FINAL
Site Inspection Report
State Military Reservation
Virginia Beach, Virginia

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

April 2023

Prepared for:

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

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%	Percent
µg/kg	Microgram(s) per kilogram
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous film forming foam
amsl	Above mean sea level
AOI	Area of interest
ARNG	Army National Guard
bgs	Below ground surface
btoc	Below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Conceptual site model
DoD	Department of Defense
DPT	Direct-push technology
DQO	Data quality objective
EA	EA Engineering, Science, and Technology, Inc., PBC
EDR™	Environmental Data Resources, Inc.™
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
FB	Field blank
FedEx	Federal Express
ft	Foot (feet)
HDPE	High-density polyethylene
HFPO-DA	Hexafluoropropylene oxide dimer acid
HQ	Hazard quotient
IDW	Investigation-derived waste
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	Liquid chromatography/tandem mass spectrometry
NELAP	National Environmental Laboratory Accreditation Program
ng/L	Nanogram(s) per liter
No.	Number
OSD	Office of the Secretary of Defense

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RI	Remedial investigation
SI	Site inspection
SL	Screening level
TOC	Total organic carbon
TPP	Technical Project Planning
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VAANG	Virginia Air National Guard

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EXECUTIVE SUMMARY

The Army National Guard (ARNG) G-9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at ARNG facilities nationwide based 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 (OSD) dated 6 July 2022 (Assistant Secretary of Defense). The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorononanoic acid (PFHxS), and hexafluoropropylene oxide-dimer acid (HFPO-DA) (GenX)[1]. These compounds are collectively referred to as "relevant compounds" throughout the document and the applicable Screening Levels (SLs) are provided below in Table ES-1.

The PA identified three Areas of Interest (AOIs) where PFAS-containing materials may have been 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 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 a comparison of SI results to screening levels (SLs) for the relevant compounds. This SI was completed at State Military Reservation in Virginia Beach, Virginia, and determined further investigation is warranted for AOI 2 – Helipad, and AOI 3 – Building 410. State Military Reservation will be referred to as the "Facility" throughout this document.

The Facility, operated by the Virginia ARNG (VAARNG), encompasses approximately 327 acres in Virginia Beach, Virginia. Founded by the Virginia state militia and formerly known as State Military Reservation State Military Reservation, State Military Reservation provides support facilities for the VAARNG, as well as the Commonwealth ChalleNGe Program and the federal and local governments. The Camp proper consists of 229.87 acres owned by the VAARNG, 27.5 acres owned by the U.S. Navy, a 60.37-acre complex leased to the U.S. Air Force, and select parcels leased to the City of Virginia Beach. The majority of the facility consists mainly of level, open grassy areas; however, some wooded areas are present on-site. State Military Reservation contains a portion of Lake Christine and is bordered to the east by the Atlantic Ocean.

The PA identified three AOIs for investigation during the SI phase. SI sampling results from the three AOIs were compared to OSD SLs. **Table ES-2** summarizes the SI results for each AOI. Based on the results of this SI, and following the CERCLA process, a remedial investigation (RI) is warranted for AOI 2: Helipad and AOI 3: Building 410.

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

Notes:

1. Assistant Secretary of Defense. July 2022. Risk Based Screening Levels Calculated for Groundwater and Soil using U.S. Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
2. 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.

µg/kg = Microgram(s) per kilogram
ng/L = Nanogram(s) per liter

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	Building 4	◐	◐	◐	No further action
2	Helipad	◐	●	◐	Proceed to RI
3	Building 410	◐	●	●	Proceed to RI

Legend:
● = Detected; exceedance of SLs
◐ = Detected; no exceedance of SLs
○ = Not detected

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) at ARNG facilities nationwide based on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on 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 components listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide-dimer acid (HFPO-DA)[2] at ARNG facilities nationwide. The ARNG performed this SI at State Military Reservation in Virginia Beach, Virginia. State Military Reservation will be referred to as the "Facility" throughout this report.

The SI project elements were performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. 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 Army requirements and guidance for field investigations.

1.2 SITE INSPECTION PURPOSE

A PA was performed at State Military Reservation (AECOM Technical Services, Inc. [AECOM] 2020) that identified three Areas of Interest (AOI) where PFAS-containing materials were used, stored, and/or disposed, or areas where known or suspected releases to the environment may have occurred. 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.

[2] 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

State Military Reservation, formerly known as State Military Reservation State Military Reservation, is located just south of the main resort area of Virginia Beach, Virginia (**Figure 2-1**). State Military Reservation provides support facilities for the Virginia Army National Guard (VAARNG), as well as tenants including the Commonwealth ChalleNGe Program, and federal and local government. State Military Reservation occupies a parcel of land owned by the U.S. Navy and leased to the VAARNG. The Virginia Air National Guard (VAANG) 203rd Civil Engineer Flight Unit occupies a portion of the Facility. State Military Reservation incorporates approximately 327 acres and is bounded by General Booth Boulevard to the west, Birdneck Road to the south, the Croatan residential neighborhood to the north, and the Atlantic Ocean to the east (AECOM 2020).

The Facility was founded by the Virginia state militia, the precursor to the VAARNG, and began construction in 1912. Originally, it comprised of approximately 400 acres. During the height of its training mission, State Military Reservation consisted of as much as 1,200 acres. The Facility was constructed during three distinct building campaigns with interspersed construction on a smaller scale since its establishment as the State Rifle Range in 1912. The first campaign laid out the original core of the rifle range, and the layout remains extant. The second campaign of major construction, performed by the U.S. Navy in 1919, brought further development of the rifle ranges. Although the buildings constructed by the U.S. Navy no longer exist, the layout and configuration of the original development areas have been retained. The final major construction campaign, completed by the U.S. Army during World War II, provides the majority of extant buildings and denotes when the facility was dedicated as State Military Reservation (AECOM 2020).

2.2 FACILITY ENVIRONMENTAL SETTING

State Military Reservation was originally established on farmland and beachfront and has since been surrounded by the development of the City of Virginia Beach. The overall terrain of State Military Reservation consists of a largely level area; with slight increases in elevation near the beach Rifle Range in the facility's eastern portion, with dunes in the area tending to be more gently sloping terrain and ranging from approximately 3 to 7 feet (ft) in height (**Figure 2-2**). The Facility also contains some drainage areas, consisting of sloping to steep areas with moderately drained soils. The elevation of the facility is approximately 26 ft above sea level (AECOM 2020).

In addition to the Atlantic Ocean, which borders the Facility to the east, Lake Christine extends into the facility footprint. Lake Christine is a freshwater body that spans approximately 0.5 mile from north to south and 0.5 mile from east to west. The Facility's cottage residences are scattered along the west and south sides of Lake Christine, including the Governor's Cottage to the south, across Jefferson Avenue, and the Post Superintendent's House at the southern end of the lake (AECOM 2020).

Although the majority of State Military Reservation's grounds consist of open, grassy spaces, there are wooded areas, including the largely wooded zone along the central portion of the Facility's northern boundary and east of Lake Christine. These wooded areas contain a variety of coniferous and deciduous trees and shrubs. The remainder of the facility landscape is developed with paved roads, buildings, and structures (AECOM 2020).

The Facility is restricted to the general public by locked fence and guarded entryways but is unrestricted to State Military Reservation personnel. Facility roads are open only to personnel associated with State Military Reservation. The areas surrounding State Military Reservation consist of commercial and suburban residential areas, as well as municipal facilities and recreational areas (AECOM 2020).

2.2.1 Geology

State Military Reservation is on the outer edge of the Atlantic Coastal Plain physiographic province. The Atlantic Coastal Plain is a broad wedge of unconsolidated sediments that dip and thicken to the east. As confirmed by observations of the subsurface geology and grain size analysis conducted during SI field activities, sediments underlying State Military Reservation consist of several thousand feet of unconsolidated sand, clay, silt, and gravels and are underlain by granite basement rock. The sediments range in age from late Cretaceous to recent. The eastern portions of State Military Reservation are underlain by beach sand and dune sand deposits, as well as marsh and intertidal mud deposits. The central and western portions of State Military Reservation are underlain by the Tabb formation Lynnhaven and Poquoson members. The Lynnhaven Member is pebbly and cobbly; fine to coarse gray sand grades upward into clayey and silty fine sand and sandy silt. Locally, at the base of the unit, medium to coarse cross-bedded sand and clayey silt containing abundant plant material fill channels cut into underlying stratigraphic units. The Poquoson Member is the surficial sediment over much of the Tabb formation area and consists of fluvial estuarine fine- to medium-sand and sandy clay (AECOM 2020).

The geologic units described in previous environmental investigations at the adjacent Naval Air Station (NAS) Oceana are the Yorktown Formation and the Columbia Group. The Columbia Group is present at the ground surface in the vicinity of the site and generally extends to approximately 20 ft below ground surface (bgs). The Yorktown Formation underlies the Columbia Group. The upper Yorktown Formation consists of interbedded layers of shelly, very fine- to coarse-sands, clayey sands, and sandy clay of Tertiary age. Regionally, the uppermost of these silt and clay beds separates the Yorktown Formation from the sediments of the Columbia Group that overlie it. This uppermost bed consists of massive, well-bedded yellow-gray to greenish-gray clays and silty clays, commonly containing shells, fine sand, and mica. The clay layers within the confining bed are generally extensive but are a series of coalescing clay beds rather than a single-deposited unit. This unit was deposited in a shallow open-marine environment of broad lagoons and quiet bays. The sediments of the Columbia Group consist of interbedded gravels, sands, silts, and clays of Pleistocene and Holocene age. The Pleistocene and Holocene sediments were deposited in fluvial-marine terrace and near-shore marine environments such as lagoons, beaches, tidal flats, and barrier islands (AECOM 2020).

During the SI, the soil underlying State Military Reservation was found to be generally composed of light brown to gray silt clay, which transitions to layers of silty sand, consistent with the fluvial-marine terrace and near-shore marine environments described above. The borings were completed at depths between 10 and 18 feet below ground surface (bgs). Samples for grain size analyses were collected at two locations, CPEN-01 (3-4 ft bgs) and CPEN-03 (7-8 ft bgs) 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 (64.2% to 67%), clay (23% to 30%), and sand (3%-10%). Boring logs are presented in **Appendix E** and grain size results are presented in **Appendix F**.

2.2.2 Hydrogeology

The surficial hydrogeologic unit at the adjacent NAS Oceana consists of the Columbia aquifer, which extends to a depth of approximately 17 to 30 ft bgs at the Facility. According to the PA, the hydrogeologic unit at NAS Oceana, and depth to groundwater, were anticipated to be similar at State Military Reservation. This hydrogeologic unit is underlain by the Yorktown confining unit across much of coastal Virginia; however, this unit is absent across most of State Military Reservation (AECOM 2020). Depth to groundwater encountered during the SI measured in September 2021 was found to be between 6.5 to 12 ft bgs. Groundwater elevations calculated using depth to groundwater measurements and survey data collected during the SI indicate groundwater within the shallow aquifer flows primarily to the north-northeast **(Figure 2-3)**.

Groundwater is not used for drinking water at State Military Reservation. Public water services are provided by the Virginia Beach Department of Public Utilities; water is sourced from Lake Gaston, via the Lake Gaston Water Supply Pipeline. The 2018 Environmental Data Resources, Inc. (EDR)™ Geocheck Radius Map Report indicated that there are no drinking water wells at State Military Reservation. VAARNG staff confirmed that no operational wells exist at State Military Reservation; however, the Virginia Department of Mines, Minerals and Energy, Division of Geology and Mineral Resources spatial data for State Military Reservation shows three groundwater wells located within the site boundary, as shown on **Figure 2-4**. The wells are listed as public/municipal/ government wells. Interviewees at State Military Reservation believe the wells may have been previously abandoned and confirmed that they are not used for drinking water (AECOM 2020).

2.2.3 Hydrology

Owl Creek and Lake Christine are the main drainage features surrounding State Military Reservation. Surface water in the northwestern section of the Facility flows north to northwest to a stormwater pond at the northern end of the facility and into Owl Creek. Surface water in the eastern section of the facility flows into Lake Christine. In the southern section of the facility, surface water flows north to northwest towards Owl Creek (**Figure 2-5**). A series of in-ground pipes and ditches take water towards two stormwater ponds and eventually discharge in Owl Creek (AECOM 2020).

The City of Virginia Beach's elevation and proximity to water makes it susceptible to flooding. According to the City of Virginia Beach's Online Mapping Service, portions of State Military Reservation are identified as areas with 0.2 percent (%) annual chance of flooding, areas with a

1% chance of annual flooding, and areas that are part of the base floodplain. The majority of State Military Reservation is not located in a Special Flood Hazard Area, which means it has a lower risk for flooding (AECOM 2020).

2.2.4 Climate

State Military Reservation is located in an area where temperature extremes are moderated by the Atlantic Ocean. The average yearly temperature is 60.0 degrees Fahrenheit, with an annual precipitation of 45.7 inches. Winds on average blow from a northerly direction from January through March and again in September and October. During the remaining months, winds generally blow from a southerly direction (AECOM 2020).

2.2.5 Current and Future Land Use

State Military Reservation's primary purposes are the training of soldiers and personnel. Both VAARNG and VAANG control portions of the facility. The entire facility boundary is fenced, and access is gained through a secured gate. When the facilities are not used by military organizations, state and local civilian agencies also conduct training on-site. Virginia Beach City authorities have repeatedly requested to convert the camp to other uses, including partial or complete conversion to a state park. The facility is also currently listed on the Virginia Landmarks Register and on the National Register of Historic Places (AECOM 2020).

The Camp proper consists of 229.87 acres owned by the VAARNG. Within the Camp, parcels are leased to the City of Virginia Beach, including 1.4 acres for equipment and materials storage, a 12.2-acre parking lot used by the Virginia Aquarium & Marine Science Center, 600 ft of beachfront, and approximately 505 parking spaces in a beachfront lot. The historic district of the Camp includes a 60.37-acre complex leased to the U.S. Air Force for use by a VAANG Civil Engineer Unit; 2.5 acres for the VAARNG Virginia Beach Readiness Center (Armory), 27.5 acres owned by the U.S. Navy, and the remainder is Lake Christine. Also, within the Camp, the Commonwealth of Virginia's Youth ChalleNGe Academy uses barracks and other buildings in Regimental Camp Area No. 2, located in the southwestern portion of the Camp, between 3rd Street and the Camp boundary along South Birdneck Road. Future land use is not expected to change (AECOM 2020).

2.2.6 Sensitive Habitat and Threatened/Endangered Species

A wildlife survey has not occurred at the Facility, and the Facility does not have any significant areas of habitat. The following species have not been identified at the Facility but may be present in the surrounding area.

The following species are listed as federally endangered, threatened, proposed, and/or candidate species in Virginia Beach City, Virginia (U.S. Fish and Wildlife Service 2021):

- Birds: Piping Plover (*Charadrius melodus*) – Federally Threatened; Red Knot (*Calidris canutus rufa)* – Federally Threatened; and Roseate Tern (*Sterna dougallii dougallii*) – Federally Endangered

- Insects: Monarch Butterfly (*Danaus plexippus*) – Federal Candidate
- Reptiles: Green Sea Turtle (*Chelonia mydas*) – Federally Threatened; Hawksbill Sea Turtle (*Eretmochelys imbricata*) – Federally Endangered; Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) – Federally Endangered; Leatherback Sea Turtle (*Dermochelys coriacea*) – Federally Endangered; and Loggerhead Sea Turtle (*Caretta caretta*) – Federally Threatened
- Mammal: Northern Long-eared Bat (*Myotis septentrionalis*) – Federally Threatened.

2.3 HISTORY OF PFAS USE

Three potential PFAS release areas were identified at the Facility during the PA (AECOM 2020). Interviews and records obtained during the PA indicate that there was a potential for the storage and release of aqueous film forming foam (AFFF) at the facility due to the known use of such products by the U.S. Navy, who historically controlled and operated the property. According to the PA, there is no evidence of a release of PFAS-containing materials at State Military Reservation.

