018). The North Carolina Department of Environmental Quality (NCDEQ) maintains a database of registered wells in the area. The database is only for public water supply wells and does not necessarily include private wells. Several public water supply wells exist within 4 miles of the facility to the east, northeast, and southeast (**Figure 2-3**).

Depths to water measured in December 2021 during the SI ranged from 6.03 to 36.29 feet bgs. Groundwater elevation contours from the SI are presented on **Figure 2-4** and indicate that groundwater at the facility flows generally to the southwest.

2.2.3 Hydrology

Wake County is part of an uplifted peneplain dissected in places by a network of streams that generally flow in a southeasterly direction (Cawthorn, 1970). The Neuse River and its tributaries drain about 80% of the county. In the Triassic Basin, the valleys are U-shaped, and the flood plains are wide. The Basin is categorized as swampy depression or lake where the rock and mineral deposits were made during the Triassic period (Cawthorn, 1970). The soil at the facility is moderately well-drained, with a fair infiltration rate, and has moderate runoff. The runoff from the

facility drains southeast toward Haleys Branch, which flows into Lake Crabtree, Crabtree Creek, and eventually the Neuse River (DA, 2018a) (**Figure 2-5**). The facility's surface drainage is diverted into two stormwater discharge outfalls (SDOs). Outfall SDO-001 drains runoff from the eastern portion of Morrisville AASF #1, including the aircraft apron, fuel farm, fueling station, firehouse, tactical equipment parking areas, and the armory. Outfall SDO-002 discharges the stormwater from the western portion of the facility that includes the area surrounding the hangar, the western boundary of the apron, gravel equipment parking areas, and the parking lot. There is minimal overland flow from the adjacent property, but runoff does not directly enter the Morrisville AASF #1 outfalls (DA, 2018a). NCARNG has repaired the stormwater system along the southeast edge with a concrete conduit and grate.

Two RDU outfalls are located near SDO-002. One of the RDU outfalls is directly adjacent to the SDO-002 pipe and housed in the same concrete structure. The other RDU outfall is located approximately 100 feet to the north of SDO-002 and drains the RDU stormwater retention pond via a riser that controls the water level in the pond. Surface drainage from the RDU Maintenance Shop is diverted to this retention pond located to the south of the shop building. Flow from the RDU outfalls and both facility outfalls go in the direction of Haleys Branch on RDU property. Haleys Branch empties to Lake Crabtree, Crabtree Creek, and eventually the Neuse River. The facility also receives minimal overland flow from the RDU Airport property that does not directly release into the stormwater outfalls (NCDEQ, 2017). There is no connectivity between the facility stormwater system and the RDU pond.

Drains in the wash rack, ground support equipment (GSE) building, hangar, and several other structures onsite are diverted to the Airport Authority's force main before transitioning to the sanitary sewer operated by the Town of Cary. The sanitary sewer drainage is diverted to the North Cary Water Reclamation Facility (NCWRF) located approximately 2 miles south of Morrisville AASF #1. The NCWRF discharges treated wastewater to Crabtree Creek, which flows into the Neuse River several miles downstream. The NCWRF is also a source of reclaimed water and biosolids. A portion of the treated effluent water is piped directly to homes and businesses in the area for reuse in irrigation, manufacturing processes, and industrial cooling. The system serves customers in designated service districts near the NCWRF (Town of Cary, 2019). The State of North Carolina permits Cary to divert up to 5.14 million gallons per day for direct reuse from their water reclamation facilities, but it is unclear what volume comes specifically from the NCWRF. Cary also operates a free bulk reclaimed water program at all three of its water reclamation facilities, including the NCWRF. Through this program, non-potable reclaimed water is available to approved customers in minimum volumes of 250 gallons per customer. The Town of Cary is permitted to provide a total of up to 600,000 gallons a day from its bulk systems; however, it is unclear what volume is produced from the NCWRF. Biosolids at the NCWRF are transported via truck to the South Cary Water Reclamation Facility, where they are dried and processed into Class A biosolids pellets using a thermal dryer (Town of Cary, 2019). The biosolids pellets are sold to the public and registered with the North Carolina Department of Agriculture and Consumer Services under the trade name Enviro Gems.

2.2.4 Climate

Morrisville AASF #1 is situated in central North Carolina, between mountains to the west and the Atlantic Ocean to the east. This particular location helps protect the facility from climate extremes (Cawthorn, 1970). Winters are mild and summers are hot and humid with plentiful rainfall throughout the year. Average temperatures range from 41.4 degrees Fahrenheit (°F) in January to 80.1°F in July. Average annual precipitation is 46.1 inches, with 5.11 inches falling in August and 2.72 falling in February. Raleigh averages 6.2 inches of snowfall per winter, with 3.3 inches accumulating in January (National Oceanic and Atmospheric Administration, 2020).

2.2.5 Current and Future Land Use

Morrisville AASF #1 is currently a controlled access facility and is adjacent to RDU. The facility supports rotary aircraft operations and is an Armory Readiness Center for the NCARNG. The facility is on North Carolina state property, which is controlled and operated by the DPS. Reasonably anticipated future land use is not expected to change from the current land use described here.

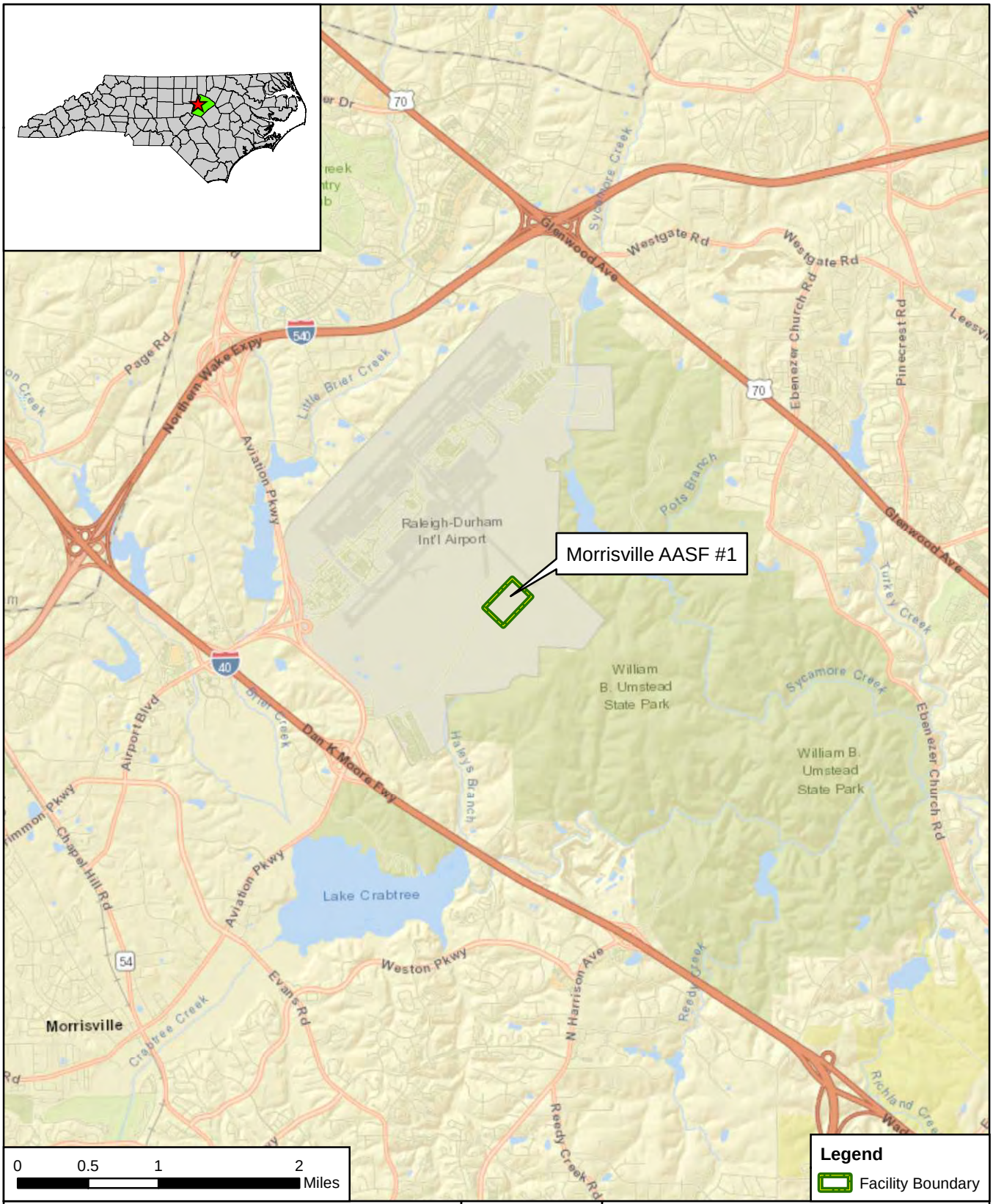
2.2.6 Sensitive Habitat and Threatened/ Endangered Species

The following amphibians, birds, clams, fishes, plants, insects, and mammals are federally endangered, threatened, proposed, and/ or are listed as candidate species in Wake County, North Carolina (US Fish and Wildlife Service [USFWS], 2022).

- **Amphibians:** Neuse River waterdog, *Necturus lewisi*, (threatened)
- **Birds**: Red-cockaded woodpecker, *Picoides borealis* (endangered)
- **Clams:** Tar River spinymussel, *Elliptio steinstansana* (endangered); Dwarf wedgemussel, *Alasmidonta heterodon* (endangered); Yellow lance, *Elliptio lanceolata* (threatened); Atlantic pigtoe, *Fusconaia masoni* (threatened); Green floater, *Lasmigona subviridis* (under review)
- **Fishes:** Carolina madtom, *Noturus furiosus* (endangered); Cape Fear shiner, *Notropis mekistocholas* (endangered)
- **Flowering plants:** Michaux's sumac, *Rhus michauxii* (endangered)
- **Insects:** Monarch butterfly, *Danaus plexippus* (candidate)
- **Mammals**: Little brown bat, *Myotis lucifugus* (under review); Tricolored bat, *Perimyotis subflavus* (under review)

2.3 History of PFAS Use

During the PA, eight potential release areas were identified: the Wash Rack Fire Training Area (FTA), Delta Row FTA, Hangar Leak Area, GSE Building Leak Area, GSE Building Temporary Tri-Max Storage, Firehouse Aqueous Film Forming Foam (AFFF) Storage Area, Firetruck Flush Area, and Long-Term Tri-Max Storage Area (AECOM, 2020). PFAS-containing AFFF may have been released during fire training activities at then Wash Rack and Delta Row FTAs; leaks from the AFFF dispensing system in the Hangar; AFFF storage in the GSE Building and Long-Term/Temporary Tri-Max Storage Areas; and AFFF releases during firetruck flushing and leaks at the Firehouse The potential release areas were grouped into five AOIs, based on proximity to one another and presumed groundwater flow. A description of AOI 1 through AOI 5 is presented in **Section 3**.



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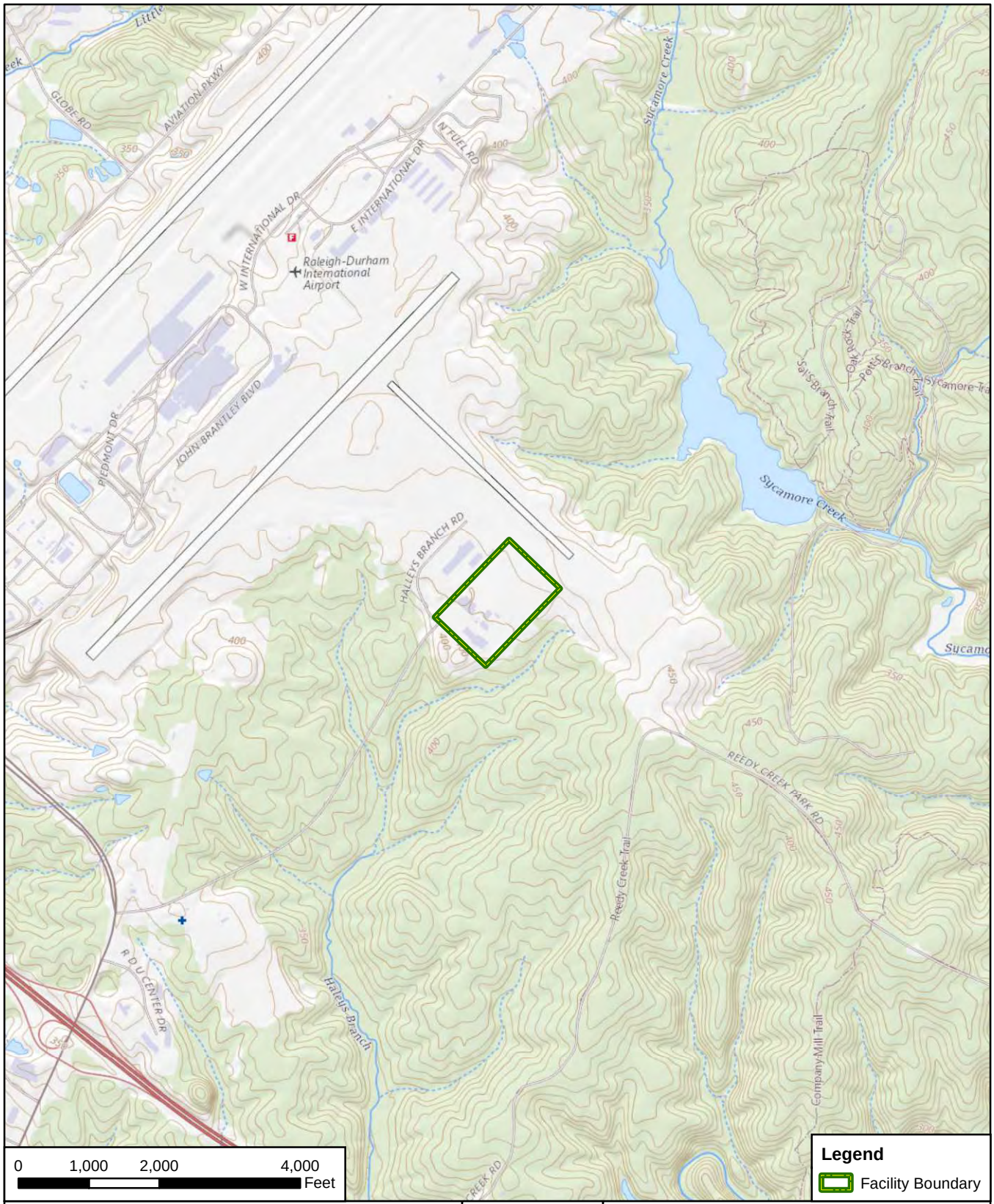
SCALE	1:63,360	CHK BY	MB	8/4/2022
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	8/4/2022