A description of each AOI is presented in **Section 3**.

2.4 HISTORICAL PFAS INVESTIGATIONS

No known historical PFAS investigations have been conducted at State Military Reservation.

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Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

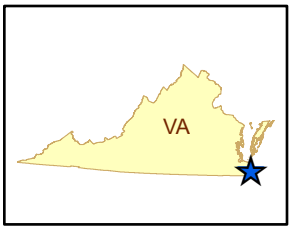
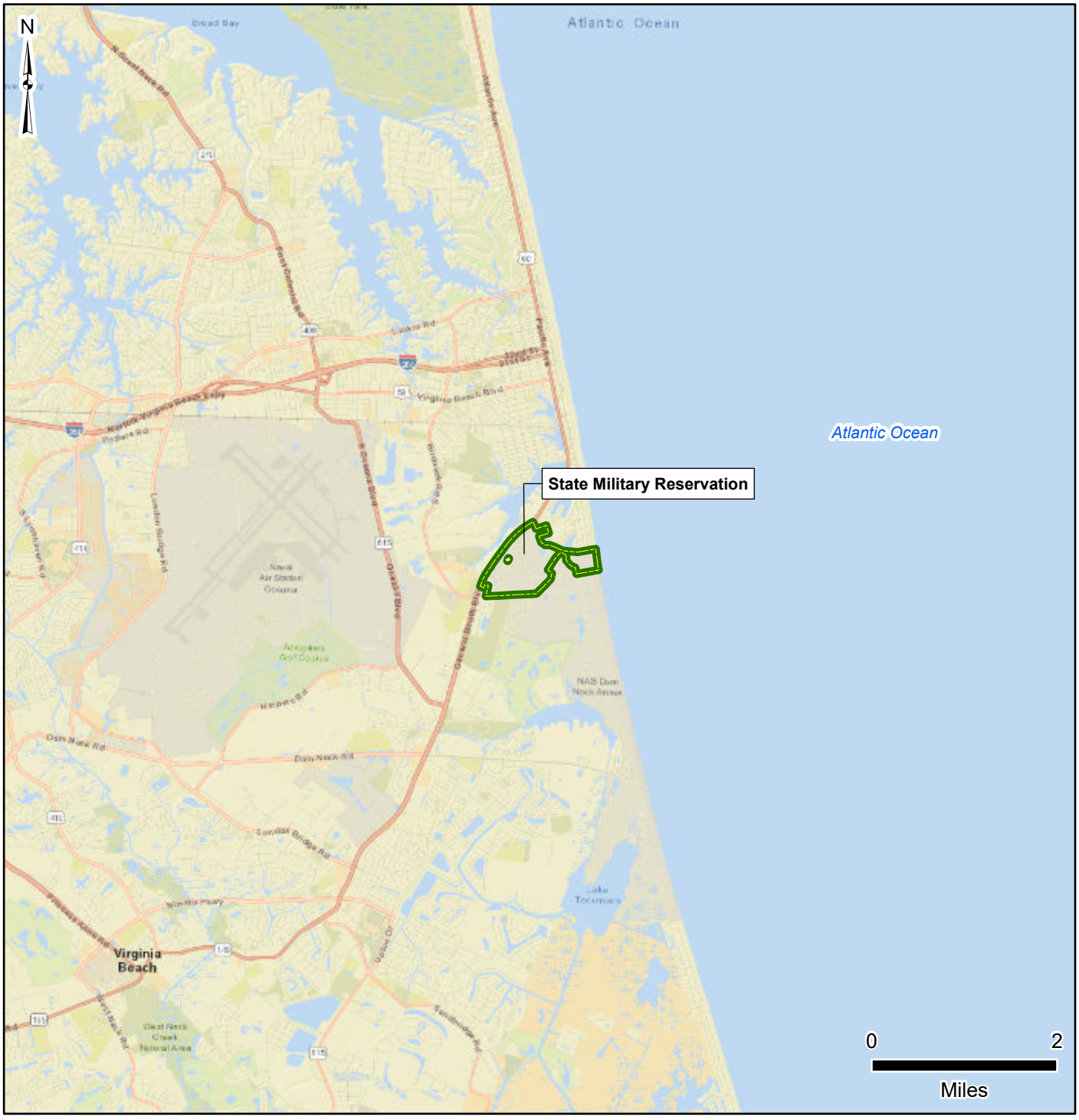


Figure 2-1
Facility Location



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Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

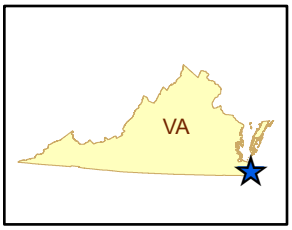

Figure 2-2
Facility Topography

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Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:..... . April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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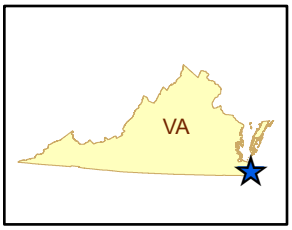
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 2-3
Groundwater Features



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Facility Data
- Facility Boundary

Well Type
- Domestic
- Industrial
- Municipal/Public/Goverment
- Monitoring/Observation

Hydrology/Hydrogeology
- Inferred Groundwater Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020
USGS NHD 2021

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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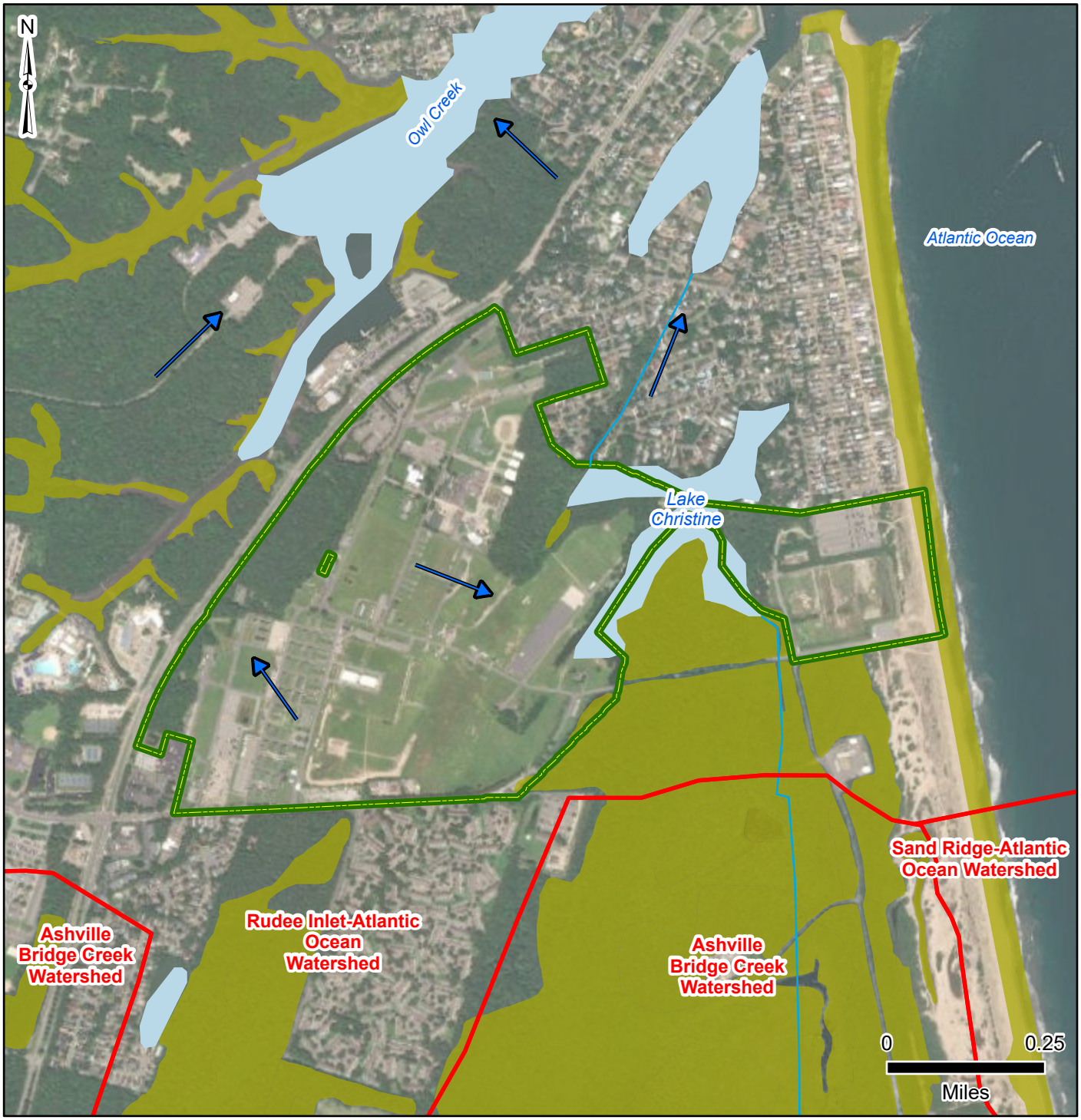
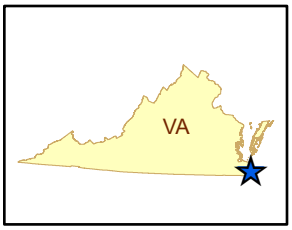
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 2-4
Surface Water Features





Facility Data
- Facility Boundary

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody
- Wetlands
- Watershed Boundary

Data Sources:
ESRI 2020
AECOM 2020
USGS NHD 2021

Date:..... April 2023
Prepared By:.....EA
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Projection:.....WGS 84 UTM 18N

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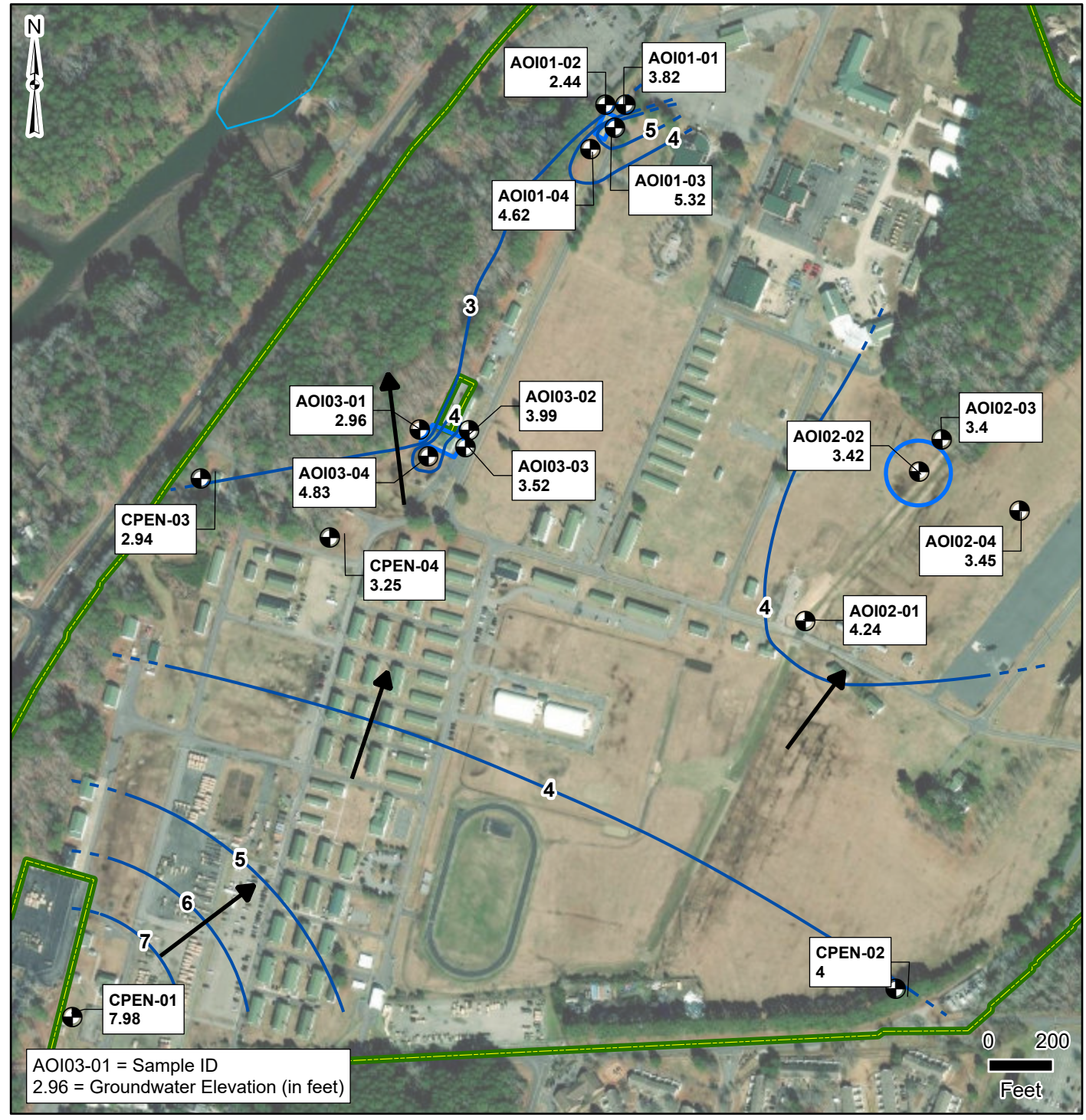
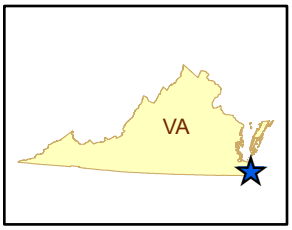
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 2-5
Groundwater Elevations





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Facility Data
- Facility Boundary
- Area of Interest

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- Groundwater Elevation Contour Interval (1 Foot)
- Dashed where Inferred
- River/Stream

Temporary Well Location

Data Sources:
ESRI 2020
AECOM 2020
USGS NHD 2021

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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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, three AOIs were identified at the facility: AOI 1 – Building 4; AOI 2 – AFFF Helipad; and AOI 3 – Building 410. The potential AOIs are shown on **Figure 3-1**.

3.1 AOI 1 – BUILDING 4

AOI 1 consists of Building 4, located adjacent to the VAANG Civil Engineer Unit Property, in the northern portion of State Military Reservation. According to VAARNG interviewees, Building 4 was leased by the U.S. Navy from the late 1990s to 2010 and supported the Military Sea Lift Command. During its operation as a U.S. Navy building, a Halon fire suppression system was present within the building. The specific type of Halon foam product used by the suppression system is unknown, but its contents were never released, according to VAARNG staff. Halon is a fire extinguishing agent, almost universally used as an aircraft fire extinguisher, which contains bromochlorodifluoromethane. As a chlorofluorocarbon, Halon production has ceased, but many Halon products remain in circulation until used for their intended purpose. The Halon fire suppression system was removed in 2010, when the building was transferred to the VAARNG; it is unknown how the U.S. Navy disposed of their Halon after removal. Based on the prevalent use and storage of AFFF at U.S. Navy facilities and the lack of U.S. Navy interviewees available during this PA, it is possible that undocumented PFAS-containing materials were used or stored at Building 4. Building 4 is considered a potential PFAS release area (AECOM 2020).

3.2 AOI 2 – HELIPAD

AOI 2 consists of the Helipad, located directly south of the VAANG property in the northern portion of State Military Reservation. Similar to Building 4, a wheeled Halon fire extinguisher was formerly staged at the Helipad. The unit described also resembles the AMEREX Halon 1211 wheeled fire extinguisher. According to interviewees, the Halon unit was never used for training or emergency response purposes and was disposed of in 2012. Based on the storage of Halon foam at the Helipad and the operational use by non-ARNG units, it is possible that undocumented use and storage of PFAS-containing materials occurred there. The Helipad is considered a potential PFAS release area (AECOM 2020).

3.3 AOI 3 – BUILDING 410

AOI 3 consists of Building 410, which served as the State Military Reservation Fire Department prior to the 1970s and is currently used as a classroom and storage building. Building 410 is located in the central portion of State Military Reservation. According to interviewees, Building 410 has never been a place for storage or use of AFFF products, nor does it have an AFFF fire suppression system. During the site visit, hoses stamped in 1976 were observed at Building 410 and appeared to have function for water only; use of PFAS for firefighting purposes by the Department of Defense (DoD) began in 1969. Based on the date stamped on firehoses, Building 410 may have been used as the State Military Reservation Fire Department after the introduction of PFAS-containing materials to the ARNG. Although no evidence gathered for Building 410

indicates that AFFF was ever used of stored at the building, it is possible that undocumented storage or use of PFAS-containing materials occurred at the building based on its uncertain dates of use. Building 410 is considered a potential PFAS release area (AECOM 2020).

3.4 ADJACENT SOURCES

Three potential off-facility sources of PFAS are adjacent to the facility and are not under the control of the VAARNG. A description of each off-facility source is presented below and shown on **Figure 3-1**.

3.4.1 NAS Oceana

The NAS Oceana base is located approximately 2 miles west of State Military Reservation. The base, including the NAS Oceana Dam Neck Annex located approximately 1.3 miles southwest of State Military Reservation, was established in 1943 as a small auxiliary airfield. Since 1943, NAS Oceana has grown to 16 times its original size and is now 6,000 acres. NAS Oceana Range Control controls aviation operations at State Military Reservation. According to interviewees, NAS Oceana has its own Fire Department that stores and uses AFFF during fire training exercises within the base. The NAS Oceana Fire Department has responded to numerous U.S. Navy crashes within the base and its vicinity using AFFF. Fire training practices and schedule, as well as firefighting equipment maintenance and disposal routines, are unknown. According to the 2018 CH2M NAS Oceana SI, only water is used during fire training at NAS Oceana; however, other releases are reported in the SI as listed below (AECOM 2020):

- **1986 Plane Crash**: A plane crashed off Oceana Boulevard. SI interviews indicated that AFFF was used in response to this crash.

- **1995 Plane Crash**: A plane crashed in the woods on the installation, but SI interviewees could not recall whether there was an associated fire.

- **2007 Plane Crash**: A civilian plane crashed during an air show practice off runway 5L. SI interviewees could not recall whether AFFF was used.

- **2012 Plane Crash**: An F18 jet crashed into the nearby Mayview Apartments. AFFF was used on the subsequent fire.

- **1100 Area Training Release**: During training near the Hush House, an AFFF release was accidentally triggered by staff. The concrete area where AFFF was released was sprayed down to push AFFF into surrounding grass.

- **Building 145 Accidental Release**: An AFFF release was accidentally triggered causing AFFF to spill out into the parking lot. Personnel were advised to cover the storm drains as best as they could, and spray water to wash the AFFF onto the grass. Remaining AFFF was vacuumed and disposed of by a contractor.

- **Hangar 111 Accidental Release**: An accidental release occurred during floor nozzle retrofitting.

- **Hangar 500 Accidental Releases**: Accidental releases of AFFF occurred approximately monthly due to suppression system sensor malfunctions. The date range of the monthly activations is unknown.

- **Building 139 Accidental Release**: In 2010, a spill occurred at the corrosion control facility. The AFFF was pushed outside to the grass swale on the southeast side of the building, and then cleaned up with a vacuum truck. Multiple releases have occurred at Building 139.

- **Hangar 122 Accidental Release**: In 2011, a storm caused stormwater to back up and fill the overflow tanks in Hangar 122, releasing AFFF to the storm drain and storm ditch.

Groundwater samples collected during the Oceana SI indicate that PFOS and PFOA concentrations in groundwater beneath the base exceed the SLs, with maximum PFOA and PFOS concentrations in the Columbia aquifer of 22,600 nanograms per liter (ng/L) and 471,000 ng/L, respectively. One off-base potable well east of the facility showed detections of PFOA (24.6 ng/L) and PFOS (9.25 ng/L). Groundwater at the base generally flows north on the northern side of the base, west-northwest at the eastern portion of the base, and south-southwest across the southern side of the base (AECOM 2020). The direction of groundwater flow under NAS Oceana and absence of PFAS detections in samples collected near the eastern NAS Oceana boundary indicate that it is unlikely contamination would influence groundwater underlying State Military Reservation.

3.4.2 Virginia Beach Fire Training Center and Fire Station 12

The Virginia Beach Fire Training Center and Station 12 are located approximately 0.2 mile southwest of State Military Reservation. The City of Virginia Beach Fire Department is responsible for emergency response at State Military Reservation. Universal Gold 1%/3% AR-AFFF is stored in 5-gallon buckets within the vehicle maintenance bays at Fire Station 12. Universal Gold 1%/3% AR-AFFF is known to contain fluoroalkyl surfactants. National Foam Knockdown Class A Foam Concentrate (non-AFFF) is also stored at Station 12. When needed, the Fire Department mixes AFFF from the concentrate with water for use at a response scene. According to City of Virginia Beach Fire Department staff, most of the City of Virginia Beach Fire Department fire stations have one AFFF-capable firetruck and two to three non-AFFF-capable response vehicles. No City of Virginia Beach Fire Department firetrucks have a history of maintenance issues related to AFFF. The City of Virginia Beach Fire Department Battalion Chief confirmed that AFFF is not used for washing spills or as a precaution for fuel spills, nor has it been used for emergency response at State Military Reservation. No joint fire training with AFFF occurs between VAARNG and the Fire Department at State Military Reservation. To the knowledge of both VAARNG and City of Virginia Beach Fire Department staff, AFFF has never been released at State Military Reservation. Fire Department staff could not confirm whether AFFF is used during training operations at the neighboring Virginia Beach Fire Training Center (AECOM 2020). Based on the direction of groundwater flow underlying State Military

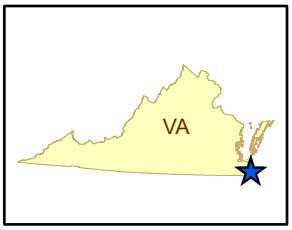
Reservation, the Virginia Beach Fire Training Center and Fire Station 12 are potentially upgradient of the AOIs.

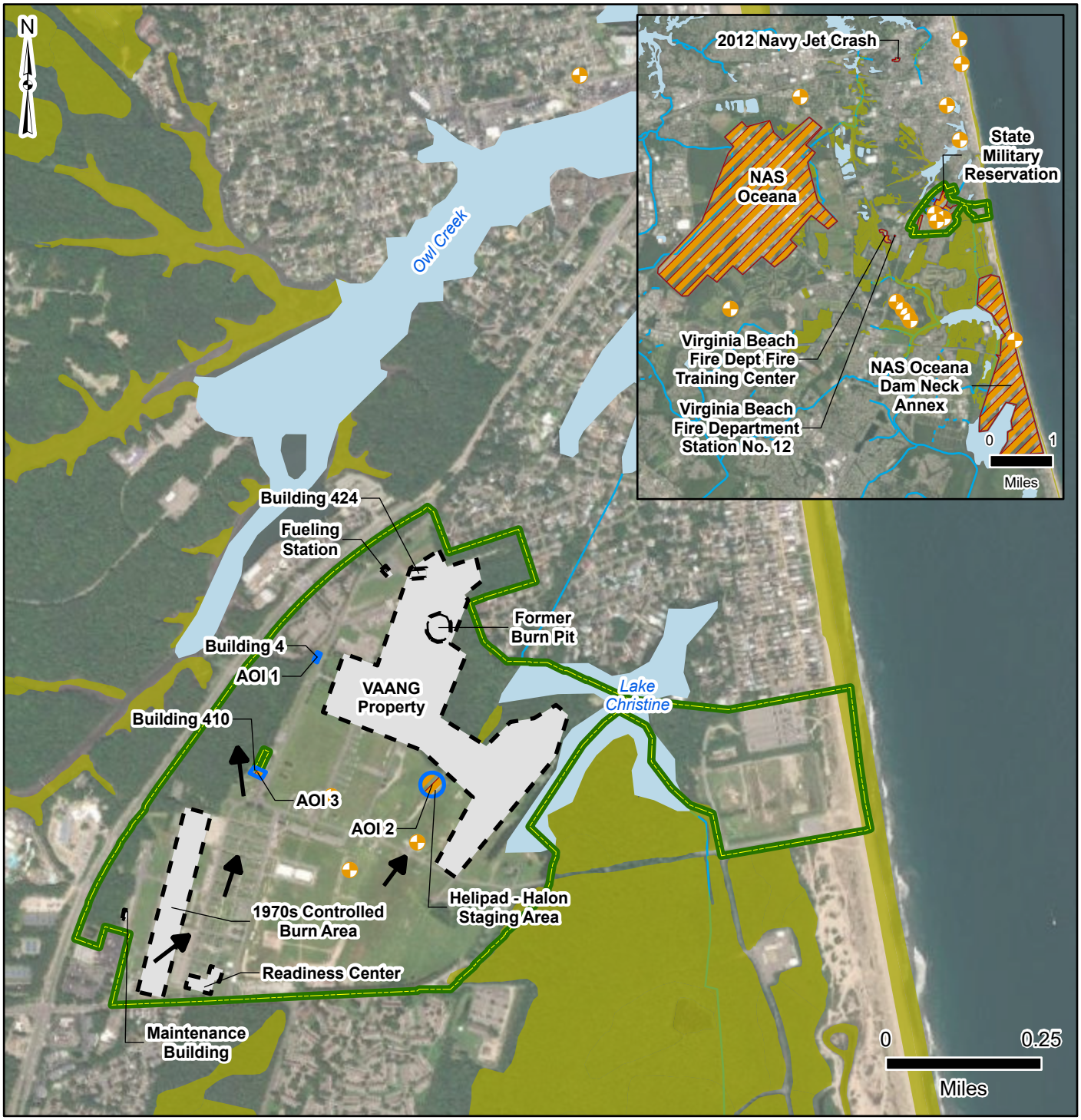
3.4.3 U.S. Navy Jet Crash Site

The 2012 U.S. Navy Jet Crash Site is located approximately 2.2 miles north of State Military Reservation, near the intersection of North Birdneck Road and Fleming Drive. The crash destroyed three buildings, and two were damaged. According to the VAARNG and City of Virginia Beach Fire Department interviewees, as well as the 2018 NAS Oceana SI Report, AFFF was used by the U.S. Navy Fire Department at the crash scene. The volume and type of AFFF used in response to the fire is unknown (AECOM 2020). The 2012 U.S. Navy Jet Crash Site is located down and cross-gradient of the AOIs.

Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 3-1
Areas of Interest





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrogeology/Hydrology
- Municipal/Public/Goverment Well Location
- Surface Water Flow Direction
- Shallow Groundwater Flow Direction
- Perennial Creek/Stream
- Waterbody
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020
USGS NHD 2021

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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4. PROJECT DATA QUALITY OBJECTIVES

As identified during the data quality objective (DQO) process and outlined in the SI Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) Addendum (EA Engineering, Science, and Technology, Inc, PBC [EA] 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 relative compounds at each of the sampled AOIs.

4.1 PROBLEM STATEMENT

ARNG will recommend AOIs for remedial investigation (RI) if site-related soil and groundwater samples have concentrations of the relevant compounds above the OSD risk-based screening levels. The SLs are presented in **Section 6.1** of this report.

4.2 INFORMATION INPUTS

Primary information inputs for the SI include the following:

- The PA Report for State Military Reservation (AECOM 2020)
- Analytical data collected during other environmental sampling efforts at State Military Reservation
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the UFP-QAPP Addendum (EA 2021a)
- Field data collected including groundwater elevations at the Facility and groundwater quality parameters measured at the time of sampling.

4.3 STUDY BOUNDARIES

The scope of the SI was bounded horizontally by the property limits of the Facility (**Figure 2-2**). Off-site sampling was not included in the scope of this SI. If future off-site 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 earliest available time field resources were available to complete the study.

4.4 ANALYTICAL APPROACH

Samples were analyzed by Eurofins Lancaster Laboratories Environmental, LLC, accredited under the DoD Environmental Laboratory Accreditation Program (ELAP); Accreditation No. 1.01). PFAS data underwent 100% Stage 2B validation in accordance with the DoD General Data Validation Guidelines (2019) and DoD Data Validation Guidelines Module 3: Data Validation Procedure of Per- and Polyfluoroalkyl Substances Analysis by Quality Systems Manual (QSM) Table B-15 (2020).

PFAS data were compared to applicable SLs and decision rules as defined in the UFP-QAPP Addendum (EA 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, 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 UFP-QAPP (EA 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 was implemented in accordance with the following approved documents.

- *Final Preliminary Assessment Report, State Military Reservation, Virginia, Virginia Army National Guard*, dated August 2020 (AECOM 2020)
- *Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide*, dated December 2020 (EA 2020a)
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, State Military Reservation, Virginia Beach, Virginia* dated July 2021 (EA 2021a)
- *Final Programmatic Accident Prevention Plan, Revision 1,* dated November 2020 (EA 2020b)
- *Final Accident Prevention Plan / Site Safety and Health Plan, State Military Reservation, Virginia, Revision 1*, dated May 2021 (EA 2021b).

The SI field activities were conducted from 7 to 10 September 2021 and consisted of DPT boring and soil sample collection, temporary monitoring well installation, and grab groundwater sample collection. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as noted in **Section 5.8**.

The following samples were collected during the SI and analyzed for a subset of 24 PFAS via liquid chromatography/tandem mass spectrometry (LC/MS/MS) compliant with QSM Version 5.3 Table B-15 to fulfill the project DQOs:

- Thirty three (33) soil samples from 16 locations (soil borings locations)
- Sixteen (16) grab groundwater samples from temporary well locations.
- Three (3) field blanks (FBs)
- Five (5) equipment rinsate samples
- Six (6) field duplicate 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 medium. 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**. 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 scoping/Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details of these activities are presented below.

5.1.1 Technical Project Planning

The U.S. Army Corps of Engineers (USACE) Technical Project Planning (TPP) Process, Engineer Manual (EM) 200-1-2 (Department of Army 2016a) defines four phases to project planning: (1) defining the project phase; (2) determining data needs; (3) developing data collection strategies; and (4) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including DQOs, and formulating a sampling approach to address the AOIs identified in the PA. There was no Virginia Department of Environmental Quality regulatory involvement in the planning process; therefore, the initial meetings included ARNG, VAARNG, USACE, and representatives familiar with the facility.

A TPP Meeting (no. 3) was held on 11 April 2023 to discuss the results of the SI. Meeting minutes for TPP 3 are included in Appendix D of this report. The stakeholders for this TPP included VAARNG, USACE, and the Virginia Department of Environmental Quality representatives familiar with the Facility, the regulations, and the community.

5.1.2 Utility Clearance

EA's drilling subcontractor contacted Miss Utility of Delmarva to notify them of intrusive work at the facility. EA contracted Inframap, a private utility location service, to perform utility clearance at the facility. Utility clearance was performed at each of the proposed boring locations on 30 August 2021 with input from the EA field team. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 ft of each boring was pre-cleared by EA's drilling subcontractor, GSI Mid-Atlantic, using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

A sample from a deionized water source at the EA Ecotoxicological Laboratory was collected on 31 March 2021, prior to mobilization. Results of the sample 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 wash rack spigot 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 PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures appendix (Appendix A) to the Programmatic UFP-QAPP (EA 2020a).