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1



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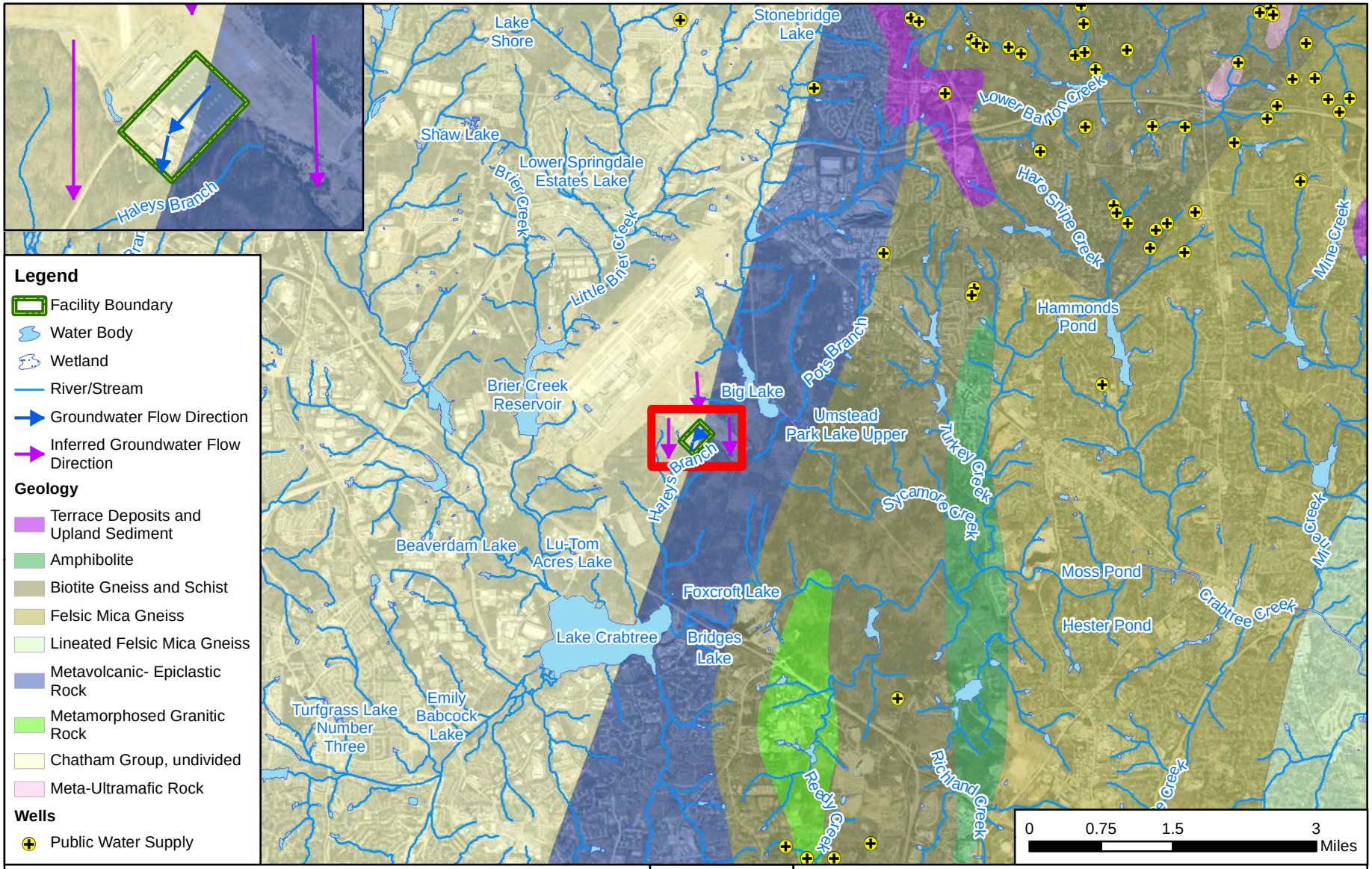
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program,		PM	CM	8/4/2022

Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2



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SCALE	1:95,040	CHK BY	MB	10/10/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	10/10/2022

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

Groundwater elevations in ft NAVD88.

* Location not inlcuded in groundwater elevation contours due to likely perched conditions on top of bedrock."

CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
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Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	10/20/2022

- Existing Monitoring Well
- Monitoring Well
- Facility Boundary
- Water Body
- River/Stream
- Utilities
- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction

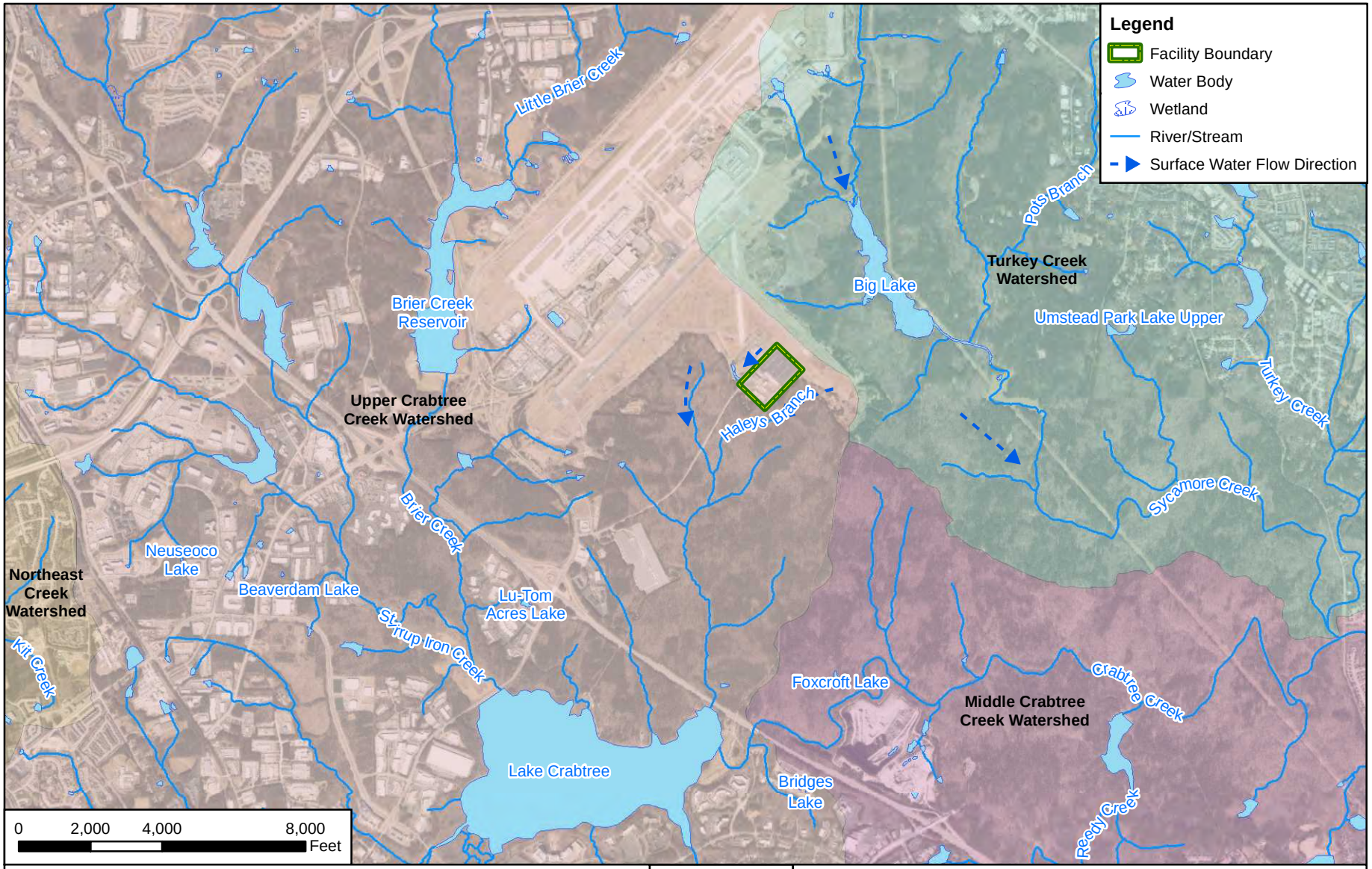
0 120 240 480 Feet

N

Groundwater Elevations, December 2021

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4



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Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/4/2022

TITLE

Surface Water Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

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3. Summary of Areas of Interest

The PA evaluated areas where PFAS-containing materials may have been used, stored, disposed, or released historically. Based on the PA findings, eight potential release areas were identified at Morrisville AASF #1 and grouped into five AOIs (AECOM, 2020). The potential release areas are shown on **Figure 3-1**.

3.1 AOI 1 Wash Rack and GSE Building

AOI 1 encompasses the Wash Rack Area, Temporary Tri-Max 30™ Storage Area, and GSE Building. The Wash Rack Area was an active FTA, with AFFF used from the 1990s until 2010. AFFF-related training was conducted approximately once every 2 years. The wash rack was also used as the designated area for filling and maintaining the Tri-Max 30™ carts. A single grated inlet in the center of the Wash Rack captures surface drainage which flows through the oil-water separator. The oil-water separator is then diverted to the Airport Authority's force main before transitioning to the sanitary sewer operated by the Town of Cary. During the AFFF-related activities within AOI 1, it is possible that AFFF was inadvertently released outside of the wash rack structure, where it would have drained into a stormwater inlet and discharged to Haleys Branch or infiltrated the surface soil near the Wash Rack Area.

The GSE Building, located to the west of the wash rack, contains a utility room housing a manual AFFF dispensing system, which has never been activated by either testing or servicing of the system. However, leaks and seepage have been observed from two of the system's pumps. The leaks were confined to the GSE Building utility room. It is unknown when or the duration in which these leaks and spills occurred. NCARNG employs absorbing socks and booms to protect the building's drainage system. In a separate room in the GSE Building, approximately 20 5-gallon buckets of Ansulite 3% AFFF were observed to be stored at the time of the PA. NCARNG has since indicated that all 5-gallon buckets of AFFF have since been removed from the facility for proper disposal. The storage room and utility room both contain floor drains that flow to an oil-water separator before flowing to the sanitary sewer system of the Town of Cary. Migration from the floor of the GSE building to the grass outside the door is possible. Surface runoff at AOI 1 drains via sheet flow toward the southwest.

3.2 AOI 2 Delta Row FTA

AOI 2 encompasses the long grassy area along Delta Row and was the targeted area for AFFF training with Tri-Max 30™ carts. The Delta Row FTA was active from the 1988 to 2010, with regular training occurring approximately once every 2 years. The RDU fire department trains along Delta Row with NCARNG on a regular basis to ensure they are properly trained to respond to helicopter emergencies to support NCARNG; during the training sessions, foam was never used. RDU spends a majority of the training sessions becoming familiar with the aircraft and completing building walk-throughs. The grassy area of the Delta Row FTA is also part of the facility's stormwater drainage system, with a series of inlet grates running parallel to the edge of the apron.

Surface water runoff at AOI 2 is captured by storm drains that channel flow southwest to several other stormwater conveyance pipes and is ultimately discharged to Haleys Branch through outfall SDO-001, which flows into Lake Crabtree and Crabtree Creek about 2 miles south before entering the Neuse River several miles downstream. As a result of AFFF releases at the Delta Row FTA, it is possible releases have been transported to Haleys Branch, Lake Crabtree, Crabtree Creek, and the Neuse River.

3.3 AOI 3 Firehouse AFFF Storage and Flush Area

AOI 3 encompasses the area inside the vehicle bay of the Firehouse, where AFFF is currently stored, and the adjacent area to the south, where one firetruck was flushed after an internal AFFF leak was discovered. At the time of the visual SI, 42 5-gallon buckets of 3% AFFF were stored along the eastern wall of the vehicle bay. These 5-gallon buckets have since been removed from the facility for proper disposal along with those from the GSE Building. The firetruck developed an internal backflow leak between the AFFF tank and the water tank. The AFFF leak was contained to the firetruck's water tank, but prior to its repair, the water tank was completely emptied onto the parking area located immediately outside the Firehouse vehicle bay.

Floor drains inside the Firehouse are routed to the oil/water separator before discharging to the sanitary sewer system of the Town of Cary. The water emptied from the leaking firetruck would have been conveyed to drains outside the vehicle bay that are part of the same stormwater drainage system associated with AOI 2. It is possible that the flushed water, which contained dilute concentrations of AFFF, also migrated to the surrounding surface soil to the south, beyond the impervious surfaces of the parking area.