5.2 SOIL BORINGS AND SOIL SAMPLING

Soil samples were collected via DPT drilling methods in accordance with Standard Operating Procedure 047 Direct-Push Technology Sampling (EA 2021a). A Geoprobe® 7822DT dual-tube sampling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top 5 ft of the boring in compliance with utility clearance procedures.

Three discrete soil samples were planned to be collected for chemical analysis from each soil boring; one sample at the surface (0 to 2 ft bgs) and two subsurface soil samples. One subsurface soil sample was to be collected approximately 1 ft above the groundwater table and one was to be collected at the mid-point between the surface and the groundwater table (not to exceed 15 ft bgs); however, one surface soil sample (0 to 2 ft bgs) and only one subsurface soil (1 ft above the groundwater table) sample were collected due to the shallow depths to groundwater encountered at most locations. Groundwater was encountered at depths ranging from 6.5 to 12 ft bgs during drilling. At location CPEN-04, three planned samples were taken due to depth to groundwater (12 ft bgs). Total boring completion depths, to accommodate temporary well installation, ranged from 10 to 18 ft bgs.

All soil sample location are shown on **Figure 5-1**, and boring sample depths are provided in **Table 5-1**. The soil boring locations were selected based on the AOI information provided in the PA (AECOM 2020) and as agreed upon by stakeholders during the scoping meeting and review of the UFP-QAPP Addendum (EA 2021a).

During DPT boring advancement, soil cores were continuously logged for lithological description by a field geologist using the Unified Soil Classification System. A photoionization detector (PID) was used to screen the breathing zone during boring activities as a part of personal safety requirements. Observations and measurements were recorded on sampling forms (**Appendix B2**) and in a non-treated field logbook. Depth interval, recovery thickness, PID concentrations, moisture, relative density, Munsell color, and Unified Soil Classification System texture were recorded. The boring logs are provided in **Appendix E**.

Each sample was collected into a laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottle and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM Version 5.3 Table B-15), total organic compound (TOC) (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the UFP-QAPP Addendum (EA 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. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, one equipment blank (EB) was

collected per day 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 (°C) during shipment.
DPT borings were converted to temporary wells, which were subsequently abandoned after sampling and surveying in accordance with the UFP-QAPP Addendum (EA 2021a). After removal of the casings, boreholes were abandoned using bentonite chips. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.3 TEMPORARY WELL INSTALLATION AND GROUNDWATER GRAB SAMPLING

Temporary wells were installed using a GeoProbe® 7822DT dual-tube sampling system. Once the borehole was advanced to the desired depth, a temporary well was constructed of a 5-ft section of 1-inch Schedule 40 polyvinyl chloride (PVC) screen with sufficient casing to reach the ground surface. New PVC pipe and screen were used at each location to avoid cross-contamination between locations. The screen intervals for the temporary wells are provided in **Table 5-2**.

Groundwater samples were collected, after a period of time following well installation to allow groundwater to infiltrate and recharge the temporary well intervals, using a peristaltic pump with PFAS-free HDPE tubing. Each sample was collected in laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. The temporary wells were purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) before each grab sample was collected in a separate container. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 in accordance with the UFP-QAPP Addendum (EA 2021a). 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.

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 blank (FB) was collected per day in accordance with the UFP-QAPP Addendum (EA 2021a). 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

Groundwater levels measurements were recorded to evaluate site-wide groundwater elevations and assess groundwater flow direction. Synoptic water level elevation measurements were collected from the newly installed temporary monitoring wells, taken from the survey mark on the northern side of the well casing. Groundwater elevation data are provided in **Table 5-3**.

5.5 SURVEYING

The northern side of each new temporary well casing was surveyed using a Trimble R10 real-time kinematic differential global positioning system. Positions were collected in the applicable Universal Transverse Mercator zone projection with World Geodetic System 1984 datum (horizontal) and North American Vertical Datum 1988 (vertical). Surveying data were collected on 10 September 2021 and are provided in **Appendix B3**.

5.6 INVESTIGATION-DERIVED WASTE

As of the date of this report, the disposal of PFAS investigation-derived waste (IDW) is not regulated federally. PFAS IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the UFP-QAPP Addendum (EA 2021a).

Soil IDW (i.e., soil cuttings) and liquid IDW (i.e., purge water, development water, and decontamination fluids) generated during the SI activities were placed back into the boring (soil) or released to the ground surface at the completion of sampling activities.

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 off-site at a licensed solid waste landfill.

5.7 LABORATORY ANALYTICAL METHODS

Samples were analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 at Eurofins Lancaster Laboratories Environmental, LLC, in Lancaster, Pennsylvania, a DoD ELAP- and National Environmental Laboratory Accreditation Program (NELAP)-certified laboratory.

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

5.8 DEVIATIONS FROM UFP-QAPP ADDENDUM

Deviations from the UFP-QAPP Addendum occurred based on conditions encountered during the field investigation activities. These deviations were discussed between EA, ARNG, and USACE. Deviations from the UFP-QAPP Addendum are noted below:

- Due the fact the groundwater was encountered below 12 feet, only two soil samples, rather than the three outlined in the UFP-QAPP Addendum, were collected at the boring locations, with the exception of CPEN-04. Three samples were collected from CPEN-04.

- A surface soil sample (0–2 ft interval) was not taken at location CPEN-02 due to the presence of a thick organic layer (topsoil) from 0 to 1.4 ft bgs.

- The temporary well purged dry at location AOI 01-03 and the sample was collected once there was sufficient recharge.

Table 5-1. Samples by Medium

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Soil Samples						
AOI02-01-SB-1-2	9/8/2021	1–2	X			
AOI03-02-SB-1-2	9/8/2021	1–2	X			
AOI02-02-SB-8-9	9/9/2021	8–9	X			
CPEN04-SB-1-2	9/8/2021	1–2	X			
CPEN03-SB-8-9	9/8/2021	8–9	X			
AOI01-04-SB-8-9	9/8/2021	8–9	X			
AOI01-02-SB-8-9	9/8/2021	8–9	X			
AOI02-03-SB-8-9	9/9/2021	8–9	X			
CPEN04-SB-11-12	9/8/2021	11–12	X			
CPEN03-SB-1-2	9/8/2021	1–2	X			
AOI03-02-SB-8-9	9/8/2021	8–9	X			
AOI01-02-SB-1-2	9/8/2021	1–2	X			
AOI03-04-SB-1-2	9/8/2021	1–2	X			
AOI01-01-SB-1-2	9/8/2021	1–2	X			
AOI03-01-SB-8-9	9/8/2021	8–9	X			
AOI02-02-SB-1-2	9/9/2021	1–2	X			
CPEN01-SB-1-2	9/8/2021	1–2	X			
CPEN01-SB-5-6	9/8/2021	5–6	X			
AOI01-01-SB-7-8	9/8/2021	7–8	X			
AOI03-01-SB-1-2	9/8/2021	1–2	X			
CPEN04-SB-6-7	9/8/2021	6–7	X			
AOI02-04-SB-6-7	9/8/2021	6–7	X			
AOI01-03-SB-8-9	9/8/2021	8–9	X			
AOI03-03-SB-1-2	9/8/2021	1–2	X			
AOI02-01-SB-7-8	9/8/2021	7–8	X			MS/MSD
AOI03-04-SB-8-9	9/8/2021	8–9	X			MS/MSD
CPEN-FD4	9/9/2021	8–9	X			Field duplicate of AOI02-02-SB-8-9
CPEN02-SB-2-3	9/9/2021	2–3	X			
AOI02-04-SB-1-2	9/8/2021	1–2	X			
AOI03-04-SB-8-9	9/8/2021	8–9		X	X	
AOI01-04-SB-1-2	9/8/2021	1–2		X	X	
AOI02-01-SB-1-2	9/8/2021	1–2		X	X	
CPEN-FD5	9/8/2021	8–9		X	X	Field duplicate of AOI04-04-SB-8-9
CPEN-01-SB-03	9/8/2021	3				Grain Size Analysis
CPEN03-SB-7-8	9/8/2021	7–8				Grain Size Analysis
AOI02-03-SB-1-2	9/9/2021	1–2	X			
AOI03-03-SB-6-7	9/8/2021	6–7	X			
AOI01-03-SB-1-2	9/8/2021	1–2	X			
CPEN-FD2	9/8/2021	8–9	X			Field duplicate of AOI03-02-SB-8-9
CPEN-FD3	9/8/2021	8–9	X			Field duplicate of AOI01-04-SB-8-9
CPEN02-SB-5-6	9/9/2021	5–6	X			
AOI01-04-SB-1-2	9/8/2021	1–2	X			

Table 5-1. Samples by Medium

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
CPEN-FD1	9/8/2021	8–9	X			Field duplicate of CPEN03-SB-8-9
Groundwater Samples						
AOI01-01-GW	9/9/2021		X			
AOI01-02-GW	9/9/2021		X			
AOI01-03-GW	9/9/2021		X			
AOI01-04-GW	9/9/2021		X			
AOI02-01-GW	9/9/2021		X			
AOI02-02-GW	9/9/2021		X			
AOI02-03-GW	9/9/2021		X			
AOI02-04-GW	9/9/2021		X			
AOI03-01-GW	9/8/2021		X			
AOI03-02-GW	9/9/2021		X			
AOI03-03-GW	9/9/2021		X			
AOI03-04-GW	9/8/2021		X			MS/MSD
CPEN-01-GW	9/8/2021		X			
CPEN-02-GW	9/9/2021		X			
CPEN-03-GW	9/8/2021		X			
CPEN-04-GW	9/8/2021		X			
CPEN-FD1-GW	9/8/2021		X			Field duplicate of CPEN-04-GW
CPEN-FD2-GW	9/8/2021		X			Field duplicate of AOI03-01-GW
CPEN-FD3-GW	9/9/2021		X			Field duplicate of AOI02-01-GW
Blank Samples						
CPEN-EB1	9/8/2021		X			Equipment Blank
CPEN-EB2	9/9/2021		X			Equipment Blank
CPEN-FB1	9/8/2021		X			Field Blank
CPEN-FB2	9/9/2021		X			Field Blank

Table 5-2. Soil Boring Depths and Temporary Well Screen Intervals
State Military Reservation, Virginia Beach, Virginia
Site Inspection Report

Area of Interest	Boring Identification	Soil Boring Depth (ft bgs)	Temporary Well Screen Interval (ft bgs)
1	AOI01-01	15	10–15
	AOI01-02	15	10–15
	AOI01-03	15	10–15
	AOI01-04	15	10–15
2	AOI02-01	15	10–15
	AOI02-02	15	10–15
	AOI02-03	15	10-15
	AOI02-04	15	10–15
3	AOI03-01	18	10–15
	AOI03-02	15	10–15
	AOI03-03	18	10–15
	AOI03-04	15	10–15
Facility Boundary	CPEN-01	10	5–10
	CPEN-02	10	5–10
	CPEN-03	18	9–14
	CPEN-04	17.5	10–15

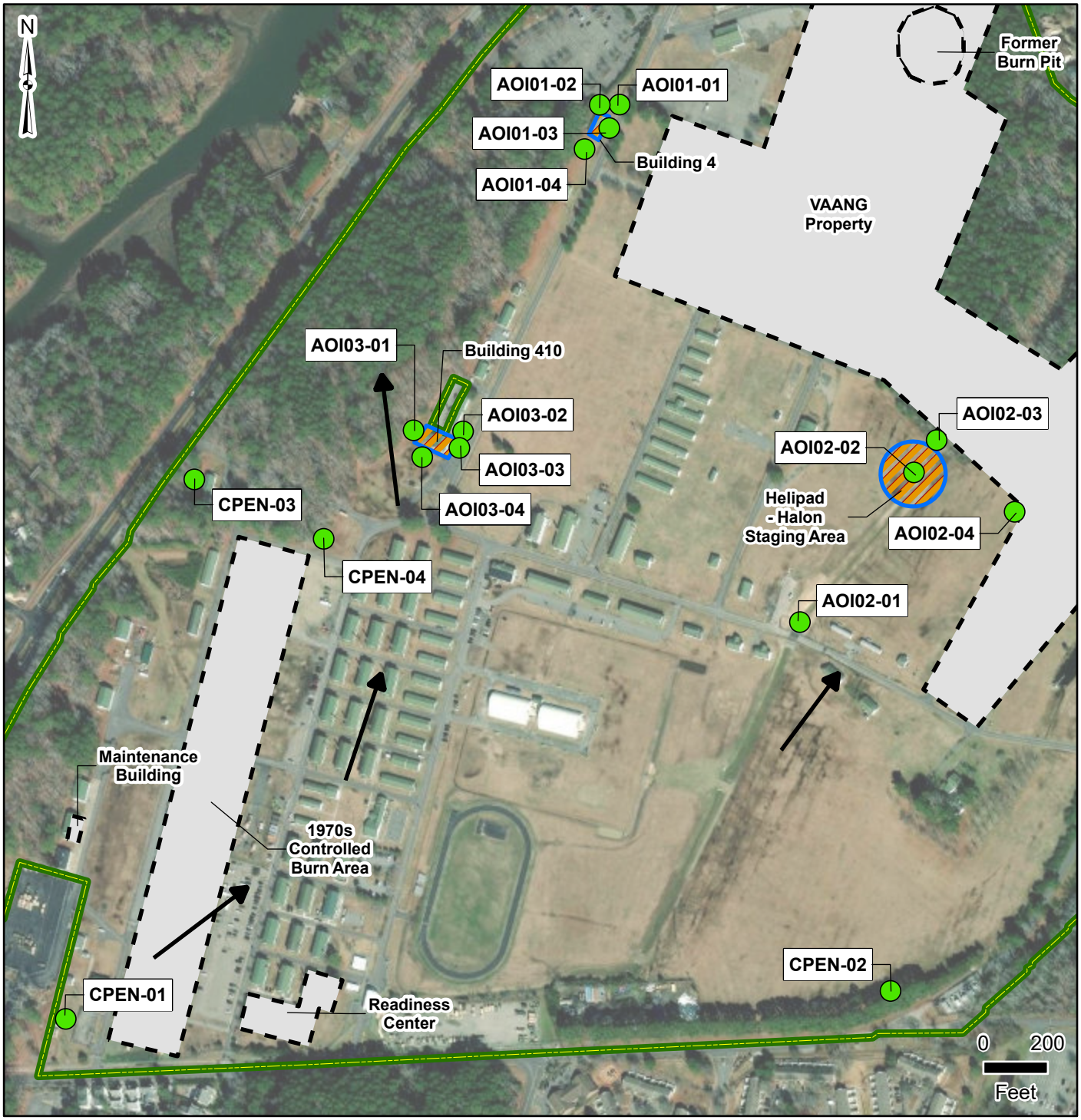
Table 5-3. Groundwater Elevation
State Military Reservation, Virginia Beach, Virginia
Site Inspection Report

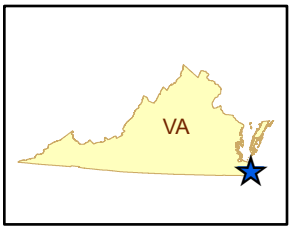
Monitoring Well ID	Top of Casing Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
AOI01-01	13.48	9.66	3.82
AOI01-02	12.29	9.85	2.44
AOI01-03	13.12	7.80	5.32
AOI01-04	12.60	7.98	4.62
AOI02-01	9.29	5.05	4.24
AOI02-02	7.37	3.95	3.42
AOI02-03	6.79	3.39	3.40
AOI02-04	11.10	7.65	3.45
AOI03-01	11.78	8.82	2.96
AOI03-02	12.33	8.34	3.99
AOI03-03	13.07	9.55	3.52
AOI03-04	11.63	6.80	4.83
CPEN-01	14.93	6.95	7.98
CPEN-02	7.70	3.70	4.00
CPEN-03	12.24	9.30	2.94
CPEN-04	11.04	7.79	3.25

Notes:
amsl = Above mean sea level
btoc = Below top of casing

Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 5-1
Site Inspection Sample Locations





Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_63425038\3\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Sample Location
- DPT

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction

Data Sources:
ESRI 2020
AECOM 2020
USGS NHD 2021

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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6. SITE INSPECTION RESULTS

This section presents the analytical results of the SI for each AOI. The analytical results are reported and evaluated in the subsequent sections. The SLs used in this evaluation are presented in **Table 6-1**. A discussion of the results for each AOI is provided in **Sections 6.3 through 6.5**. **Tables 6-2 through 6-4** present PFAS results for samples with detections in soil and groundwater; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 SCREENING LEVELS

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

Notes:
1. Assistant Secretary of Defense. 2022. Risk-Based SLs in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient=0.1. 6 July 2022.
2. 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.

µg/kg = Microgram(s) per kilogram
ng/L = Nanogram(s) per liter

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 receptor identified at the Facility; the residential scenario is applied to surface soil results (0 to 2 ft bgs) and the industrial/commercial worker scenario is applied to shallow subsurface soil results (2 to 15 ft bgs). The industrial/commercial worker scenario was applied to shallow subsurface soil samples collected from mid-point at the soil borings (below 15 ft bgs) in each AOI, providing a conservative assessment of that potential exposure route for the industrial/commercial workers. The SLs are not applied to deep subsurface soil results (greater than 15 ft bgs) because 15 ft is the anticipated limit of construction activities. No soil samples were collected below 12 ft bgs.

6.2 SOIL PHYSICOCHEMICAL ANALYSES

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

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions, and are therefore relatively mobile in groundwater (Xiao et al. 2015) but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins 2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (e.g., pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC 2018).

Soil pH was measured as 4.9 in samples collected from AOI 1. Soil pH was measured as 4.7 in samples collected from AOI 2. Soil pH was measured as 4.8 in a sample collected from AOI 3. TOC ranged from a low of 400,000 mg/kg in the sample collected from AOI 3 to a high of 3,900,000 mg/kg in the sample collected from AOI 1.

6.3 AOI 1

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1 – Building 4, which was historically leased by the U.S. Navy. 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

Figure 6-1 through **6-5** present the ranges of detections in soil. **Tables 6-2 and 6-3** summarize the detected compounds in soil.

Soil was sampled in four boring locations associated with one potential release area at AOI 1. Soil was sampled from two intervals, shallow (0–2 ft bgs) and intermediate depths (less than 15 ft bgs), at four locations.

PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in samples taken from the shallow interval. PFOS was detected in one sample, taken from AOI01-04 at a depth of 8–9 ft bgs (subsurface soil), with a value of 0.84 µg/kg. Location AOI01-04 is located to the southwest of Building 4. PFOA, PFHxS, PFNA, and PFBS were not detected in any other subsurface soil samples collected from the boring locations associated with AOI 1.

6.3.2 AOI 1 – Groundwater Analytical Results

Figures 6-6 and 6-7 presents the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater samples were collected from four temporary wells at AOI 1 during the SI activities. PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in groundwater at concentrations exceeding associated SLs. PFOA was detected in groundwater at concentrations ranging from 0.62 J ng/L (AOI01-01) to 3.0 ng/L (AOI01-03). PFOS, PFHxS, PFNA, and PFBS were detected in groundwater at location AOI01-03 at concentrations of 3.4 ng/L, 0.82 ng/L, 1.5 ng/L, and 0.84 J ng/L, respectively. PFOS, PFHxS, PFNA, and PFBS were detected at one location AOI01-03, which also had the highest concentration of PFOA.

6.3.3 AOI 1 – Conclusions

Based on the results of the SI, PFOS was detected in soil and PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in groundwater at concentrations below their respective SLs. Therefore, further evaluation at AOI 1 is not warranted.

6.4 AOI 2

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2 - Helipad where a wheeled Halon fire extinguisher was formerly staged. 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**.

6.4.1 AOI 2 – Soil Analytical Results

Figure 6-1 through **6-5** present the ranges of detections in soil. **Tables 6-2 and 6-3** summarize the detected compounds in soil.

Soil was sampled in four boring locations associated with one potential release area at AOI 2. Soil was sampled from two intervals, at shallow (0–2 ft bgs) and intermediate depths (less than 15 ft bgs), at four locations.

PFOA was detected in two surface soil samples (0–2 ft bgs), taken from AOI02-02 and AOI02-04, with values of 0.28 J µg/kg and 0.22 J µg/kg, respectively. PFOS, PFHxS, PFNA, and PFBS were not detected in any shallow soil samples collected from the boring locations associated with AOI 2. Additionally, PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in any subsurface soil samples collected from the boring locations associated with AOI 2.

6.4.2 AOI 2 – Groundwater Analytical Results

Figures 6-6 and 6-7 presents the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater samples were collected from four temporary wells at AOI 2 during the SI activities.

PFNA was not detected in any samples. PFOA, PFHxS, and PFBS were not detected in groundwater at concentrations exceeding associated SLs. PFOS was detected at a concentration 5.1 J ng/L, which exceeds the SL (4 ng/L). All detections of the aforementioned analytes, including the exceedance, were detected in the groundwater sample collected at location AOI02-01, which was located southwest of the helipad, adjacent to the surrounding road and upgradient of the AOI.

6.4.3 AOI 2 – Conclusions

Based on the results of the SI, PFOA was detected in soil and PFOA, PFHxS, and PFBS were detected in groundwater at concentrations below their respective SLs. However, PFOS was detected at a concentration, which exceeded the associated SL. Based on the exceedance of an SL in 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 1 - Building 410, which served as the State Military Reservation Fire Department prior to the 1970s. 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**.

6.5.1 AOI 3 – Soil Analytical Results

Figure 6-1 through **6-5** present the ranges of detections in soil. **Tables 6-2 and 6-3** summarize the detected compounds in soil.

Soil was sampled in four boring locations associated with one potential release area at AOI 3. Soil was sampled from two intervals at four locations, at shallow (0–2 ft bgs) and intermediate depths (less than 15 ft bgs).

PFOA and PFHxS were detected in one surface soil sample (0–2 ft bgs), taken from AOI03-01, with a values of 0.28 J µg/kg and 0.27 µg/kg, respectively. PFOS was detected in two surface soil samples, taken from AOI03-01 and AOI03-03, with values of 0.35 J µg/kg and 0.51 J µg/kg, respectively. PFBS and PFNA were not detected in any shallow soil samples collected from the boring locations associated with AOI 3. Additionally, PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in any subsurface soil samples collected from the boring locations associated with AOI 3.

6.5.2 AOI 3 – Groundwater Analytical Results

Figures 6-6 and 6-7 presents the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater samples were collected from four temporary wells at AOI 3 during the SI activities.

PFNA, PFHxS, and PFBS were not detected in groundwater at concentrations exceeding associated SLs. However, at temporary well AOI03-03, PFOS and PFOA were detected at concentrations of 5.8 ng/L and 6.2 ng/L, which exceed the associated SLs of 4 ng/L and 6 ng/L, respectively. In addition to these exceedances, the highest concentrations of PFBS (1.1 ng/L) and PFNA (2.0 ng/L) were also detected at location AOI03-03, located east of Building 410, in the grass adjacent to the garage door.

6.5.3 AOI 3 – Conclusions

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

6.6 BOUNDARY SAMPLE LOCATIONS

This section presents the analytical results for soil and groundwater in comparison to SLs at the facility boundary. 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**.

6.6.1 Facility Boundary – Soil Analytical Results

Figure 6-1 through **6-5** present the ranges of detections in soil. **Tables 6-2 and 6-3** summarize the detected compounds in soil.

Soil was sampled in four boring locations not associated with the AOIs, predominantly located around the facility boundary. Soil was sampled from two intervals at four locations, at shallow (0–2 ft bgs) and intermediate depths (less than 15 ft bgs), with the exception of CPEN-04 (three total samples due to deeper groundwater depth encountered at this location) and CPEN-02 (one sample collected 2–3 ft bgs and one <15 ft bgs), as previously described in **Section 5.8**.

PFOS was detected in two surface soil samples (0–2 ft bgs), collected from CPEN-01 and CPEN-04, with values of 0.26 J µg/kg and 0.27 J µg/kg, respectively. PFOA was detected in two surface soil samples, taken from CPEN-01 and CPEN-04, with values of 0.55 J µg/kg and 0.46 J µg/kg, respectively. PFBS, PFHxS, and PFNA were not detected in any soil samples collected from the boring locations associated with the facility boundary.

6.6.2 Facility Boundary – Groundwater Analytical Results

Figures 6-6 and 6-7 presents the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater samples were collected from four temporary wells not associated with the AOIs, predominantly located around the facility boundary, during the SI activities.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in groundwater samples collected from four temporary wells. In general, the detections of these analytes were below associated SLs. However, PFOA was detected at locations CPEN-01 and CPEN-03 at concentrations of 9.5 ng/L and 8.9 ng/L, respectively. Both of these detections exceeded the SL of 6 ng/L. Similarly, PFOS was detected at locations CPEN-01 and CPEN-03 at concentrations of 11 ng/L and 13 ng/L, respectively. Both of these detections exceeded the SL of 4 ng/L. Based on the location of these exceedances (upgradient and cross gradient boundaries), there is likely an off-facility source (Virginia Beach Fire Training Center and Fire Station 12), which may be contributing PFAS to the groundwater migrating onto the site from the northeast.

6.6.3 Facility Boundary – Conclusions

Based on the results of the SI, PFOS and PFOA were detected in soils and PFHxS, PFNA, and PFBS were detected in groundwater below their respective SLs. However, PFOS and PFOA were detected in groundwater at concentrations, which exceeded their respective SLs. Based on the exceedances of SLs in groundwater, further evaluation of the facility boundary is warranted.

Table 6-2. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, State Military Reservation

	Location ID	AOI01								AOI02								AOI03								CPEN					
	Sample Name	AOI01-01-SB-1-2		AOI01-02-SB-1-2		AOI01-03-SB-1-2		AOI01-04-SB-1-2		AOI02-01-SB-1-2		AOI02-02-SB-1-2		AOI02-03-SB-1-2		AOI02-04-SB-1-2		AOI03-01-SB-1-2		AOI03-02-SB-1-2		AOI03-03-SB-1-2		AOI03-04-SB-1-2		CPEN01-SB-1-2		CPEN03-SB-1-2		CPEN04-SB-1-2	
	Parent Sample ID																														
	Sample Date	9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/9/2021		9/9/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021	
	Depth (ft bgs)	1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2		1-2	
Analyte	**Screening Level[1,2]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (µg/kg)																															
Perfluorobutanesulfonic acid (PFBS)	1900	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid	130	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.27	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid	19	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	13	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	0.35	J	ND	U	0.51	J	ND	U	0.27	J	ND	U	0.26	J
Perfluorooctanoic acid (PFOA)	19	ND	U	ND	U	ND	U	ND	U	ND	U	0.28	J	ND	U	0.22	J	0.28	J	ND	U	ND	U	ND	U	0.55	J	ND	U	0.46	J

Notes:
J = Estimated concentration.
U = Analyte was not detected.
µg/kg = Microgram(s) per kilogram
1. The Screening Levels for soil are based on incidental ingestion of soil in a residential scenario.
2. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.

Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted

Values exceeding the Screening Level are shaded gray.
ft bgs = Feet below ground surface.
ND = Analyte not detected above the LOD.
Qual = Qualifier.

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Table 6-3. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, State Military Reservation

	Location ID	AOI01										AOI02										AOI03									
	Sample Name	AOI01-01-SB-7-8		AOI01-02-SB-8-9		AOI01-03-SB-8-9		AOI01-04-SB-8-9		CPEN-FD3		AOI02-01-SB-7-8		AOI02-02-SB-8-9		AOI02-03-SB-8-9		AOI02-04-SB-6-7		CPEN-FD4		AOI03-01-SB-8-9		AOI03-02-SB-8-9		AOI03-03-SB-6-7		AOI03-04-SB-8-9		CPEN-FD2	
	Parent Sample ID									AOI01-04-SB-8-9										AOI02-02-SB-8-9										AOI03-02-SB-8-9	
	Sample Date	9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/9/2021		9/9/2021		9/8/2021		9/9/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021		9/8/2021	
	Depth (ft bgs)	7-8		8-9		8-9		8-9		8-9		7-8		8-9		8-9		6-7		8-9		8-9		8-9		6-7		8-9		8-9	
Analyte	**Screening Level[1,2]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ug/kg)																															
Perfluorobutanesulfonic acid (PFBS)	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid	1600	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	ND	U	ND	U	ND	U	0.84		ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U

Notes:
U = Analyte was not detected.
ug/kg = Microgram(s) per kilogram
1. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial worker scenario.
2. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
Values exceeding the Screening Level are shaded gray.
3. Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted
ft bgs = Feet below ground surface.
ND = Analyte not detected above the LOD.
Qual = Qualifier.

Table 6-3. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, State Military Reservation

Location ID		CPEN									
Sample Name		CPEN01-SB-5-6		CPEN02-SB-2-3		CPEN03-SB-8-9		CPEN-FD1		CPEN04-SB-6-7	
Parent Sample ID								CPEN03-SB-8-9			
Sample Date		9/8/2021		9/9/2021		9/8/2021		9/8/2021		9/8/2021	
Depth (ft bgs)		5-6		2-3		8-9		8-9		6-7	
Analyte	**Screening Level[1,2]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ug/kg)											
Perfluorobutanesulfonic acid (PFBS)	25000	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid	1600	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid	250	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	ND	U	ND	U	ND	U	ND	U	ND	U

Notes:
U = Analyte was not detected.
ug/kg = Microgram(s) per kilogram
1. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial worker scenario.
2. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
Values exceeding the Screening Level are shaded gray.
3. Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted
ft bgs = Feet below ground surface.
ND = Analyte not detected above the LOD.
Qual = Qualifier.

Table 6-4. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Deep Subsurface Soil Site Inspection Report, State Military Reservation

Location ID	CPEN			
Sample Name	CPEN02-SB-5-6		CPEN04-SB-11-12	
Parent Sample ID				
Sample Date	9/9/2021		9/8/2021	
Depth (ft bgs)	5-6		11-12	
Analyte	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (µg/kg)				
Perfluorobutanesulfonic acid (PFBS)	ND	U	ND	U
Perfluorohexanesulfonic acid	ND	U	ND	U
Perfluorononanoic acid	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	ND	U	ND	U

Notes:
U = Analyte was not detected.
Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted
µg/kg = Microgram(s) per kilogram
ft bgs = Feet below ground surface.
ND = Analyte not detected above the LOD.

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Table 6-5. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, State Military Reservation

Location ID		AOI01								AOI02										AOI03									
Sample Name		AOI-01-01-GW		AOI01-02-GW		AOI01-03-GW		AOI01-04-GW		AOI02-01-GW		AOI02-02-GW		AOI02-03-GW		AOI02-04-GW		CPEN-FD3-GW		AOI03-01-GW		AOI03-02-GW		AOI03-03-GW		AOI03-04-GW		CPEN-FD2-GW	
Parent Sample ID																		AOI02-01-GW										AOI03-01-GW	
Sample Date		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/9/2021		9/8/2021		9/9/2021		9/9/2021		9/8/2021		9/8/2021	
Analyte	**Screening Level[1]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ng/L)																													
Perfluorobutanesulfonic acid (PFBS)	601	ND	U	ND	U	0.84	J	ND	U	1	J	ND	U	ND	U	ND	U	0.99	J	ND	U	0.84	J	1.1	J	ND	U	ND	U
Perfluorohexanesulfonic acid	39	ND	U	ND	U	0.82	J	ND	U	2		ND	U	ND	U	ND	U	2		1.1	J	1.4	J	2		ND	U	1.1	J
Perfluorononanoic acid	6	ND	U	ND	U	1.5	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	2		0.52	J	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	4	ND	U	ND	U	3.4		ND	U	5.1	J	ND	U	ND	U	ND	U	5	J	1.1	J	1.6	J	5.8		ND	U	1.1	J
Perfluorooctanoic acid (PFOA)	6	0.62	J	0.64	J	3		0.75	J	2.6		ND	U	ND	U	ND	U	2.2		0.63	J	1.4	J	6.2		0.79	J	ND	U

Notes:
J = Estimated concentration
U = Analyte was not detected.
ng/L = Nanogram(s) per liter.
1. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
2. Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted
Values exceeding the Screening Level are shaded gray.
ND = Analyte not detected above the LOD.
Qual = Qualifier.