3.4 AOI 4 Hangar

AOI 4 encompasses the Morrisville AASF #1 Hangar, which contains an actively charged AFFF dispensing system. Located on the floor in the center of each wall of the Hangar, Ansul AFFF pumps are connected to hand-reels and are currently charged with 35 gallons of 3% AFFF. The Ansul pump in the center of the southwestern wall developed a leak overnight in 2018. The volume of the leak was approximately 5 gallons and was confined to the area immediately surrounding the pump. Floor drains in the Hangar are routed to the oil/water separator before discharging to the sanitary sewer operated by the Town of Cary. It is possible, however, that AFFF also leached through the concrete floor and into the subsurface soil and groundwater.

3.5 AOI 5 Long-Term Tri-Max 30™ Storage Area

AOI 5 encompasses the Long-Term Tri-Max 30™ Storage Area on the gravel-covered ground north of the Morrisville AASF #1 Hangar, where Tri-Max 30™ carts are permanently stored. At the time of the PA, 12 empty Tri-Max 30™ carts were located in this storage area. The Tri-Max 30™ carts have been stored in their current location since 2009 with no known AFFF leaks or releases. NCARNG personnel have indicated that AFFF-containing Tri-Max 30™ carts remain at the facility; however, are scheduled to have their contents consolidated and removed for proper disposal in August 2023.

Surface water in the Long-Term Tri-Max 30™ Storage Area drains to the south, and a stormwater inlet grate is located immediately south of the Tri-Max 30™ carts. This stormwater grate is connected to the stormwater outfall near the western boundary of the facility, which drains to an unnamed tributary of Haleys Branch.

CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	9/13/2022	GIS BY	HO	9/13/2022
SCALE	1:3,600	CHK BY	MB	9/13/2022
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	9/13/2022

- Area of Interest
- Potential Release
- Facility Boundary
- Water Body
- River/Stream
- Surface Water Flow Direction
- Groundwater Flow Direction

N

Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

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4. Project Data Quality Objectives

As identified during the Data Quality Objective (DQO) process and outlined in the SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2021a), the objective of the SI is to identify whether there has been a release to the environment at the AOIs identified in the PA. For each AOI, ARNG determines if further investigation is warranted, a removal action is required to address immediate threats, or whether no further action is warranted. This SI evaluated groundwater and soil for presence or absence of relevant compounds at each of the sampled AOIs.

4.1 Problem Statement

ARNG will recommend an AOI for Remedial Investigation (RI) if related soil and groundwater samples have concentrations of the relevant compounds above the OSD risk-based SLs. The SLs are presented in **Section 6.1** of this report.

4.2 Information Inputs

Primary information inputs included:

- The PA for Morrisville AASF #1 (AECOM, 2020);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-QAPP Addendum (AECOM, 2021a); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-2**). 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). Temporal boundaries were limited to the late fall and early winter seasons, which was the earliest available time field resources were available to complete the study.

4.4 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the Department of Defense (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 within this document and decision rules as defined in the SI QAPP Addendum (AECOM, 2021a).

4.5 Data Usability Assessment

The Data Usability Assessment (DUA), which is provided in **Appendix A**, 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, 2019a; DoD, 2019b; USEPA, 2017).

Based on the DUA, the environmental data collected during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUA and its associated data validation reports. These data are of sufficient quality to meet the objectives and requirements of the SI QAPP Addendum (AECOM, 2021a).

5. 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 implemented in accordance with the following approved documents:

- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP)* dated March 2018 (AECOM, 2018a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b);
- *Final Preliminary Assessment Report, Morrisville Army Aviation Support Facility #1, North Carolina* dated August 2020 (AECOM, 2020);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Morrisville Army Aviation Support Facility #1, North Carolina* dated September 2021 (AECOM, 2021a); and
- *Final Site Safety and Health Plan, Morrisville Army Aviation Support Facility #1, North Carolina* dated November 2021 (AECOM, 2021b).

The SI field activities were conducted from 2 to 30 December 2021 and consisted of utility clearance, sonic soil boring drilling, soil sample collection, permanent monitoring well installation, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a).

The following samples were collected during the SI and analyzed for a subset of 18 compounds by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table B-15 to fulfill the project DQOs:

- Twenty (20) soil samples from 14 boring locations;
- Six groundwater samples from six newly installed permanent monitoring wells;
- Two groundwater samples from two existing permanent monitoring wells; and
- Twenty (20) quality assurance (QA)/quality control (QC) samples.

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**. Sampling forms are provided in **Appendix B2**, Well Development Forms are provided in **Appendix B3**, and land survey data are provided in **Appendix B4**. 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 for each of these activities are presented below.

5.1.1 Technical Project Planning

The US Army Corps of Engineers (USACE) TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 2016) 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 DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 3 June 2021, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI include the ARNG, NCARNG, USACE, NCDEQ, and RDU. 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, 2021a).

A TPP Meeting 3 will be scheduled to discuss the results of the SI. Meeting minutes for TPP 3 will be included in **Appendix D** of this report. Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

AECOM's drilling subcontractor, Cascade Technical Services, LLC. placed a ticket with the North Carolina 811 utility clearance provider to notify them of intrusive work on 23 November 2021. Additionally, AECOM contracted Ground Penetrating Radar Systems (GPRS), a private utility location service, to perform utility clearance. GPRS performed utility clearance of the proposed boring locations on 2 December 2021 with input from the AECOM field team and Morrisville AASF #1 facility staff. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 feet 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 Sampling Equipment Acceptability

A potable water source at Morrisville AASF #1 was sampled on 14 April 2021 to assess usability for decontamination of drilling equipment. Because it had been over 6 months since the first potable water source sample (MA-DECON) was collected, another sample was collected on 22 December 2021 (MA-PW-02). Results of both samples collected confirmed this source to be acceptable for use in this investigation; therefore, it was used throughout the field activities. Specifically, the samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15. The results of the decontamination water sample associated with the source used during the SI are provided in **Appendix F**. A discussion of the results is presented in the DUA (**Appendix A**).

Materials that were used within the sampling zone were confirmed as acceptable for use in the sampling environment. The checklist of acceptable materials for use in the sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2021a). Prior to the start of field work each day, a 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

Borings were installed in grass or unpaved areas where possible, to avoid disturbing concrete or asphalt surfaces. Soil samples were collected via Sonic drilling methods, in accordance with the SI QAPP Addendum (AECOM, 2021a). A Terra Sonic TSI 150CC 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 feet of the boring, in accordance with AECOM utility clearance procedures. The soil boring locations are shown on **Figure 5-1**, and depths are provided **Table 5-2**.

In general, three discrete soil samples were collected from the vadose zone for chemical analysis from each soil boring: one surface soil sample (0 to 2 feet bgs), one subsurface soil sample approximately 1 foot above the groundwater table, and one subsurface soil sample at the mid-point between the surface and the groundwater table, if the depth to water was up to 30 feet bgs or shallower, or from 13 to 15 feet bgs. However, only two soil samples were collected from locations AOI01-01, MA-01, MA-02, MA-03 and MA-04 due to the presence of conglomerate rock in the interval above the water table. Additionally, only one soil sample (0 to 2 feet bgs) was collected from location AOI01-02 as the area was inaccessible by the drill rig due to space constraints. Multiple attempts were made to collect subsurface soil samples at AOI01-02 via hand auger; however, gravel was repeatedly encountered at approximately 2 feet bgs.

The soil cores were continuously logged for lithological descriptions by an AECOM 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**.

Soil borings completed during the SI found low to high plasticity fines with varying levels of sand as the dominant lithology of the unconsolidated sediments below Morrisville AASF #1. The borings were completed at depths between 40 and 80 feet bgs. Below the unconsolidated sediments various rock layers were observed including conglomerate, sandstone, siltstone, granite, and felsic schist. Rock was first encountered at various depths ranging from 5 feet bgs to 30 feet bgs. These observations are consistent with the understood depositional environment of the region.

Each soil 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 by LC/MS/MS compliant with QSM 5.3 Table B-15, total organic carbon (TOC) (USEPA Method 9060A), pH (USEPA Method 9045D), and grain size (ASTM Method D-422) in accordance with the SI QAPP Addendum (AECOM, 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS)/MS duplicates (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 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 6 degrees Celsius during shipment.

Soil borings were converted to permanent monitoring wells. This conversion is described in **Section 5.3** below.

5.3 Permanent Well Installation and Groundwater Sampling

During the SI, six permanent monitoring wells were installed within or downgradient of potential source areas. The locations of the wells are shown on **Figure 5-1**.

A Terra Sonic Crawler TSi 150CC drill rig was used to install six 2-inch diameter monitoring wells. The monitoring wells were constructed with Schedule 40 polyvinyl chloride, flush threaded 10-foot sections of riser, 10-foot section of 0.010-inch slotted well screen, and a threaded bottom cap. A filter pack of 20/40 silica sand was installed in the annulus around the well screen to a minimum of 4-feet above the well screen. A 5-foot-thick bentonite seal was placed above the filter

sand and hydrated with distilled water. Bentonite grout was placed in the well annulus from the top of the bentonite seal to ground surface. The bentonite grout was allowed to set for 24 hours prior to well completion in accordance with the SI QAPP Addendum (AECOM, 2021a). All monitoring wells were completed with flush mount well vaults. The screen interval of each of the groundwater monitoring wells is provided in **Table 5-2**.

Well screens were constructed to bracket the surficial water table based on lithology and field conditions as interpreted by the on-site field geologists. Rotary sonic drilling methods require the introduction of drilling fluids (potable water) to the borehole for lubrication and cooling during coring. Adding water to the borehole makes it difficult to determine the precise elevation at which groundwater is first encountered. Techniques such as packer testing, where the borehole was sealed and subsequently purged dry to monitor for potential groundwater recharge, were implemented to assist in determining natural groundwater elevation during well installation. Additionally, there is potential that formational groundwater at some of the monitoring well locations could be under pressure and is pushing up into the well and reflecting a submerged screen.

Development and sampling of wells was completed in accordance with the SI QAPP Addendum (AECOM, 2021a). The newly installed monitoring wells were developed no sooner than 24 hours following installation by pumping and surging using a variable speed submersible pump. Samples were collected no sooner than 24 hours following development via low-flow sampling methods using a QED Sample Pro® bladder pump with disposable, PFAS-free, HDPE tubing. New tubing was used at each well, and the pumps were decontaminated between each well. The wells were purged at a rate determined in the field to reduce draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Water levels were measured to the nearest 0.01 inch and recorded. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to identify if there were 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 by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2021a).

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 was collected in accordance with the PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 °C during shipment.

5.4 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 30 December 2021. Groundwater elevation measurements were collected from the six new temporary monitoring wells and two existing monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-4**. Groundwater elevation data are provided in **Table 5-2**.

5.5 Surveying

The northern side of each well casing was surveyed by North Carolina-licensed land surveyors following guidelines provided in the SOPs provided in the SI QAPP Addendum (AECOM, 2021a).

Survey data from the newly installed wells on the facility were collected on 30 December 2021 in the applicable Universal Transverse Mercator zone projection with North American Datum of 1983 (horizontal) and North American Vertical Datum 1988 (vertical). The surveyed well data are provided in **Appendix B4**.

5.6 Investigation-Derived Waste

As of the date of this report, the disposal of investigation-derived waste (IDW) is not regulated federally. IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the SI QAPP Addendum (AECOM, 2021a) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018b).

Soil IDW (i.e., soil cuttings) generated during the SI activities were contained in labeled, 55-gallon drums and left onsite in a designated waste storage area. The soil IDW was not sampled and assumes the characteristics of the associated soil samples collected from that source location. Based on laboratory results, containerized soil cuttings will be managed and disposed by ARNG, under a separate contract held by EA Engineering, Science, and Technology, Inc. (EA). EA will distribute the soil on the downgradient side of the associated borehole.

Liquid IDW generated during SI activities (i.e., purge water, development water, and decontamination fluids) were contained in labeled, 55-gallon drums, and left onsite in a designated waste storage area. The liquid IDW was not sampled and assumes the characteristics of the associated groundwater samples collected from that source location. Based on laboratory results, containerized liquid IDW will be managed and disposed by ARNG under a separate contract for Treating Liquid Investigation-Derived Material (Purge water, drilling water, and decontamination fluids) (EA, 2021).

Other solids such as spent personal protective equipment, 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 by LC/MS/MS compliant with QSM 5.3 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.8 Deviations from SI QAPP Addendum

No deviations from the SI QAPP Addendum were identified during review of the field documentation.