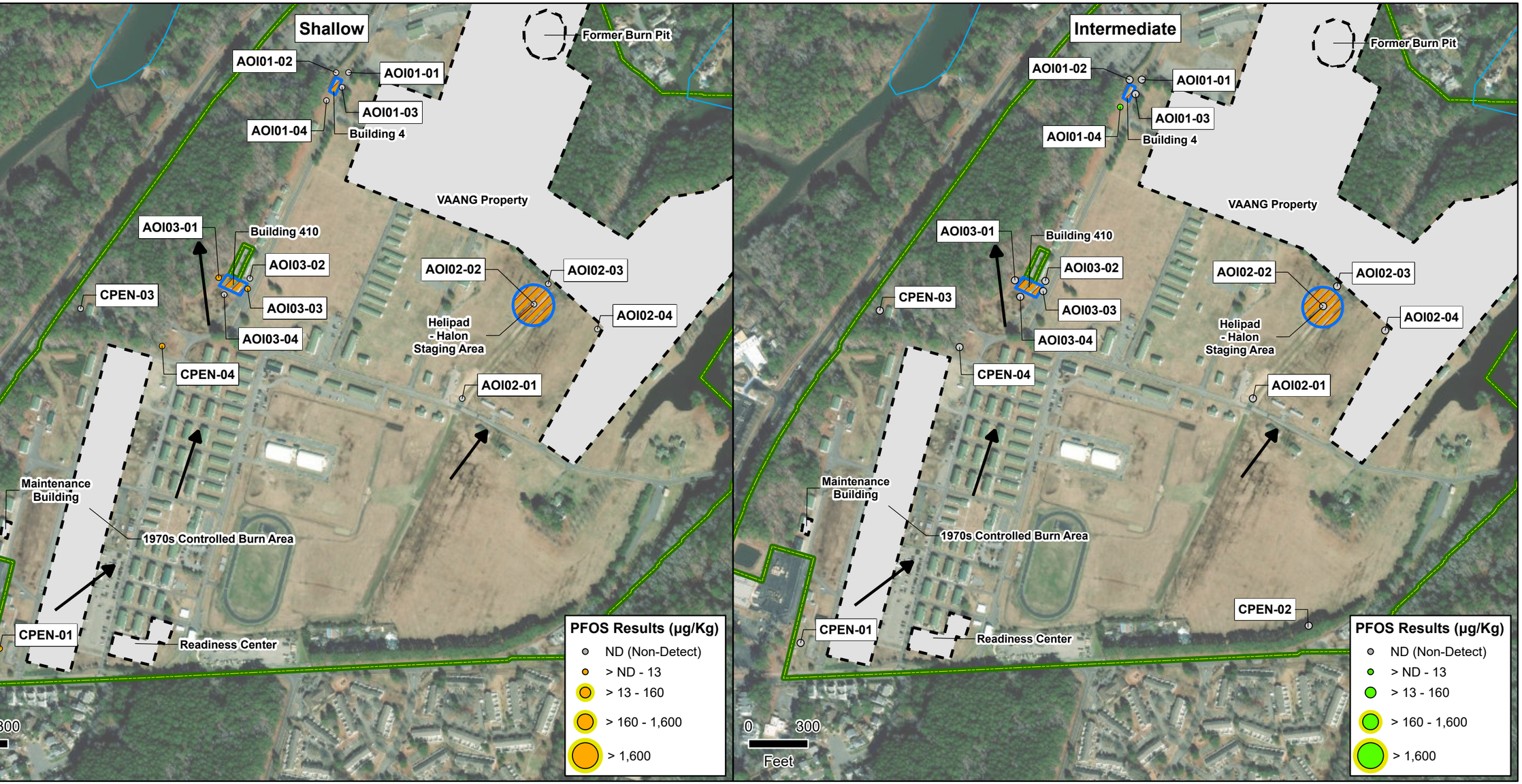
Table 6-5. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, State Military Reservation

Location ID		CPEN									
Sample Name		CPEN-01-GW		CPEN-02-GW		CPEN-03-GW		CPEN-04-GW		CPEN-FD1-GW	
Parent Sample ID										CPEN-04-GW	
Sample Date		9/8/2021		9/9/2021		9/8/2021		9/8/2021		9/8/2021	
Analyte	**Screening Level[1]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ng/L)											
Perfluorobutanesulfonic acid (PFBS)	601	4.4		ND	U	11		0.61	J	0.64	J
Perfluorohexanesulfonic acid	39	3.4		ND	U	20		0.58	J	0.48	J
Perfluorononanoic acid	6	2.3		ND	U	1.2	J	0.46	J	0.46	J
Perfluorooctanesulfonic acid (PFOS)	4	11		ND	U	13		0.52	J	0.8	J
Perfluorooctanoic acid (PFOA)	6	9.5		ND	U	8.9		0.69	J	0.83	J

Notes:
J = Estimated concentration
U = Analyte was not detected.
ng/L = Nanogram(s) per liter.
1. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
2. Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted
Values exceeding the Screening Level are shaded gray.
ND = Analyte not detected above the LOD.
Qual = Qualifier.

Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-1
PFOS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

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

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton_SI.aprx

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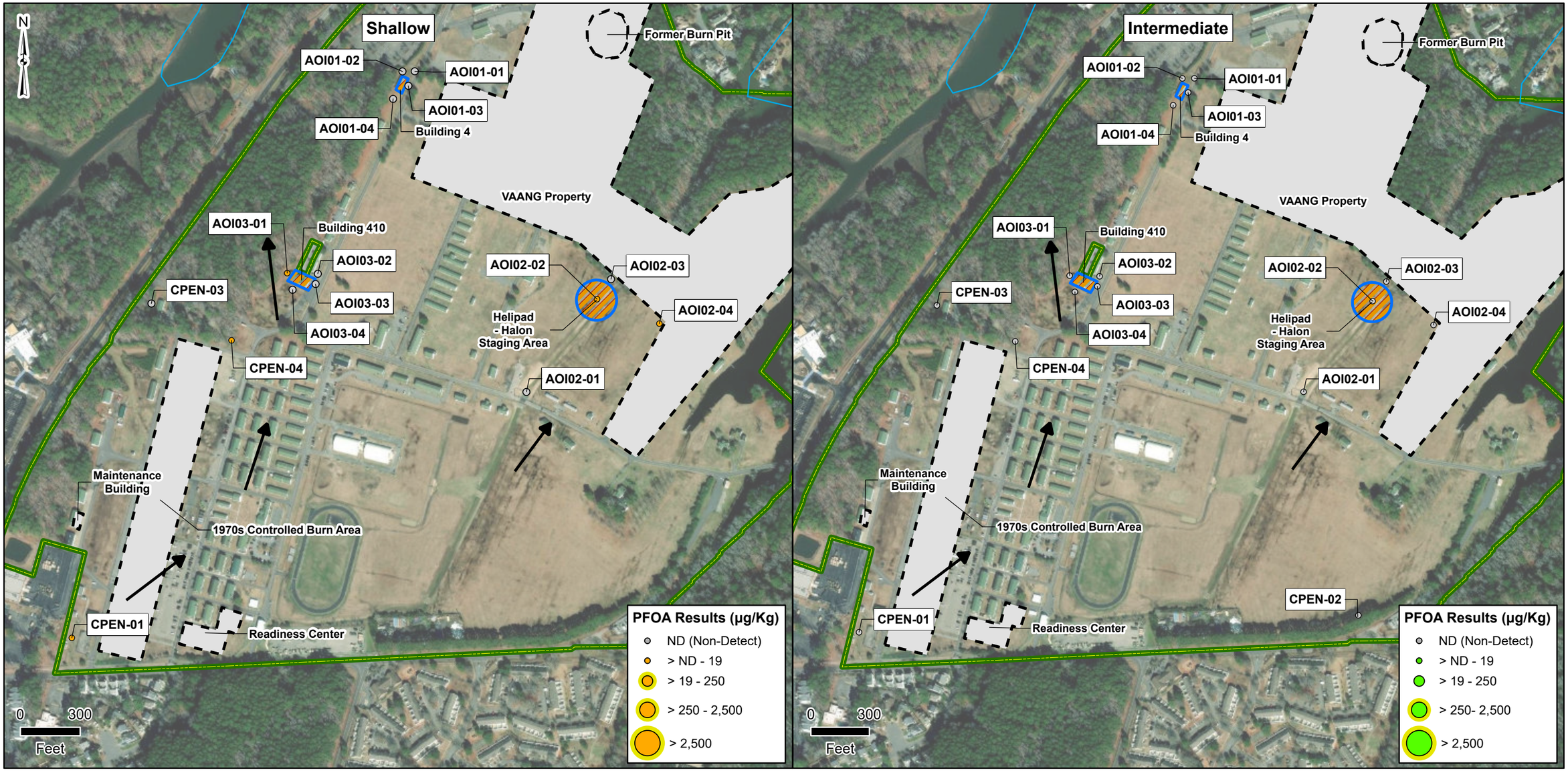
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-2
PFOA Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

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

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

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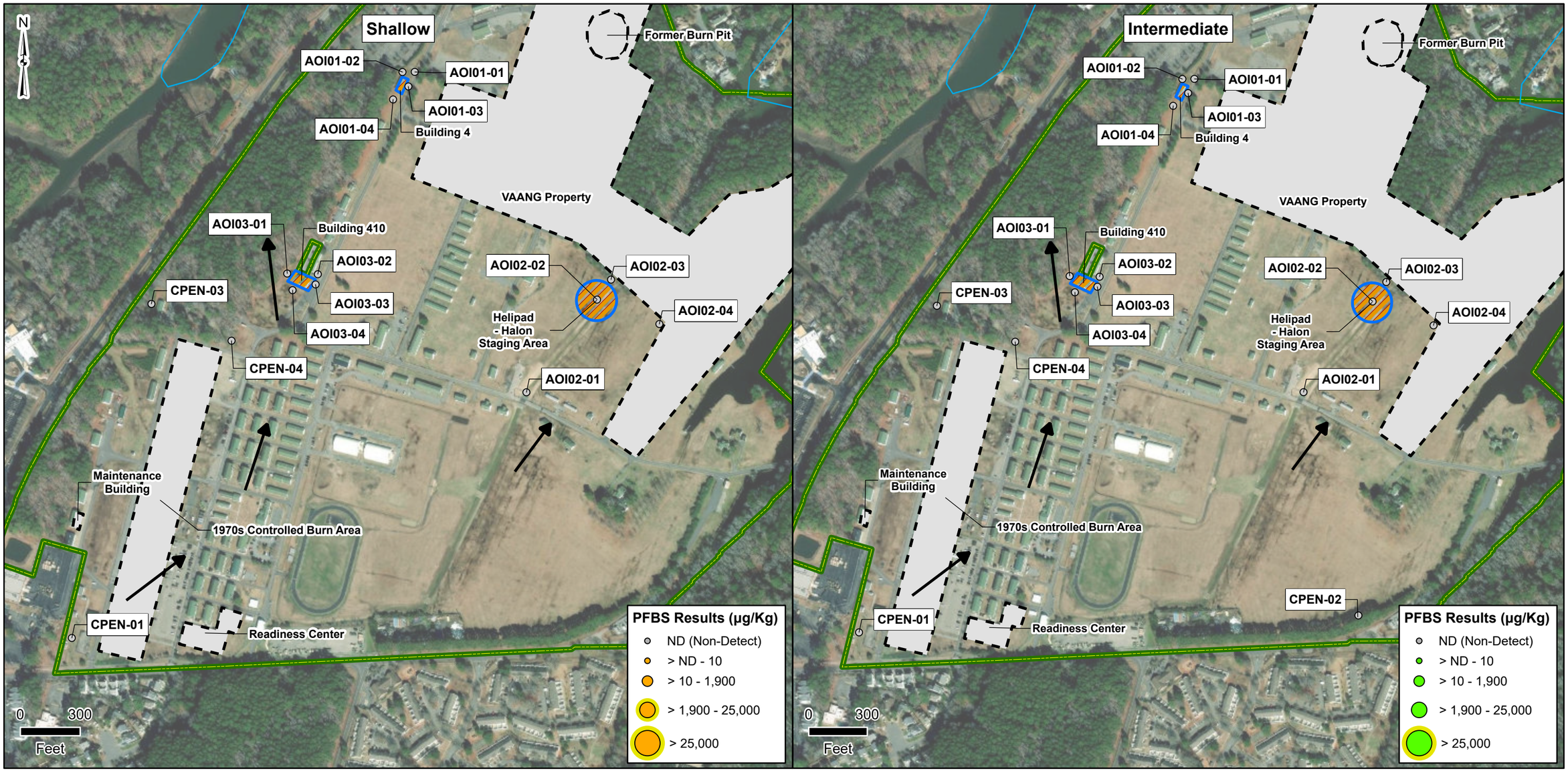
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-3
PFBS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

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

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

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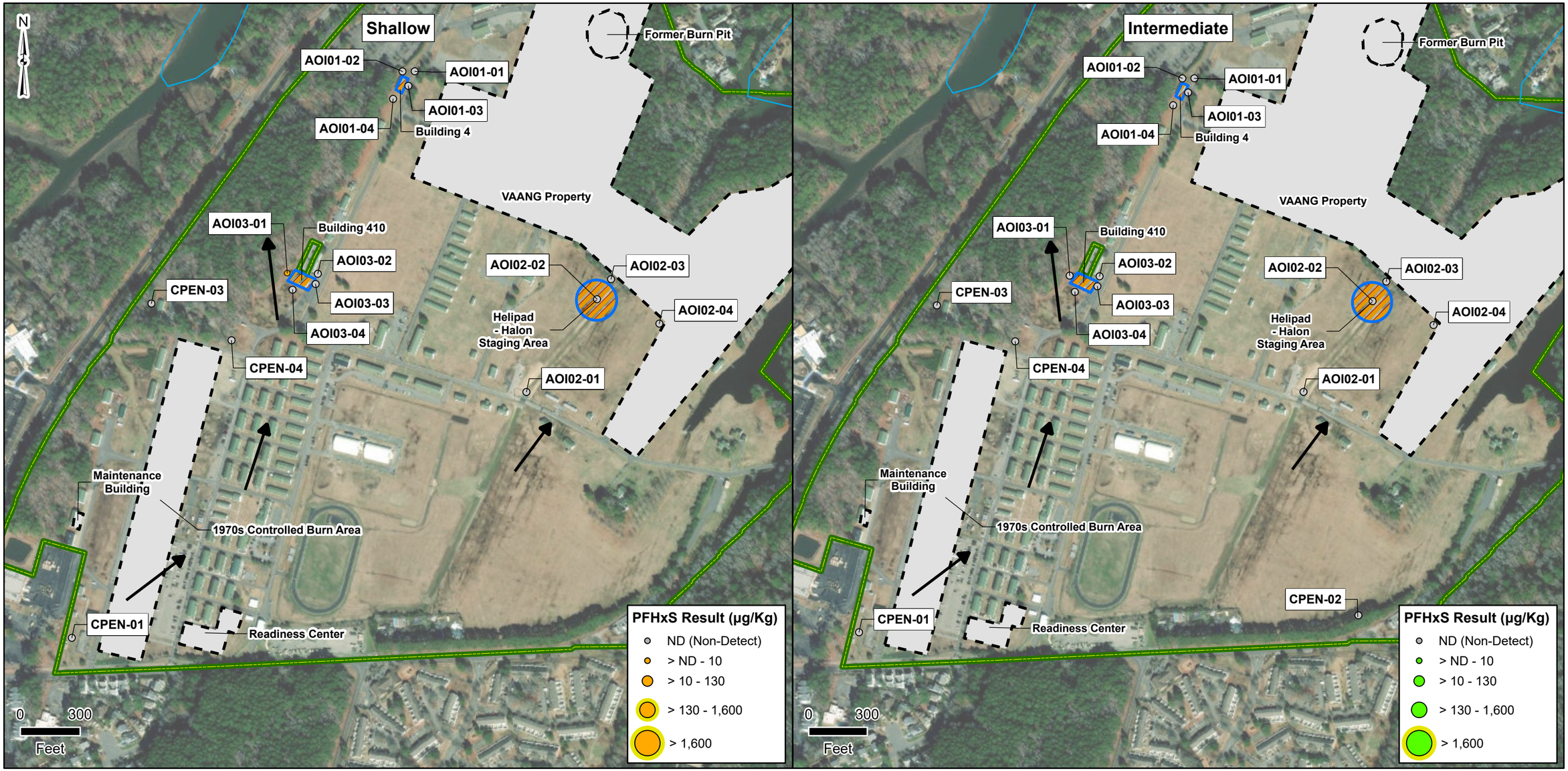
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-4
PFHxS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

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

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

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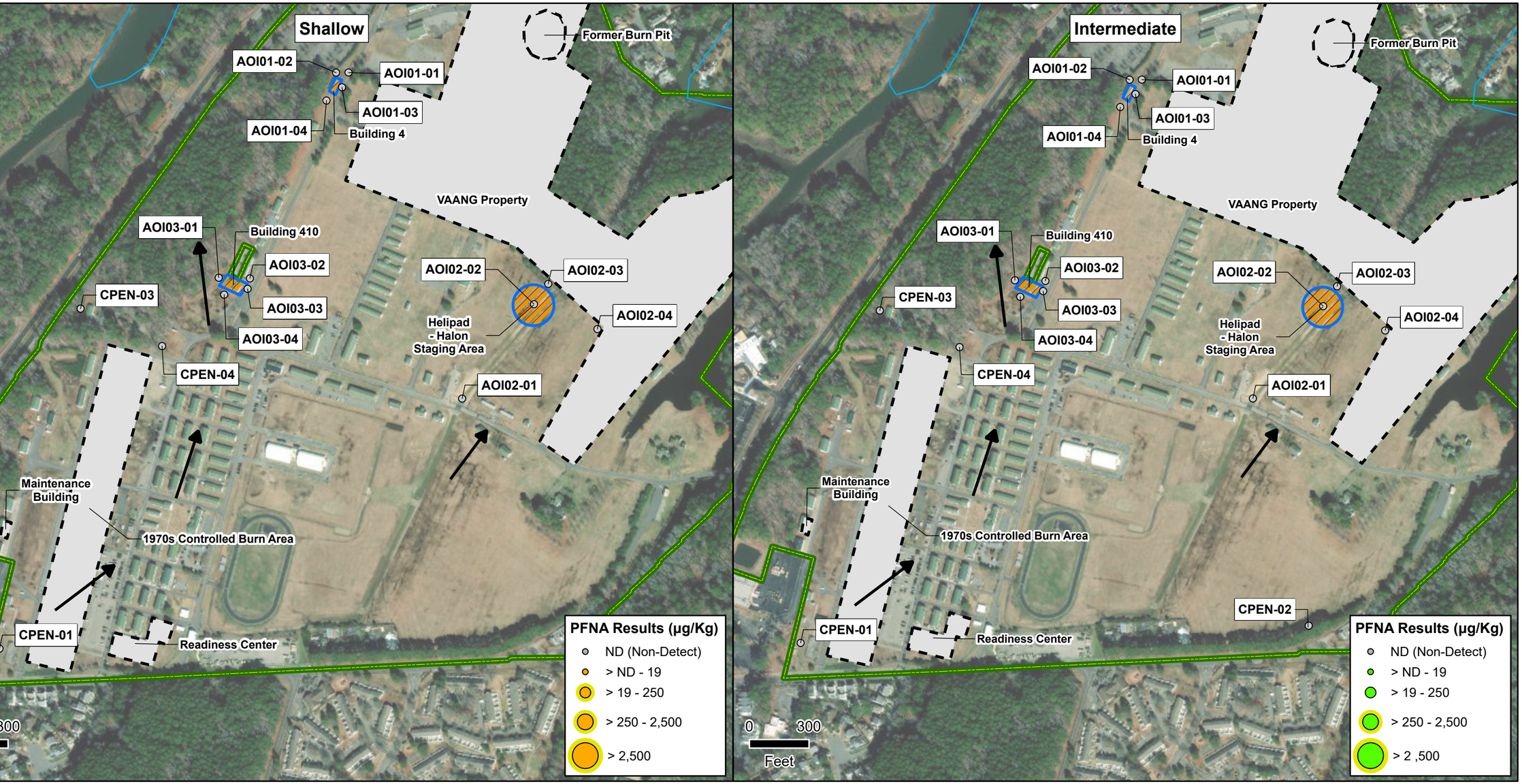
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-5
PFNA Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

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

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

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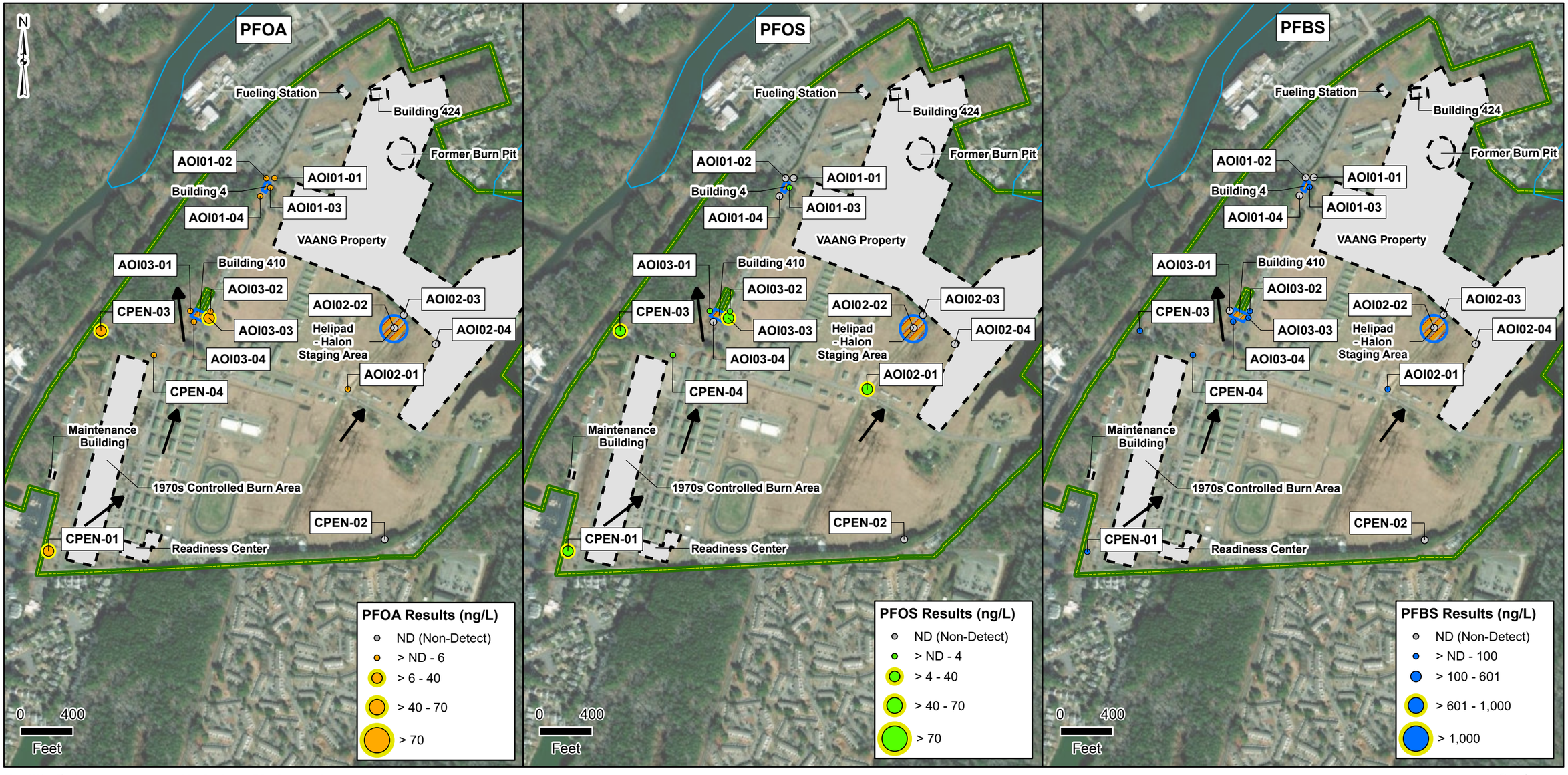
Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-6
PFOA, PFOS and PFBS Detections in Groundwater



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

Notes:
PFOA = Perfluorooctanesulfonic acid
PFOS = Perfluorooctanoic acid
PFBS = Perfluorobutanesulfonic acid
Exceedances of the OSD SL are depicted with a yellow halo.

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GIS\data\Federal\Nationwide\PFAS\MA ES_634250383\PROJECTS\SIReport\CampPendleton\CamPendleton_SI.aprx

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Army National Guard Site Inspections
Site Inspection Report
State Military Reservation, Virginia

Figure 6-7
PFHxS and PFNA Detections in Groundwater

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Shallow Groundwater Flow Direction
- River/Stream

Notes:
PFHxS = Perfluorohexanesulfonic acid
PFNA = Perfluorononanoic acid
Exceedances of the OSD SL are depicted with a yellow halo.

Data Sources:
ESRI 2020
AECOM 2020

Date:..... April 2023
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\CampPendleton\CampPendleton_SI.aprx

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7. EXPOSURE PATHWAYS

The conceptual site models (CSM) for the AOIs, revised based on the SI findings, are presented on **Figures 7-1** through **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 solely 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. SLs are presented in Section 6.1 of this report.

1. Contaminant source
2. Environmental fate and transport
3. Exposure point
4. Exposure route
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 no identified complete 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 a remedial investigation (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 PFAS exposure pathways are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of PFAS toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, and recreational users of Lake Christine and Owl Creek (and its tributaries). The CSM for AOIs 1, 2, and 3, revised based on the SI findings, are presented on **Figures 7-1 through 7-3**.

7.1 SOIL EXPOSURE PATHWAY

The SI results for soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 through AOI 3 based on the aforementioned criteria.

7.1.1 AOI 1 – Building 4

AOI 1 – Building 4 was potentially used for undocumented storage of PFAS-containing materials. PFOS was detected in subsurface soil (8-9 ft bgs) at a low level in one boring location at AOI 1. Based on the results of the SI at AOI 1, ground-disturbing activities to subsurface soil could potentially result in construction worker exposure to detected constituents via incidental ingestion. Therefore, the exposure pathway for ingestion of subsurface soil is potentially complete for construction workers. As PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in the surface soil interval, there is no potential exposure to site or construction workers via inhalation of dust or incidental ingestion of soil and the associated exposure pathways are incomplete for these receptors. The CSM for this AOI is presented in **Figure 7-1**.

7.1.2 AOI 2 – Helipad

AOI 2 – Helipad was potentially used for undocumented storage of PFAS-containing materials. PFOA was detected in surface soil (0–2 ft bgs) at low levels in two boring locations completed 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. As PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in the subsurface soil interval, there is no potential exposure to construction workers via incidental ingestion of subsurface soil and the associated exposure pathway is incomplete for this receptor. The CSM is presented in **Figure 7-2**.

7.1.3 AOI 3 – Building 410

AOI 2 – Building 410 served as the State Military Reservation Fire Department prior to the 1970s. PFOS and PFOA were detected in surface soil (0–2 ft bgs) at low levels in two boring locations completed 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. As PFOA, PFOS, PFHxS, PFNA, and PFBS were not detected in the subsurface soil interval, there is no potential exposure to construction workers via incidental ingestion of subsurface soil and the associated exposure pathway is incomplete for this receptor. The CSM is presented in **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 at each AOI based on the aforementioned criteria.

7.2.1 AOI 1 – Building 4

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in groundwater from the temporary wells associated with AOI 1; however, no concentrations exceeded their respective SLs. Due to the shallow occurrence of groundwater (6.5–12 ft bgs), there is potential exposure to construction workers via incidental ingestion of shallow groundwater during trenching activities. Therefore, the exposure pathway for construction workers is potentially complete. The PA noted that Owl

Creek acts as a hydraulic barrier between the AOI and downgradient wells identified as public, municipal, or government wells (AECOM 2020). Additionally, groundwater is not used for drinking water at State Military Reservation. Therefore, the exposure pathway for site workers, off-facility residents, and trespassers via the ingestion of groundwater is considered to be incomplete due to the absence of an exposure point or route to those receptors. The CSM is presented in **Figure 7-1**.

7.2.2 AOI 2 – Helipad

PFOA, PFHxS, and PFBS were detected in groundwater from the temporary well location AOI02-01, associated with AOI 2; however, no concentrations exceeded their respective SLs. PFOS was detected at a concentration which exceeded the SL. Due to the shallow occurrence of groundwater (6.5–12 ft bgs), there is potential exposure to construction workers via incidental ingestion of shallow groundwater during trenching activities. Therefore, the exposure pathway for construction workers is potentially complete. The PA noted the lack of potable wells downgradient of AOI 2 and the assumption that shallow groundwater discharges to Lake Christine (AECOM 2020). Additionally, groundwater is not used for drinking water at State Military Reservation. Therefore, the exposure pathway for site workers, off-facility residents, and trespassers via the ingestion of groundwater is considered to be incomplete due to the absence of an exposure point or route to those receptors. The CSM is presented in **Figure 7-2**.

7.2.3 AOI 3 – Building 410

PFNA, PFHxS, and PFBS were detected in groundwater from the temporary well locations associated with AOI 3; however, no concentrations exceeded their respective SLs. PFOS and PFOA were detected at concentrations which exceeded their associated SLs. Due to the shallow occurrence of groundwater (6.5–12 ft bgs), there is potential exposure to construction workers via incidental ingestion of shallow groundwater during trenching activities. Therefore, the exposure pathway for construction workers is potentially complete. The PA noted that Owl Creek acts as a hydraulic barrier between the AOI and downgradient wells identified as public, municipal, or government wells (AECOM 2020). Additionally, groundwater is not used for drinking water at State Military Reservation. Therefore, the exposure pathway for site workers, off-facility residents, and trespassers via the ingestion of groundwater is considered to be incomplete due to the absence of an exposure point or route to those receptors. The CSM is presented in **Figure 7-3**.

7.3 SURFACE WATER EXPOSURE PATHWAY

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in groundwater from the temporary wells associated with AOI 1. Due to the likelihood of shallow groundwater discharging to neighboring surface water bodies (on- and off-site), and the known groundwater detections found during the SI, there is potential exposure to site workers, construction workers, and off-site recreational users of Owl Creek, its tributaries, and Lake Christine. Surface water and sediment were not sampled as part of this SI, as the scope of sampling was limited to the presence or absence of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil and groundwater within the facility boundary. Therefore, the exposure pathways for these receptors are considered potentially complete.