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Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Salisbury AASF #2, North Carolina

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Soil Samples							
AOI01-01-SB-00-02	12/14/2021 10:30	0-2	x				
AOI01-01-SB-13-15	12/16/2021 13:00	13-15	x			x	
AOI01-02-SB-00-02	12/7/2021 8:20	0-2	x	x	x		
AOI01-02-SB-00-02D	12/7/2021 8:20	0-2		x	x		FD
AOI01-02-SB-00-02-MS	12/7/2021 8:20	0-2		x	x		MS
AOI01-02-SB-00-02-MSD	12/7/2021 8:20	0-2		x	x		MSD
AOI01-03-SB-00-02	12/6/2021 15:00	0-2	x				
AOI01-04-SB-00-02	12/6/2021 16:40	0-2	x				
AOI01-05-SB-00-02	12/10/2021 11:50	0-2	x				
AOI02-01-SB-00-02	12/16/2021 9:30	0-2	x	x	x		
AOI02-01-SB-00-02-D	12/16/2021 9:30	0-2	x				FD
AOI02-01-SB-08-10	12/16/2021 11:30	8-10				x	
AOI02-01-SB-13-15	12/16/2021 11:40	13-15	x				
AOI02-02-SB-00-02	12/7/2021 15:00	0-2	x				
AOI03-01-SB-00-02	12/6/2021 13:30	0-2	x	x	x		
AOI04-01-SB-00-02	12/6/2021 14:15	0-2	x	x	x		
AOI05-01-SB-00-02	12/7/2021 13:35	0-2	x	x	x		
MA-01-SB-00-02	12/6/2021 12:30	0-2	x				
MA-01-SB-00-02MS	12/6/2021 12:30	0-2	x				MS
MA-01-SB-00-02MSD	12/6/2021 12:30	0-2	x				MSD
MA-01-SB-11-13	12/6/2021 13:30	11-13	x				
MA-02-SB-00-02	12/9/2021 12:30	0-2	x				
MA-02-SB-00-02MS	12/9/2021 12:30	0-2	x				MS
MA-02-SB-00-02MSD	12/9/2021 12:30	0-2	x				MSD
MA-02-SB-03-05	12/9/2021 12:45	3-5	x				
MA-03-SB-00-02	12/7/2021 16:00	0-2	x				
MA-03-SB-00-02-D	12/7/2021 16:00	0-2	x				FD
MA-03-SB-13-15	12/7/2021 16:55	13-15	x	x	x		
MA-04-SB-00-02	12/9/2021 15:45	0-2	x				
MA-04-SB-02-04	12/9/2021 16:15	2-4	x				
Groundwater Samples							
AOI01-01-GW	12/30/2021 14:35	NA	x				
AOI02-01-GW	12/30/2021 12:55	NA	x				
AOI02-01-GW-D	12/30/2021 12:55	NA	x				FD
AOI03-MW-DEEP-GW	12/7/2021 12:40	NA	x				
AOI03-MW-SHALLOW-GW	12/7/2021 10:25	NA	x				
MA-01-GW	12/14/2021 14:15	NA	x				
MA-01-GW-MS	12/14/2021 14:15	NA	x				MS
MA-01-GW-MSD	12/14/2021 14:15	NA	x				MSD
MA-02-GW	12/30/2021 15:45	NA	x				
MA-03-GW	12/13/2021 14:50	NA	x				
MA-04-GW	12/30/2021 10:35	NA	x				
Quality Control Samples							
MA-DECON	4/14/2021 11:10	NA	x				Decon water source
MA-FRB-04142021	4/14/2021 11:15	NA	x				
MA-FRB-01	12/8/2021 13:30	NA	x				
MA-ERB-01	12/7/2021 14:20	NA	x				Hand Auger
MA-ERB-02	12/9/2021 12:00	NA	x				
MA-ERB-03	12/7/2021 11:00	NA	x				Bladder Pump
MA-ERB-04	12/30/2021 16:10	NA	x				Bladder Pump
MA-PW-02	12/22/2021 8:30	NA	x				

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Salisbury AASF #2, North Carolina

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments

Notes:

AASF = Army Aviation Support Facility
AOI = Area of Interest
ASTM = American Society for Testing and Materials
bgs = below ground surface
D = duplicate
DECON = decon water source
ERB = equipment rinsate blank
FD = field duplicate
FRB = field reagent blank
GW = groundwater
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MA = Morrisville AASF
MS/MSD = matrix spike/ matrix spike duplicate
MW = monitoring well
NA = not applicable
pH = potential for hydrogen
PW = potable water
QSM = Quality Systems Manual
SB = soil boring
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Soil Boring Depths, Permanent Monitoring Well Screen Intervals, and Groundwater Elevations
Site Inspection Report, Salisbury AASF #2, North Carolina

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)	Permanent Well Screen Interval (feet bgs)	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)
Boundary	MA-01	60	49 - 59	402.03	402.30	5.76	6.03	396.27
	MA-02	40	29 - 39	389.59	389.97	33.51	33.89	356.08
	MA-03	50	39 - 49	398.12	398.36	23.47	23.71	374.65
	MA-04	80	69 - 79	392.77	393.05	34.25	34.53	358.52
1	AOI01-01	60	49 - 59	399.73	400.11	13.12	13.50	386.61
2	AOI02-01	40	29 - 39	399.92	400.09	10.21	10.38	389.71
3	AOI03-MW-Shallow	NA	4.5 - 9.5	395.00	395.28	6.45	6.73	388.55
3	AOI03-MW-Deep	NA	41.3 - 51.3	395.15	395.42	36.02	36.29	359.13

Notes:
Permanent well screen set above total depth to capture groundwater interface

AASF = Army Aviation Support Facility
AOI = Area of Interest
bgs = below ground surface
btoc = below top of casing
MA = Morrisville AASF
MW = monitoring well
NAVD88 = North American Vertical Datum 1988

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CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	9/13/2022	GIS BY	MS	9/13/2022
SCALE	1:2,880	CHK BY	MB	9/13/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/13/2022

- Existing Monitoring Well
- Monitoring Well
- Surface Soil Sample
- Facility Boundary
- Water Body
- River/Stream
- Utilities
- Surface Water Flow Direction
- Groundwater Flow Direction

N

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

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6. Site Inspection Results

This section presents the analytical results of the SI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for each AOI is provided in **Section 6.3** through **Section 6.7**. **Tables 6-2** through **Table 6-4** present results in soil or groundwater for the relevant compounds. 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 6 July 2022 (Assistant Secretary of Defense, 2022). 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 the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1** below.

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

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

The data in the subsequent sections are compared against the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion. The SLs for soil are based on incidental ingestion and are applied to the depth intervals reasonably anticipated to be encountered by the receptors identified at the facility: the residential scenario is applied to surface soil results (0 to 2 feet bgs) and the industrial/commercial worker scenario is applied to shallow subsurface soil results (2 to 15 feet bgs). The SLs are not applied to deep subsurface soil results (>15 feet bgs) because 15 feet is the anticipated limit of construction activities.

6.2 Soil Physicochemical Analyses

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

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport. According to the Interstate Technology Regulatory Council (ITRC), several important 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

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1: Wash Rack Area and GSE Building. The soil and groundwater results are summarized on **Table 6-2** through **Table 6-4**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.3.1 AOI 1 Soil Analytical Results

Table 6-2 and **Table 6-3** summarize the soil results. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI01-01 through AOI01-05. Soil was also sampled from shallow subsurface soil (13 to 15 feet bgs) from boring location AOI01-01. PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at concentrations below their respective SLs. The maximum concentrations detected were PFOA at 3.90 micrograms per kilogram (µg/kg); PFOS at 6.67 µg/kg; PFHxS at 3.34 µg/kg; PFNA at 3.56 µg/kg; and PFBS at 0.097 J µg/kg.

PFHxS and PFBS were detected in shallow subsurface soil at concentrations below their respective SLs. PFHxS was detected at location AOI01-01, with a concentration of 0.101 J µg/kg. PFBS was detected at location AOI01-01, with a concentration of 0.039 J µg/kg. PFOA, PFOS, and PFNA were not detected in shallow subsurface soil.

Soil was also sampled from surface soil (0 to 2 feet bgs) at the facility boundary locations MA-02 and MA-04, which are downgradient of AOI 1. Soil was also sampled from shallow subsurface soil with intervals of 2 to 4 feet bgs (MA-04) and 3 to 5 feet bgs (MA-02). PFOA, PFOS, and PFHxS were detected in surface soil at concentrations below their respective SLs. The maximum concentrations detected were PFOA at 0.156 J µg/kg; PFOS at 0.246 J µg/kg; and PFHxS at 0.114 J µg/kg. PFNA and PFBS were not detected in surface soil at either location. PFOS was detected in shallow subsurface soil below the SL with a maximum concentration of 0.074 J µg/kg. PFOA, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil at either location.

6.3.2 AOI 1 Groundwater Analytical Results

Table 6-4 summarizes the groundwater results. **Figure 6-6** and **Figure 6-7** present the ranges of detections in groundwater.

Groundwater was sampled from permanent monitoring well AOI01-01. PFHxS was detected above the SL of 39 nanograms per liter (ng/L), with a concentration of 73.3 ng/L. PFOA and PFBS were detected in groundwater at concentrations below their respective SLs at a concentration of 4.76 ng/L and 32.9 ng/L, respectively. PFOS and PFNA were not detected in groundwater at AOI01-01.

Groundwater was also sampled from permanent monitoring wells MA-02 and MA-04, which are downgradient of AOI 1. PFOS and PFNA were not detected in groundwater at either location. PFOA and PFHxS were detected in groundwater, at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOA was detected below the SL at location MA-02, with a concentration of 0.816 J ng/L. PFOS, PFHxS, PFNA, and PFBS were not detected in groundwater.
- PFOA was detected above the SL of 6 ng/L at location MA-04, with a concentration of 6.91 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 42.0 ng/L. PFBS was detected below the SL, with a concentration of 5.05 ng/L. PFOS and PFNA were not detected in groundwater.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil below their respective SLs. PFOA and PFHxS were detected in groundwater, at concentrations above their respective SLs at AOI01-01 and MA-04, downgradient of AOI 1. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 1 is warranted.

6.4 AOI 2

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2: Delta Row FTA. The results in soil and groundwater are summarized on **Table 6-2** through **Table 6-4**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.4.1 AOI 2 Soil Analytical Results

Table 6-2 and **Table 6-3** summarize the soil results. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI02-01 and AOI02-02. Soil was also sampled from shallow subsurface soil (13 to 15 feet bgs) from boring location AOI02-01. PFOA and PFNA were detected in surface soil at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOA was detected below the SL at location AOI02-01, with a concentration of 0.435 J µg/kg. PFNA was detected below the SL at location AOI02-01, with a concentration of 0.882 J µg/kg.
- PFOA was detected above the SL of 19 µg/kg at AOI02-02, with a concentration of 32.5 µg/kg. PFNA was detected above the SL of 19 µg/kg, with a concentration of 57.3 µg/kg.

PFOS, PFHxS, and PFBS were detected in surface soil at concentrations below their respective SLs at both locations AOI02-01 and AOI02-02. All concentrations were below 6 µg/kg. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil.

Soil was also sampled from surface soil (0 to 2 feet bgs) and shallow subsurface soil (3 to 5 feet bgs) at the facility boundary location MA-02, which is downgradient of AOI 2. PFOA, PFOS, and PFHxS were detected in surface soil, at concentrations below their respective SLs. All

concentrations were below 1 J µg/kg. PFNA and PFBS were not detected in surface soil at location MA-02. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil at location MA-02.

6.4.2 AOI 2 Groundwater Analytical Results

Table 6-4 summarizes the groundwater results. **Figure 6-6** and **Figure 6-7** present the ranges of detections in groundwater.

Groundwater was sampled from permanent monitoring well AOI02-01. PFOA was detected above the SL of 6 ng/L, with a maximum concentration of 7.96 ng/L in the field duplicate sample (AOI02-01-GW-D). PFHxS and PFBS were detected in groundwater at concentrations below their respective SLs, with maximum concentrations in the field duplicate sample of 37.2 ng/L and 7.49 ng/L, respectively. PFOS and PFNA were not detected in groundwater at AOI02-01.

Groundwater was also sampled from the permanent monitoring well MA-02, which is downgradient of AOI 2. PFOA was detected below the SL of 6 ng/L, with a concentration of 0.816 J ng/L. PFOS, PFHxS, PFNA, and PFBS were not detected in groundwater at location MA-02.

6.4.3 AOI 2 Conclusions

Based on the results of the SI, PFOA and PFNA were detected in soil at concentrations above their respective SLs. PFOA was detected in groundwater at concentrations above its respective SL. Based on the exceedances of the SLs in soil and groundwater, further evaluation at AOI 2 is warranted.

6.5 AOI 3

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 3: Firehouse AFFF Storage and Firetruck Flush Areas. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-4**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.5.1 AOI 3 Soil Analytical Results

Table 6-2 and **Table 6-3** summarize the soil results. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring location AOI03-01. PFOA, PFOS, PFHxS, PFNA, and PFBS were detected at concentrations below their respective SLs in surface soil. The maximum concentrations detected were PFOA at 0.232 J µg/kg; PFOS at 1.59 µg/kg; PFHxS at 0.133 J µg/kg; PFNA at 0.344 J µg/kg; and PFBS at 0.026 J µg/kg.

Soil was also sampled from surface soil (0 to 2 feet bgs) at the facility boundary locations MA-02 and MA-04, which are downgradient of AOI 3. Soil was also sampled from shallow subsurface soil with intervals of 2 to 4 feet bgs (MA-04) and 3 to 5 feet bgs (MA-02). PFOA, PFOS, and PFHxS were detected in surface soil, at concentrations below their respective SLs. The maximum concentrations detected were PFOA at 0.156 J µg/kg; PFOS at 0.246 J µg/kg; PFHxS at 0.114 J µg/kg. PFNA and PFBS were not detected in surface soil at either location. PFOS was detected in shallow subsurface soil below the SL at 0.074 J µg/kg. PFOA, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil at either location.

6.5.2 AOI 3 Groundwater Analytical Results

Table 6-4 summarizes the groundwater results. **Figure 6-6** and **Figure 6-7** present the ranges of detections in groundwater.

Groundwater was sampled from existing monitoring wells AOI03-MW-Deep and AOI03-MW-Shallow. PFOA, PFOS, and PFHxS were detected in groundwater, at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOA was detected above the SL of 6 ng/L AOI03-MW-Shallow, with a concentration of 80.0 ng/L. PFOS was detected above the SL of 4 ng/L, with a concentration of 316 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 1,620 ng/L. PFNA and PFBS were detected in groundwater at concentrations below their respective SLs. PFNA was detected at 2.95 J ng/L and PFBS was detected at 534 ng/L.
- PFOA was detected above the SL of 6 ng/L at AOI03-MW-Deep with a concentration of 27.3 ng/L. PFOS was detected above the SL of 4 ng/L, with a concentration of 90.5 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 406 ng/L. PFNA and PFBS were detected in groundwater at concentrations below their respective SLs. PFNA was detected at 1.48 J ng/L and PFBS was detected at 145 ng/L.

Groundwater was also sampled from permanent monitoring wells MA-02 and MA-04, which are downgradient of AOI 3. PFOS and PFNA were not detected in groundwater at either location. PFOA and PFHxS were detected in groundwater, at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOA was detected below the SL at location MA-02, with a concentration of 0.816 J ng/L. PFOS, PFHxS, PFNA, and PFBS were not detected in groundwater.
- PFOA was detected above the SL of 6 ng/L at location MA-04, with a concentration of 6.91 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 42.0 ng/L. PFBS was detected below the SL, with a concentration of 5.05 ng/L. PFOS and PFNA were not detected in groundwater.

6.5.3 AOI 3 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil at concentrations below their respective SLs. PFOA, PFOS, and PFHxS were detected in groundwater at concentrations above their respective SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 3 is warranted.

6.6 AOI 4

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 4: Hangar. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-4**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.6.1 AOI 4 Soil Analytical Results

Table 6-2 and **Table 6-3** summarize the soil results. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring location AOI04-01. PFOA, PFOS, PFHxS, and PFNA were detected at concentrations below their respective SLs in surface soil. PFOA was detected at a concentration of 1.52 µg/kg. PFOS was detected at a concentration of

10.9 µg/kg. PFHxS was detected at a concentration of 0.203 J µg/kg. PFNA was detected at a concentration of 4.52 µg/kg. PFBS was not detected at location AOI04-01.

Soil was also sampled from surface soil (0 to 2 feet bgs) at the facility boundary locations MA-01 and MA-03. Soil sample MA-01 was upgradient of AOI 4 and MA-03 was downgradient of AOI 4. Soil was also sampled from shallow subsurface soil with intervals of 11 to 13 feet bgs (MA-01) and 13 to 15 feet bgs (MA-03). PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at concentrations below their respective SLs. The maximum concentrations detected were PFOA at 0.233 J µg/kg; PFOS at 6.79 µg/kg; PFHxS at 2.96 J µg/kg; PFNA at of 0.040 J µg/kg; and PFBS was detected at 0.041 J µg/kg. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil at either location.

6.6.2 AOI 4 Groundwater Analytical Results

Table 6-4 summarizes the groundwater results. **Figure 6-6** and **Figure 6-7** present the ranges of detections in groundwater.

Groundwater was sampled from permanent monitoring wells MA-01 and MA-03. Monitoring well MA-01 is upgradient of AOI 4, and MA-03 is downgradient of AOI 4. PFOA, PFOS, and PFHxS were detected in groundwater at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOS was detected above the SL of 4 ng/L at location MA-01, with a concentration of 5.40 ng/L. PFOA was detected below the SL of 6 ng/L, with a concentration of 1.28 J ng/L. PFHxS was detected below the SL, with a concentration of 8.10 ng/L. PFBS was detected below the SL, with a concentration of 1.80 J ng/L. PFNA was not detected in groundwater.
- PFOA was detected above the SL of 6 ng/L at location MA-03, with a concentration of 14.1 ng/L. PFOS was detected above the SL of 4 ng/L, with a concentration 31.9 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 109 ng/L. PFBS was detected below the SL with a concentration of 23.9 ng/L. PFNA was not detected in groundwater.

6.6.3 AOI 4 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, and PFNA were detected at concentrations below their respective SLs in surface soil. PFOS was detected in groundwater at a concentration above its respective SL at location MA-01, upgradient of AOI 4. PFOA, PFOS, and PFHxS, were detected in groundwater at concentrations above their respective SLs at location MA-03, downgradient of AOI 4. Based on the exceedances of the SLs groundwater at locations upgradient and downgradient of AOI 4, further evaluation at AOI 4 is warranted.

6.7 AOI 5

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 5: Long-Term Tri-Max 30™ Storage Area. The results in soil and groundwater are presented in **Table 6-2** through **Table 6-4**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.7.1 AOI 5 Soil Analytical Results

Table 6-2 and **Table 6-3** summarize the soil results. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring location AOI05-01. PFOA, PFOS, PFHxS, and PFNA were detected at concentrations below their respective SLs in surface soil. The maximum concentrations detected were PFOA at 0.646 J µg/kg; PFOS at 0.695 J µg/kg; PFHxS at 0.122 J µg/kg; and PFNA at 1.22 J µg/kg. PFBS was not detected at location AOI05-01.

Soil was also sampled from surface soil (0 to 2 feet bgs) at the facility boundary locations MA-01 and MA-03. Soil sample MA-01 was upgradient of AOI 5 and MA-03 was downgradient of AOI 5. Soil was also sampled from shallow subsurface soil with intervals of 11 to 13 feet bgs (MA-01) and 13 to 15 feet bgs (MA-03). PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at concentrations below their respective SLs. The maximum concentrations detected were PFOA at 0.233 J µg/kg; PFOS at 6.79 µg/kg; PFHxS at 2.96 J µg/kg; PFNA at of 0.040 J µg/kg; and PFBS was detected at 0.041 J µg/kg. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in shallow subsurface soil at either location.

6.7.2 AOI 5 Groundwater Analytical Results

Table 6-4 summarizes the groundwater results. **Figure 6-6** and **Figure 6-7** present the ranges of detections in groundwater.

Groundwater was sampled from permanent monitoring wells MA-01 and MA-03. Monitoring well MA-01 is upgradient of AOI 5, and MA-03 is downgradient of AOI 5. PFOA, PFOS, and PFHxS were detected in groundwater at concentrations above their respective SLs. The maximum concentrations detected are as follows:

- PFOS was detected above the SL of 4 ng/L at location MA-01, with a concentration of 5.40 ng/L. PFOA was detected below the SL, with a concentration of 1.28 J ng/L. PFHxS was detected below the SL, with a concentration of 8.10 ng/L. PFBS was detected below the SL, with a concentration of 1.80 J ng/L. PFNA was not detected in groundwater.
- PFOA was detected above the SL of 6 ng/L at location MA-03, with a concentration of 14.1 ng/L. PFOS was detected above the SL of 4 ng/L with a concentration 31.9 ng/L. PFHxS was detected above the SL of 39 ng/L, with a concentration of 109 ng/L. PFBS was detected below the SL a concentration of 23.9 ng/L. PFNA was not detected in groundwater.

6.7.3 AOI 5 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, and PFNA were detected at concentrations below their respective SLs in surface soil. PFOS was detected in groundwater, at a concentration above its SL at location MA-01, upgradient of AOI 5. PFOA, PFOS, and PFHxS, were detected in groundwater at concentrations above their respective SLs at location MA-03, downgradient of AOI 5. Based on the exceedances of the SLs groundwater at locations upgradient and downgradient of AOI 5, further evaluation at AOI 5 is warranted.

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Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Morrisville AASF #1

Area of Interest		AOI01										AOI02						AOI03		AOI04	
Sample ID		AOI01-01-SB-00-02		AOI01-02-SB-00-02		AOI01-03-SB-00-02		AOI01-04-SB-00-02		AOI01-05-00-02		AOI02-01-SB-00-02		AOI02-01-SB-00-02-D		AOI02-02-SB-00-02		AOI03-01-SB-00-02		AOI04-01-SB-00-02	
Sample Date		12/14/2021		12/07/2021		12/06/2021		12/06/2021		12/10/2021		12/16/2021		12/16/2021		12/07/2021		12/06/2021		12/06/2021	
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		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**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	ND	U	0.056	J	0.027	J	0.054	J	0.097	J	0.084	J	ND	UJ	0.045	J	0.026	J	ND	U
PFHxS	130	0.077	J	1.37		0.164	J	3.34		1.14		0.896	J	0.061	J	0.340	J	0.133	J	0.203	J
PFNA	19	ND	U	3.56		0.133	J	0.802	J	0.636	J	0.882	J	ND	U	57.3		0.344	J	4.52	
PFOA	19	ND	U	3.78		ND	U	3.90		0.970	J	0.435	J	ND	UJ	32.5		0.232	J	1.52	
PFOS	13	0.239	J	3.40		2.52		1.57		6.67		5.31	J	0.072	J	2.03		1.59		10.9	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
MA	Morrisville AASF #1
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

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Morrisville AASF #1

Area of Interest		AOI05		Facility Boundary									
Sample ID		AOI05-01-SB-00-02		MA-01-SB-00-02		MA-02-SB-00-02		MA-03-SB-00-02		MA-03-SB-00-02-D		MA-04-SB-00-02	
Sample Date		12/07/2021		12/06/2021		12/09/2021		12/07/2021		12/07/2021		12/09/2021	
Depth		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**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)													
PFBS	1900	ND	U	0.041	J	ND	U	ND	U	ND	U	ND	U
PFHxS	130	0.122	J	0.207	J	0.114	J	0.221	J	0.296	J	ND	U
PFNA	19	1.22	J	ND	U	ND	U	0.040	J	0.035	J	ND	U
PFOA	19	0.646	J	ND	U	0.156	J	0.209	J	0.233	J	ND	U
PFOS	13	0.695	J	0.323	J+	0.246	J	6.79		6.54		0.098	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
MA	Morrisville AASF #1
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

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Morrisville AASF #1

Area of Interest		AOI01		AOI02		Facility Boundary							
Sample ID		AOI01-01-SB-13-15		AOI02-01-SB-13-15		MA-01-SB-11-13		MA-02-SB-03-05		MA-03-SB-13-15		MA-04-SB-02-04	
Sample Date		12/16/2021		12/16/2021		12/06/2021		12/09/2021		12/07/2021		12/09/2021	
Depth		13-15 ft		13-15 ft		11-13 ft		3-5 ft		13-15 ft		2-4 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)													
PFBS	25000	0.039	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFHxS	1600	0.101	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFNA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	ND	U	ND	U	ND	U	ND	U	ND	U	0.074	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
MA	Morrisville AASF #1
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

Table 6-4
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Morrisville AASF #1

	Area of Interest	AOI01		AOI02				AOI03				Facility Boundary							
	Sample ID	AOI01-01-GW		AOI02-01-GW		AOI02-01-GW-D		AOI03-MW-DEEP-GW		AOI03-MW-SHALLOW-GW		MA-01-GW		MA-02-GW		MA-03-GW		MA-04-GW	
	Sample Date	12/30/2021		12/30/2021		12/30/2021		12/07/2021		12/07/2021		12/14/2021		12/30/2021		12/13/2021		12/30/2021	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)																			
PFBS	601	32.9		6.62		7.49		145		534		1.80	J	ND	U	23.9		5.05	
PFHxS	39	73.3		32.4		37.2		406		1620		8.10		ND	U	109		42.0	
PFNA	6	ND	U	ND	U	ND	U	1.48	J	2.95	J	ND	U	ND	U	ND	U	ND	U
PFOA	6	4.76		6.80		7.96		27.3		80.0		1.28	J	0.816	J	14.1		6.91	
PFOS	4	ND	U	ND	U	ND	U	90.5		316		5.40		ND	U	31.9		ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

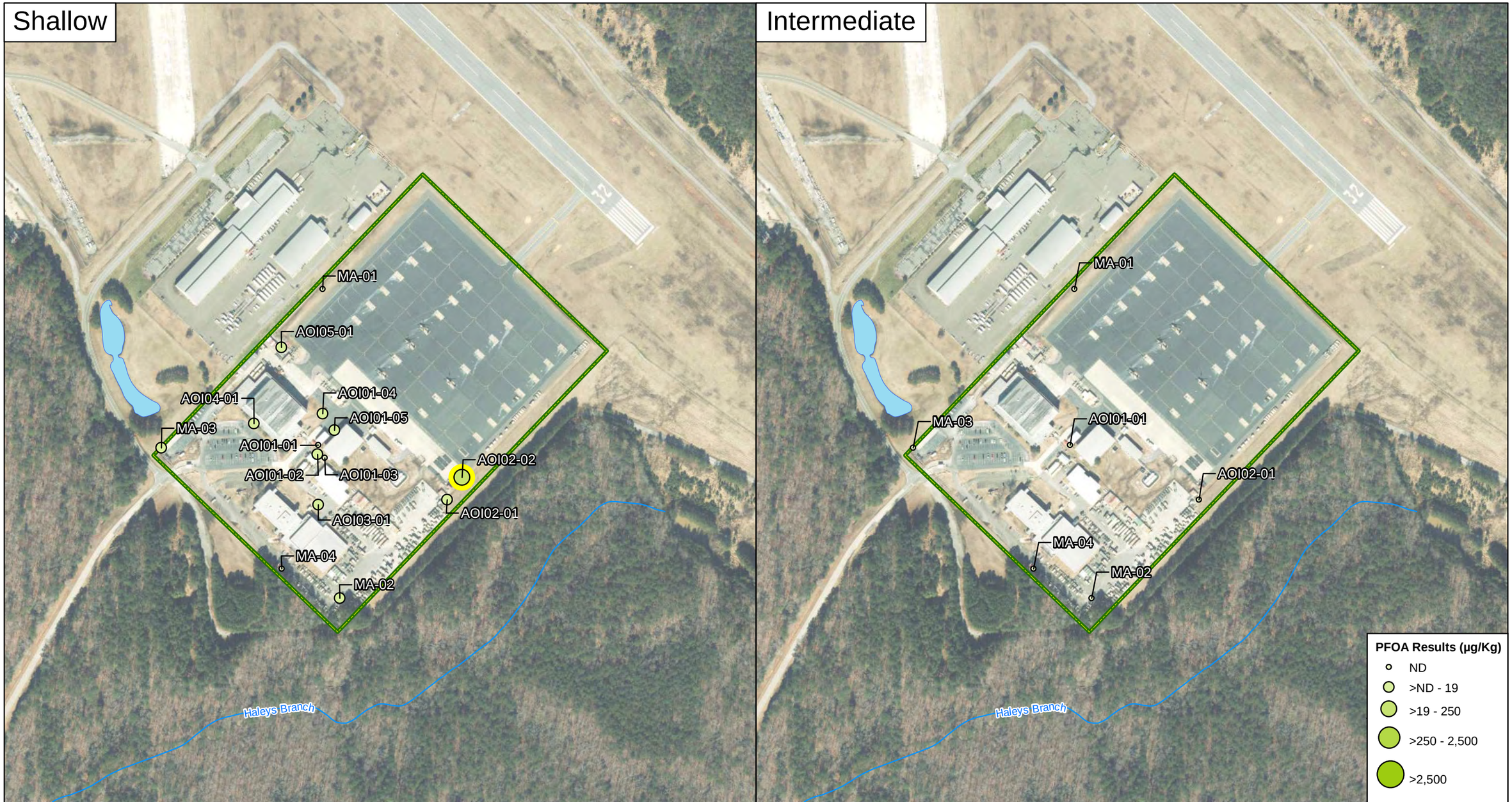
U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
MA	Morrisville AASF #1
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter



CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	8/26/2022	GIS BY	MS	8/26/2022
SCALE	1:4,560	CHK BY	MB	8/26/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/26/2022

Legend

- Facility Boundary
- Water Body
- River/Stream

0 190 380 760 Feet

Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

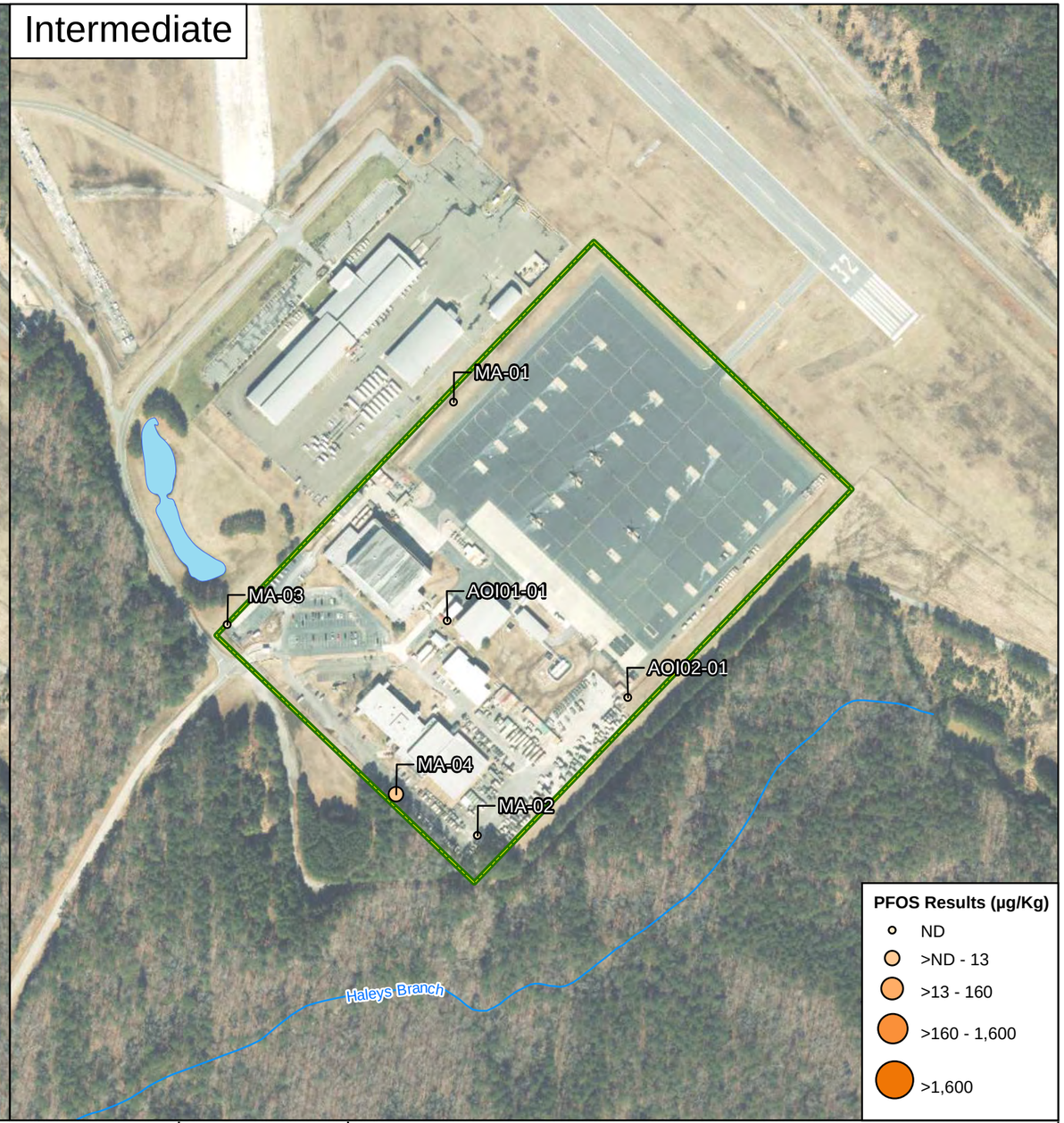
PFOA Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1

Shallow

Intermediate



CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	8/26/2022	GIS BY	MS	8/26/2022
SCALE	1:4,560	CHK BY	MB	8/26/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/26/2022

Legend

- Facility Boundary
- Water Body
- River/Stream

0 190 380 760 Feet

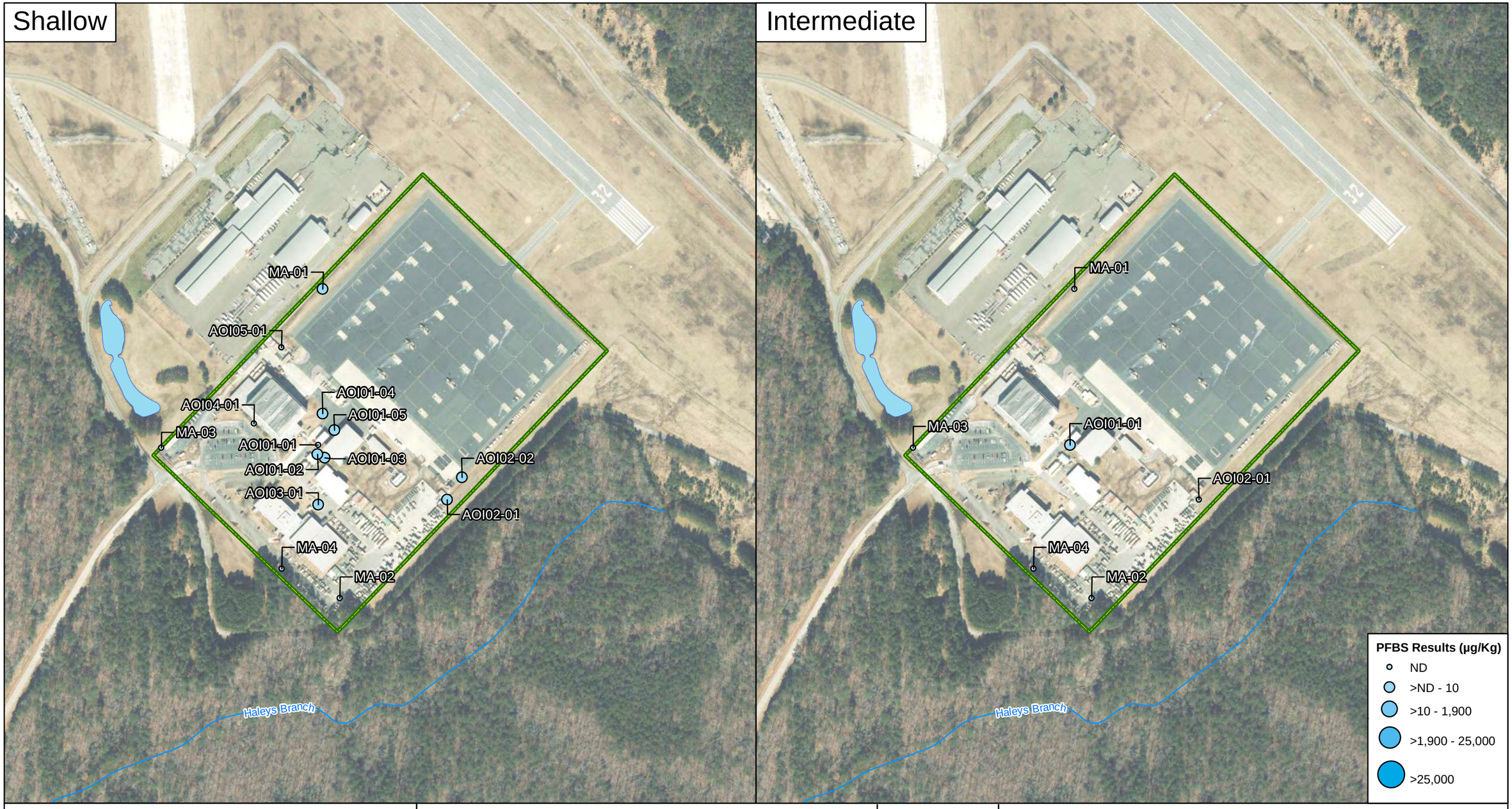
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

PFOS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-2



CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	8/26/2022	GIS BY	MS	8/26/2022
SCALE	1:4,560	CHK BY	MB	8/26/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/26/2022

Legend

- Facility Boundary
- Water Body
- River/Stream

0 190 380 760 Feet

Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

PFBS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-3

Shallow

Intermediate

MA-01
AOI05-01
AOI04-01
AOI01-04
AOI01-05
MA-03
AOI01-01
AOI01-02
AOI01-03
AOI02-02
AOI02-01
AOI03-01
MA-04
MA-02
Haleys Branch
32

PFHxS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 130
- >130 - 1,600
- >1,600

CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	8/26/2022	GIS BY	MS	8/26/2022
SCALE	1:4,560	CHK BY	MB	8/26/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/26/2022

Legend

- Facility Boundary
- Water Body
- River/Stream

0 190 380 760 Feet

Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

PFHxS Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-4

Shallow

Intermediate

MA-01
AOI05-01
AOI04-01
AOI01-04
AOI01-05
MA-03
AOI01-01
AOI01-02
AOI01-03
AOI02-02
AOI02-01
AOI03-01
MA-04
MA-02
Haleys Branch
32

PFNA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	8/26/2022	GIS BY	MS	8/26/2022
SCALE	1:4,560	CHK BY	MB	8/26/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/26/2022

Legend

- Facility Boundary
- Water Body
- River/Stream

0 190 380 760 Feet

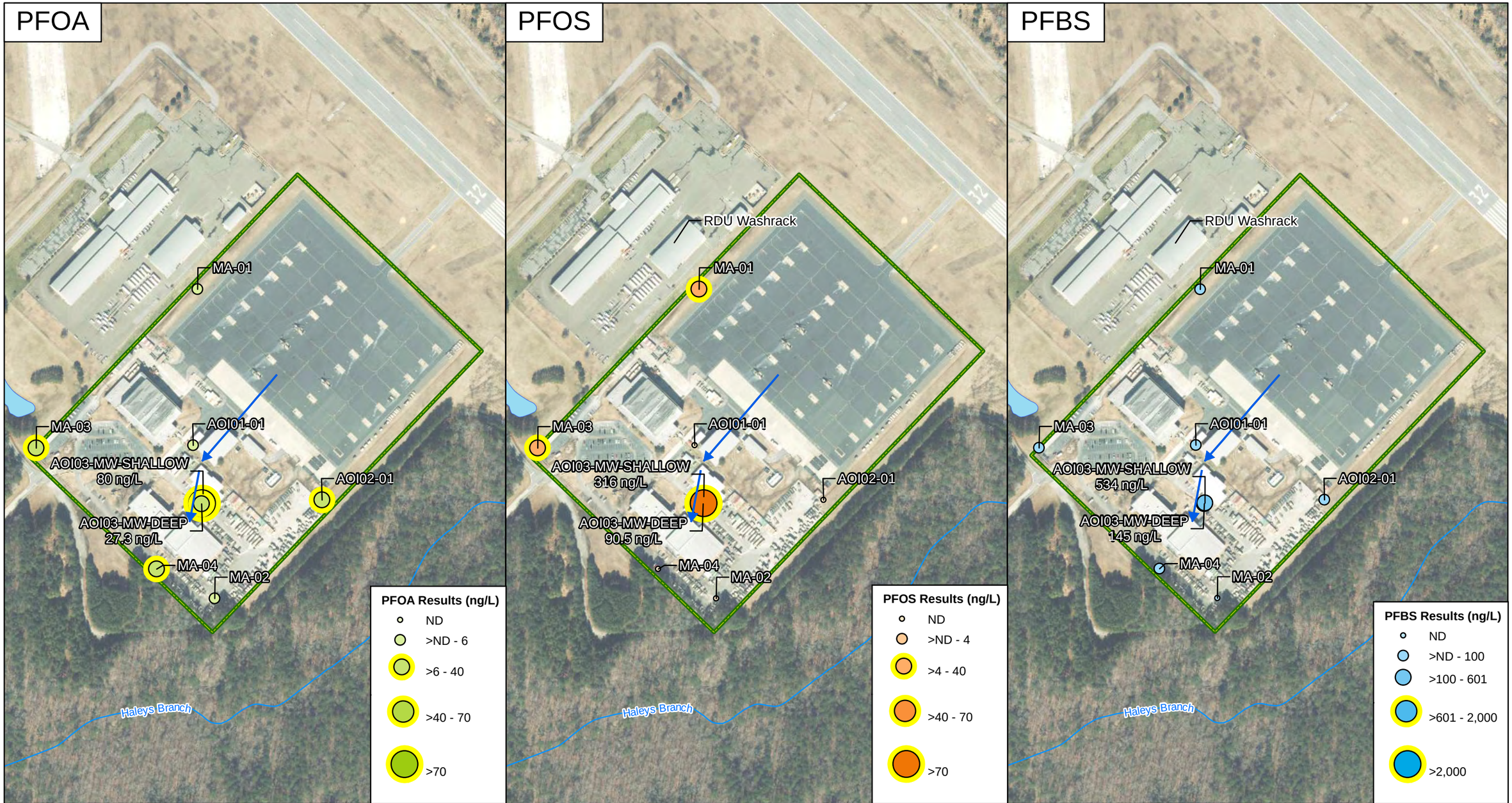
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