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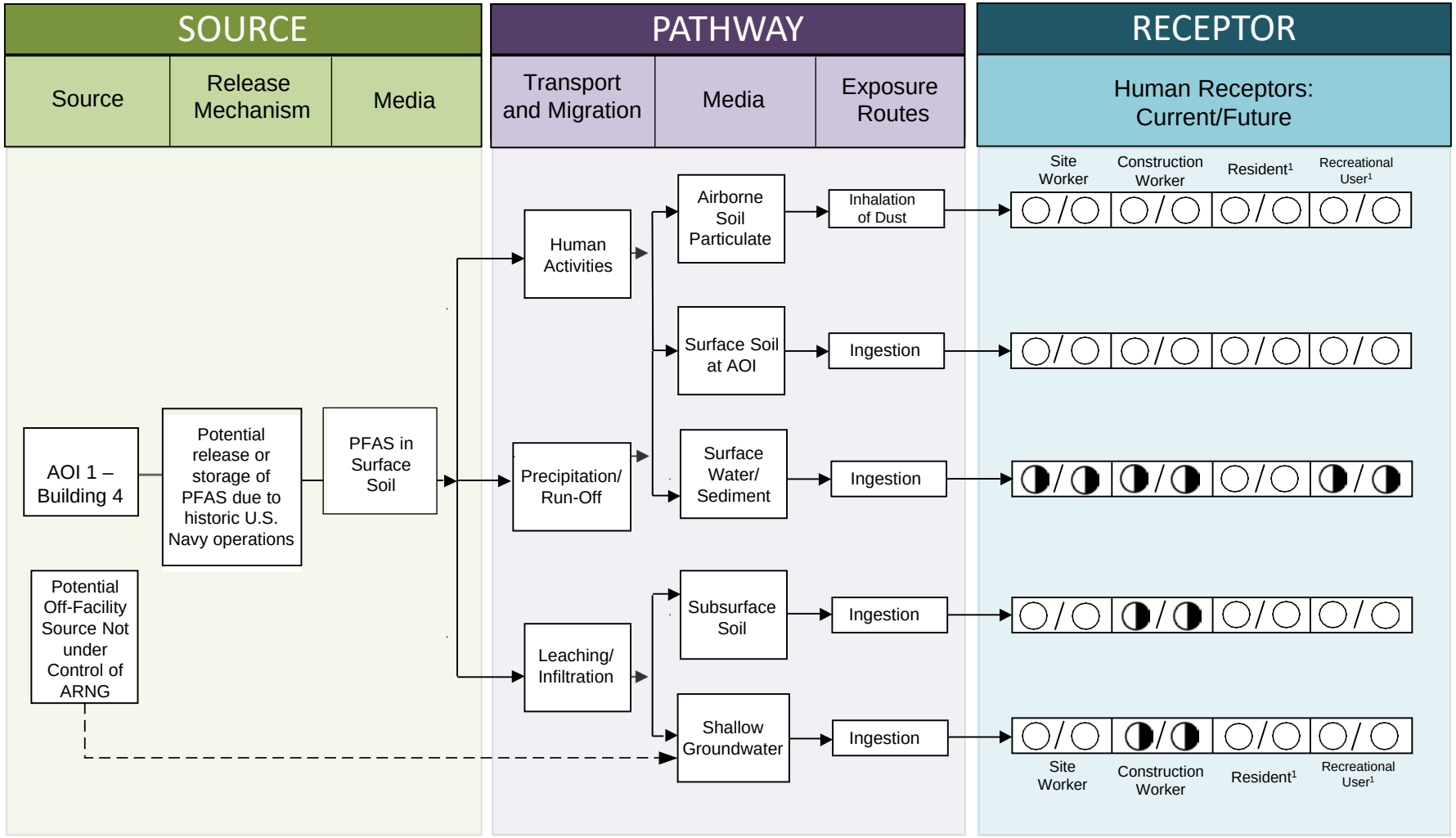

LEGEND

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

Notes:

1. The resident and recreational users refer to off-site receptors.

Figure 7-1 Conceptual Site Model
AOI 1 State Military Reservation

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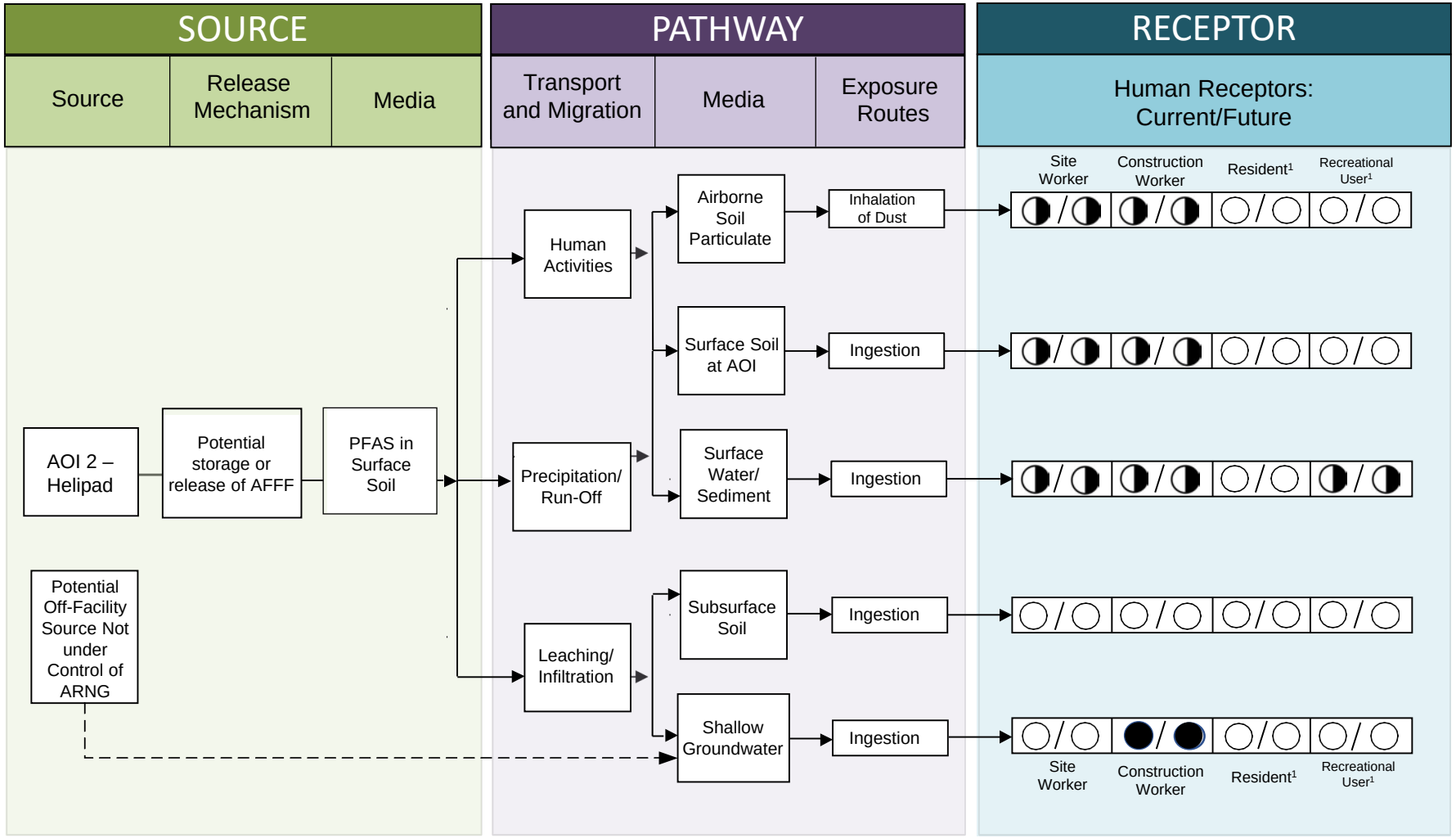

LEGEND

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

Notes:

1. The resident and recreational users refer to off-site receptors.

Figure 7-2 Conceptual Site Model AOI 2 State Military Reservation

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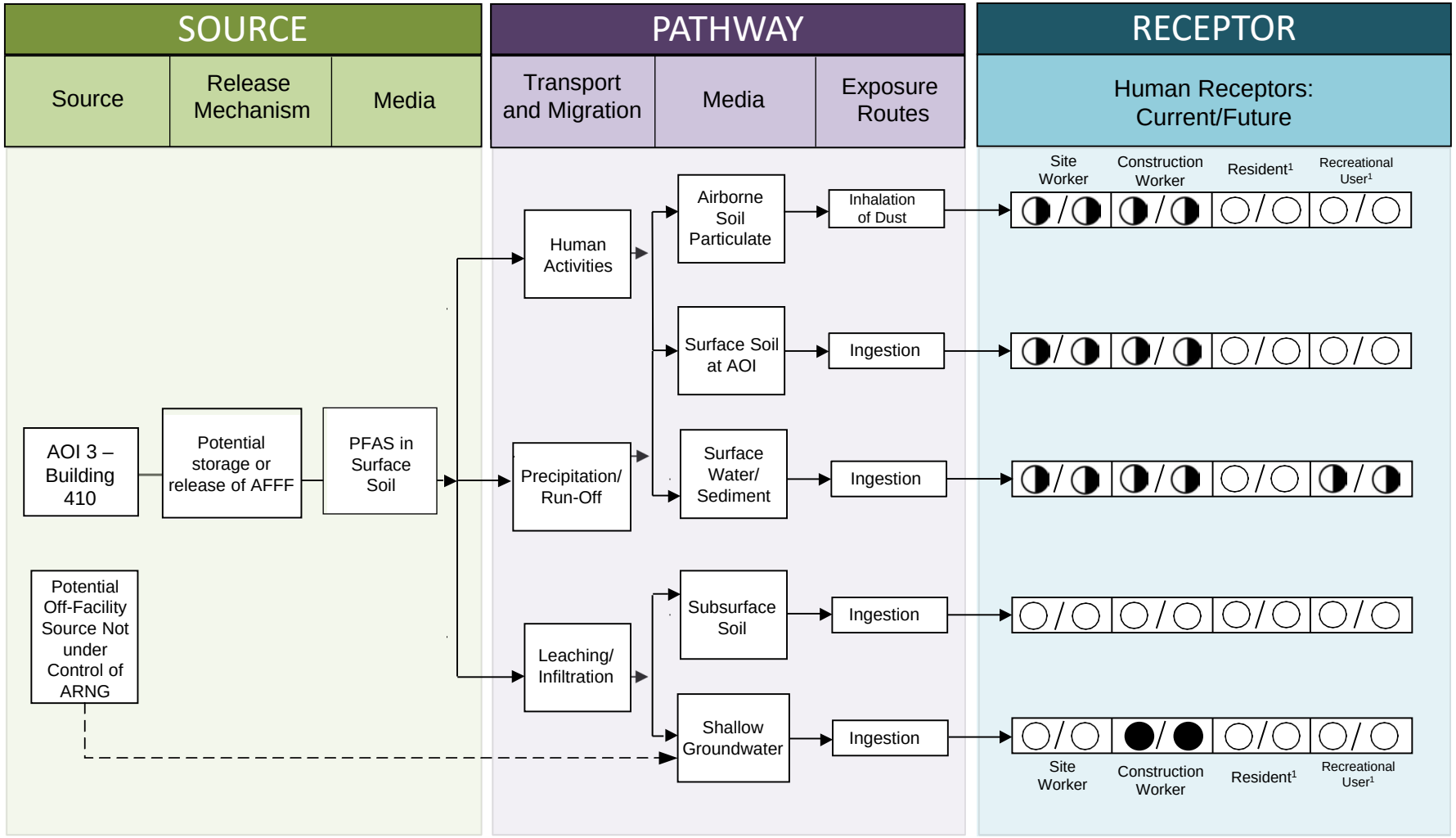

LEGEND

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

Notes:

1. The resident and recreational users refer to off-site receptors.

Figure 7-3 Conceptual Site Model
AOI 3 State Military Reservation

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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 SITE INSPECTION ACTIVITIES SUMMARY

The SI field activities at the facility were conducted from 7 to 10 September 2021. The SI field activities included soil and groundwater sampling. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as previously noted in **Section 5.8**.

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

- Thirty-three soil (33) samples from 16 locations (soil borings locations)
- Sixteen (16) grab groundwater samples from temporary well locations.
- Thirteen QA/QC samples.

An SI is conducted when the PA determines an AOI exists 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 to PFOA, PFOS, PFBS, PFNA, and PFHxS at the AOIs, described in **Section 7**.

8.2 OUTCOME

Based on the results of this SI, further evaluation in the form of a RI is warranted for AOI 2 and AOI 3. Based on the CSMs developed and revised in light of the SI findings, there is no potential for exposure to drinking water receptors from potential on-site releases of PFAS or potential off-site, adjacent sources.

Sample chemical analytical concentrations collected during this SI were compared against the project SLs for PFOA, PFOS, PFBS, PFNA, and PFHxS in soil and groundwater, as described in **Table 6-1**. The following bullets summarize the SI results:

- AOI 1:
    - PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in groundwater in the sample locations associated with AOI 1. There were no exceedances of the SLs. Based on the results of the SI, no further evaluation of AOI 1 is warranted.

- PFOA, PFHxS, PFNA, and PFBS were not detected in soil in the sample locations associated with AOI 1. PFOS was detected at a concentration that did not exceed the SL. Based on the results of the SI, no further evaluation of AOI 1 is warranted.

- AOI 2:

  - PFOA, PFHxS, and PFBS were not detected in groundwater at concentrations exceeding associated SLs. PFOS was detected at a concentration 5.1 J ng/L, which exceeds the SL (4.0 ng/L). All detections of the aforementioned analytes, including the exceedance, were detected in the groundwater sample collected at location AOI02-01, which was located southwest of the helipad, adjacent to the surrounding road and upgradient of the AOI. Based on the results of the SI, further evaluation of AOI 2 is warranted in the RI.

  - PFOS, PFHxS, PFNA, and PFBS were not detected in soil in the sample locations associated with AOI 2. PFOA was detected at a concentration that did not exceed the SL.

- AOI 3:

  - PFNA, PFHxS, and PFBS were not detected in groundwater at concentrations exceeding associated SLs. PFOS and PFOA were detected at concentrations of 5.8 ng/L and 6.2 ng/L, which exceed the associated SLs of 4.0 ng/L and 6.0 ng/L, respectively. In addition to these exceedances, the highest concentrations of PFBS (1.1 ng/L) and PFNA (2.0 ng/L) were also detected at location AOI03-03, located east of Building 410, in the grass adjacent to the garage door. Based on the results of the SI, further evaluation of AOI 3 is warranted in the RI.

  - PFBS and PFNA were not detected in any soil samples collected from the boring locations associated with AOI 3. PFOA, PFHxS, and PFOS were detected at concentrations that did not exceed associated SLs.

- Upgradient Boundary:

  - PFHxS, PFNA, and PFBS were detected in groundwater at concentrations below associated SLs. PFOA was detected at locations CPEN-01 and CPEN-03 at concentrations of 9.5 ng/L and 8.9 ng/L, respectively. Both of these detections exceeded the SL of 6.0 ng/L. Similarly, PFOS was detected at locations CPEN-01 and CPEN-03 at concentrations of 11 ng/L and 13 ng/L, respectively. Both of these detections exceeded the SL of 4.0 ng/L. These locations are upgradient of AOI 3. The groundwater detections of PFOA and PFOS at these locations represent the highest concentrations observed at the Facility. Based on the results of the SI, further evaluation of the boundary locations is warranted in the RI.

— PFBS, PFHxS, and PFNA were not detected in any soil samples collected from the boring locations associated with the facility boundary. PFOA and PFOS were detected at concentrations that did not exceed associated SLs.

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	Building 4	◐	◐	◐	No further action
2	Helipad	◐	●	◐	Proceed to RI
3	Building 410	◐	●	●	Proceed to RI

Legend:
● = Detected; exceedance of SLs
◐ = Detected; no exceedance of SLs
○ = Not detected

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