N

PFNA Detections in Soil

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-5



CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
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SCALE	1:4,560	CHK BY	MB	10/13/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	10/13/2022

Facility Boundary
Water Body
River/Stream
Groundwater Flow Direction

0 190 380 760 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

N

PFOA, PFOS, and PFBS Detections in Groundwater

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-6

PFHxS

MA-01
MA-03
AOI01-01
AOI03-MW-SHALLOW
1620 ng/L
AOI02-01
AOI03-MW-DEEP
406 ng/L
MA-04
MA-02
Haleys Branch

PFHxS Results (ng/L)

- ND
- >ND - 39
- >39 - 100
- >100 - 1,000
- >1,000

PFNA

RDU Washrack
MA-01
MA-03
AOI01-01
AOI03-MW-SHALLOW
2.95 ng/L
AOI02-01
AOI03-MW-DEEP
1.48 ng/L
MA-04
MA-02
Haleys Branch

PFNA Results (ng/L)

- ND
- >ND - 6
- >6 - 100
- >100 - 1,000
- >1,000

CLIENT	ARNG			
PROJECT	Site Inspection at Morrisville AASF #1, NC			
REVISED	9/13/2022	GIS BY	MS	9/13/2022
SCALE	1:4,560	CHK BY	MB	9/13/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/13/2022

- Facility Boundary
- Water Body
- River/Stream
- Groundwater Flow Direction

0 190 380 760 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

N

PFHxS and PFNA Detections in Groundwater

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-7

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7. Exposure Pathways

The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1** through **Figure 7-3**. Please note that while the CSM discussion assists in determining if a receptor may be impacted, the decision to move from SI to RI or interim action is determined based upon exceedances of the SLs for the relevant compounds and whether the release is more than likely attributable to the DoD. 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 figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds 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 relevant compounds above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in an RI or no action at this time is based on the comparison of the SI analytical results for the relevant compounds to the SLs.

In general, the potential routes of exposure to the relevant compounds 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 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, residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 through AOI 5 based on the aforementioned criteria.

7.1.1 AOI 1

AOI 1 is the Wash Rack Area, where AFFF releases may have occurred during fire training activities and Tri-Max unit maintenance.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their respective SLs in surface soil at AOI 1. Site workers and construction workers could contact constituents in surface soil via

incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. PFHxS and PFBS were detected below their respective SLs in subsurface soil at AOI 1. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for construction workers is potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.1.2 AOI 2

AOI 2 encompasses the long grassy area along Delta Row was the targeted area for AFFF training with Tri-Max 30™ carts. The Delta Row FTA was active from the 1988 to 2010, with regular training occurring approximately once every 2 years.

PFOA and PFNA were detected above their respective SLs in surface soil at AOI 2. Site workers and construction workers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in subsurface soil at AOI 2; therefore, all exposure pathways are considered incomplete. The CSM for AOI 2 is presented on **Figure 7-2**.

7.1.3 AOI 3

AOI 3 encompasses the area inside the vehicle bay of the Firehouse, where AFFF is currently stored, and the adjacent area to the south, where one firetruck was flushed after an internal AFFF leak was discovered.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their respective SLs in surface soil at AOI 3. Site workers and construction workers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. PFOS was detected below its respective SL in subsurface soil at location MA-04, downgradient of AOI 3. Construction workers could contact constituents in subsurface soil via incidental ingestion; therefore, the subsurface soil exposure pathway for construction workers is potentially complete. The CSM for AOI 3 is presented on **Figure 7-1**.

7.1.4 AOI 4

AOI 4 encompasses the Morrisville AASF #1 Hangar, which contains an actively charged AFFF dispensing system which developed a leak in 2018, discharging approximately 5 gallons of AFFF.

PFOA, PFOS, PFHxS, and PFNA were detected below their respective SLs in surface soil at AOI 4. Site workers and construction workers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in subsurface soil at facility boundary locations upgradient or downgradient of AOI 4; therefore, all subsurface soil exposure pathways are considered incomplete. The CSM for AOI 4 is presented on **Figure 7-3**.

7.1.5 AOI 5

AOI 5 encompasses the Long-Term Tri-Max 30™ Storage Area on the gravel north of the Morrisville AASF #1 Hangar, where Tri-Max 30™ carts are permanently stored.

PFOA, PFOS, PFHxS, and PFNA were detected below their respective SLs in surface soil at AOI 5. Site workers and construction workers could contact constituents in surface soil via incidental

ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in subsurface soil at facility boundary locations upgradient or downgradient of AOI 5; therefore, all subsurface soil exposure pathways are considered incomplete. The CSM for AOI 5 is presented on **Figure 7-3**.

7.2 Groundwater Exposure Pathway

The SI results in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria.

7.2.1 AOI 1

PFHxS was detected above its SL in the groundwater sample collected at AOI 1. The depth to water measured at AOI 1 in December 2021 during the SI was 13.50 feet bgs. As a result, construction workers could contact constituents in shallow groundwater via incidental ingestion. Therefore, the shallow groundwater exposure pathway for construction workers is potentially complete.

Drinking water at Morrisville AASF #1 is provided by the Town of Cary, which sources all of its water from the Jordan Lake. The Jordan Lake water intake is located approximately 16 miles southwest of the Morrisville AASF #1 facility (Town of Cary, 2018). Several public supply wells exist within 4 miles of the facility to the east, northeast, and southeast. These wells are cross-gradient and upgradient of the facility and not likely to be influenced by potential releases at Morrisville AASF #1. Therefore, the ingestion exposure pathway for site workers and residents is considered incomplete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.2.2 AOI 2

PFOA was detected above its SL in the groundwater sample collected at AOI 2. The depth to water measured at AOI 2 in December 2021 during the SI was 10.38 feet bgs. As a result, construction workers could contact constituents in shallow groundwater via incidental ingestion. Therefore, the shallow groundwater exposure pathway for construction workers is potentially complete. As mentioned in **Section 7.2.1** above, due to the groundwater flow direction and distance to drinking water receptors, the ingestion exposure pathway for off-facility residents is considered incomplete. Since drinking water at the facility is provided by the Town of Cary, the ingestion exposure pathway for site workers is considered incomplete. The CSM for AOI 2 is presented on **Figure 7-2**.

7.2.3 AOI 3

PFOA, PFOS, and PFHxS were detected above their respective SLs in groundwater samples collected at AOI 3. The depth to water measured at AOI 3 in December 2021 during the SI ranged from 6.73 to 36.29 feet bgs. As a result, construction workers could contact constituents in shallow groundwater via incidental ingestion. Therefore, the shallow groundwater exposure pathway for construction workers is potentially complete. As mentioned in **Section 7.2.1** above, due to the groundwater flow direction and distance to drinking water receptors, the ingestion exposure pathway for off-facility residents is considered incomplete. Since drinking water at the facility is provided by the Town of Cary, the ingestion exposure pathway for site workers is considered incomplete. The CSM for AOI 3 is presented on **Figure 7-1**.

7.2.4 AOI 4

PFOS was detected above its SL in the groundwater sample collected upgradient (MA-01) of AOI 4. PFOA, PFOS, and PFHxS were detected above their respective SLs in the groundwater sample collected downgradient (MA-03) of AOI 4. The depth to water measured at the locations upgradient and downgradient of AOI 4 in December 2021 during the SI ranged from 6.03 to 23.71 feet bgs. As a result, construction workers could contact constituents in shallow groundwater via incidental ingestion. Therefore, the shallow groundwater exposure pathway for construction workers is potentially complete. As mentioned in **Section 7.2.1** above, due to the groundwater flow direction and distance to drinking water receptors, the ingestion exposure pathway for off-facility residents is considered incomplete. Since drinking water at the facility is provided by the Town of Cary, the ingestion exposure pathway for site workers is considered incomplete. The CSM for AOI 4 is presented on **Figure 7-3**.

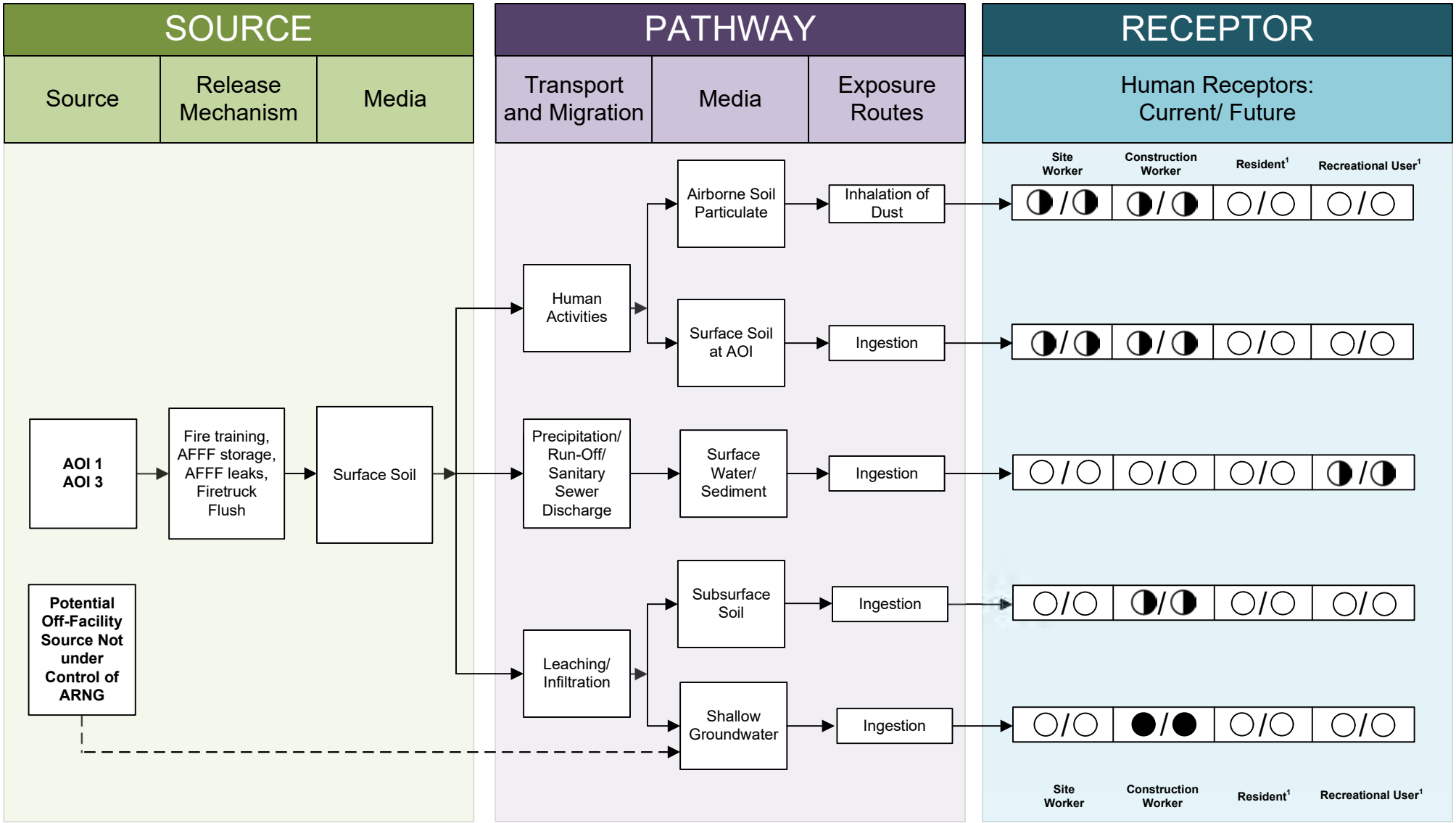
7.2.5 AOI 5

PFOS was detected above its SL in the groundwater sample collected upgradient (MA-01) of AOI 5. PFOA, PFOS, and PFHxS were detected above their respective SLs in the groundwater sample collected downgradient (MA-03) of AOI 5. The depth to water measured at the locations upgradient and downgradient of AOI 5 in December 2021 during the SI ranged from 6.03 to 23.71 feet bgs. As a result, construction workers could contact constituents in shallow groundwater via incidental ingestion. Therefore, the shallow groundwater exposure pathway for construction workers is potentially complete. As mentioned in **Section 7.2.1** above, due to the groundwater flow direction and distance to drinking water receptors, the ingestion exposure pathway for and off-facility residents is considered incomplete. The CSM for AOI 5 is presented on **Figure 7-3**.

7.3 Surface Water and Sediment Exposure Pathway

The SI results in soil and groundwater, in combination with knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

Because PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil and groundwater at the AOIs, it is possible that those compounds may have migrated from soil and groundwater to Haleys Branch via groundwater discharge or the stormwater system outfall. Haleys Branch flows into Lake Crabtree, Crabtree Creek, and eventually the Neuse River; therefore, the surface water and sediment ingestion exposure pathway for recreational users is considered potentially complete. The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1** through **Figure 7-3**.



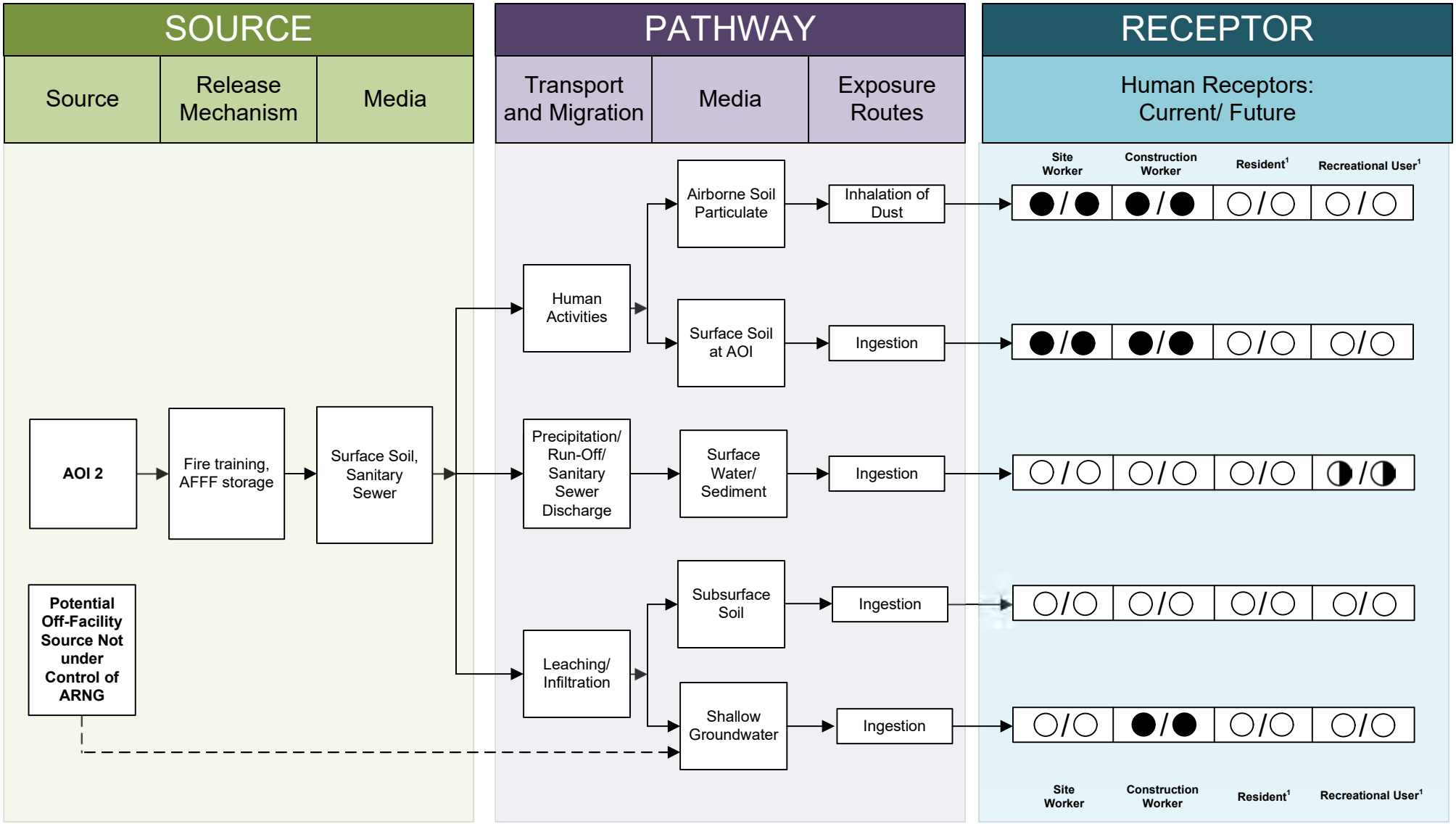
LEGEND

- 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 and recreational user.

Figure 7-1
Conceptual Site Model - AOI 1 and AOI 3
Morrisville AASF #1



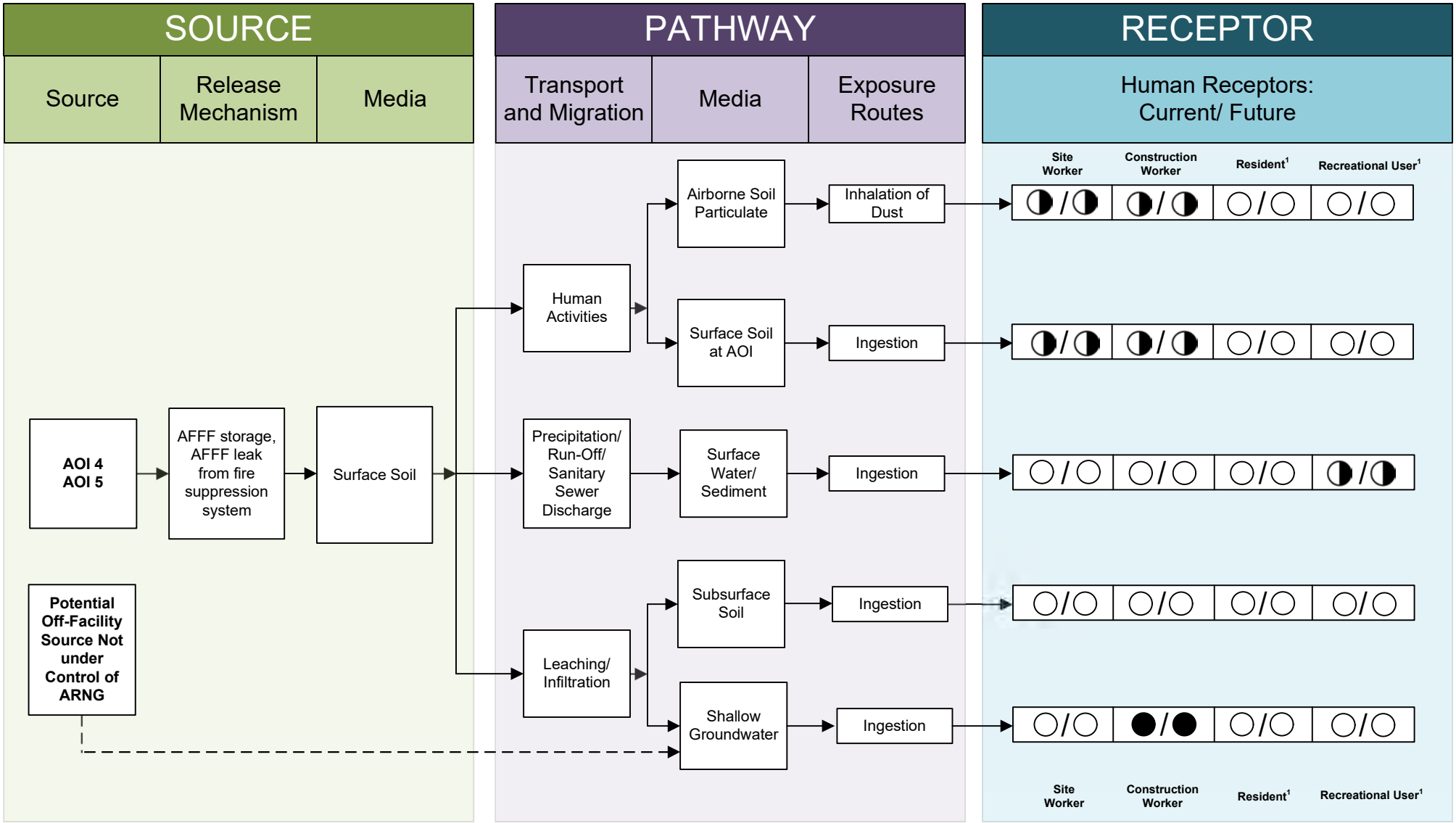
LEGEND

- 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 and recreational user.

Figure 7-2
Conceptual Site Model - AOI 2
Morrisville AASF #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 and recreational user.

Figure 7-3
Conceptual Site Model - AOI 4 and AOI 5
Morrisville AASF #1

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8. 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

The SI field activities were conducted from 2 to 30 December 2021 and consisted of utility clearance, sonic soil boring, soil sample collection, permanent monitoring well installation, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2021a).

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2021a), samples were collected and analyzed for a subset of 18 compounds by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows.

- Twenty (20) soil samples from 14 boring locations;
- Six groundwater samples from six newly installed permanent monitoring wells;
- Two groundwater samples from two existing permanent monitoring wells; and
- Twenty (20) QA/QC samples.

An SI is conducted when the PA determines an AOI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at AOIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOIs, which are described in **Section 7**.

8.2 Outcome

Based on the results of this SI, further evaluation under CERCLA is warranted in an RI for AOI 1, AOI 2, AOI 3, AOI 4, and AOI 5 (see **Table 8-1**). Based on the CSMs developed and revised in light of the SI findings, there is no potential for exposure to drinking water receptors from the AOIs from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared to the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to the SLs is as follows:

- At AOI 1:
    - PFOA in groundwater exceeded the SL of 6 ng/L at well AOI01-01, with a concentration of 73.3 ng/L. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.
    - Additionally, PFOA and PFHxS exceeded their respective SLs at facility boundary well MA-04, downgradient of AOI 1. PFOA exceeded the SL of 6 ng/L, with a concentration of 6.91 ng/L. PFHxS exceeded the SL of 39 ng/L, with a concentration of 42.0 ng/L.
    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at AOI 1 were below their respective SLs.

    - The detected concentrations of PFOA, PFOS, and PFHxS in soil at facility boundary locations MA-02 and MA-04, downgradient of AOI 1, were below their respective SLs.

- At AOI 2:

    - PFOA in groundwater exceeded the SL of 6 ng/L, with a maximum concentration of 7.96 ng/L in the field duplicate sample (AOI02-01-GW-D). Based on the results of the SI, further evaluation of AOI 2 is warranted in an RI.

    - The detected concentration of PFOA in groundwater at facility boundary well MA-02, downgradient of AOI 2, was below the respective SL.

    - PFOA and PFNA in surface soil exceeded their respective SLs. PFOA exceeded the SL of 19 µg/kg, with a concentration of 32.5 µg/kg at location AOI02-02. PFNA exceeded the SL of 19 µg/kg, with a concentration of 57.3 µg/kg at location AOI02-02. Based on the results of the SI, further evaluation of AOI 2 is warranted in an RI.

    - The detected concentrations of PFOA, PFOS, and PFHxS in soil at facility boundary location MA-02, downgradient of AOI 2, were below their respective SLs.

- At AOI 3:

    - PFOA, PFOS, and PFHxS in groundwater exceeded their respective SLs. PFOA exceeded the SL of 6 ng/L, with a maximum concentration of 80.0 ng/L. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 316 ng/L. PFHxS exceeded the SL of 39 ng/L, with a maximum concentration of 1,620 ng/L. Based on the results of the SI, further evaluation of AOI 3 is warranted in an RI.

    - Additionally, PFOA and PFHxS exceeded their respective SLs at facility boundary well MA-04, downgradient of AOI 3. PFOA exceeded the SL of 6 ng/L, with a concentration of 6.91 ng/L. PFHxS exceeded the SL of 39 ng/L, with a concentration of 42.0 ng/L.

    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at AOI 3 were below their respective SLs.

    - The detected concentrations of PFOA, PFOS, and PFHxS in soil at facility boundary locations MA-02 and MA-04, downgradient of AOI 3, were below their respective SLs.

- At AOI 4:

    - PFOA, PFOS, and PFHxS in groundwater exceeded their respective SLs at facility boundary wells upgradient and downgradient of AOI 4. PFOA exceeded the SL of 6 ng/L, with a maximum concentration of 14.1 ng/L at well MA-03. PFOS exceeded the SL of 4 ng/L, with a maximum concentration of 31.9 ng/L at well MA-03. PFHxS exceeded the SL of 39 ng/L, with a maximum concentration of 109 ng/L at well MA-03. Based on the results of the SI, further evaluation of AOI 4 is warranted in an RI.

    - The detected concentrations of PFOA, PFOS, PFHxS, and PFNA in soil at AOI 4 were below their respective SLs.

    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at facility boundary locations upgradient (MA-01) and downgradient (MA-03) of AOI 4 were below their respective SLs.

- At AOI 5:

- The detected concentrations of PFOA, PFOS, PFHxS, and PFNA in soil at AOI 5 were below their respective SLs; therefore, no further evaluation of AOI 5 is warranted.

Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table 8-1 summarizes the SI results for soil and groundwater used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI.

Table 8-1: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Wash Rack Area and GSE Building	◐	●	●	Proceed to RI
2	Delta Row FTA	●	●	◐	Proceed to RI
3	Firehouse Storage and Flush Area	◐	●	●	Proceed to RI
4	Hangar Leak Area	◐	N/A	●	Proceed to RI
5	Long-Term Tri-Max 30™ Storage Area	◐	N/A	●	Proceed to RI

Legend:

● = detected; exceedance of the screening levels

◐ = detected; no exceedance of the screening levels

○ = not detected

N/A = Not Applicable

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