Naval Facilities Engineering Systems Command Mid-Atlantic
Norfolk, Virginia

Final

Preliminary Assessment for Per- and Polyfluoroalkyl Substances

Naval Auxiliary Landing Field Fentress
Chesapeake, Virginia

December 2021

Naval Facilities Engineering Systems Command Mid-Atlantic
Norfolk, Virginia

Final

Preliminary Assessment for Per- and Polyfluoroalkyl Substances

Naval Auxiliary Landing Field Fentress
Chesapeake, Virginia

December 2021

Prepared for NAVFAC Mid-Atlantic
by CH2M HILL, Inc.
Virginia Beach, Virginia
Contract N62470-16-D-9000
CTO WE01

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

°F	degrees Fahrenheit
AFFF	aqueous film forming foam
air ops	air operations
AOC	area of concern
ASD	Assistant Secretary of Defense
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
CTO	Contract Task Order
DASN	Deputy Assistant Secretary of the Navy
DoD	Department of Defense
DOE	Department of Energy
EC	Emerging Chemicals
EDR	Environmental Data Resources, Inc.
EECA	Engineering Evaluation and Cost Analysis
EI&E	Energy, Installations and Environment
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration
ESV	ecological screening value
ft	feet
ft/day	feet per day
ft/year	feet per year
FY17	Fiscal Year 2017
GAC	granular-activated carbon
IAS	Initial Assessment Study
iNFADS	internet Naval Facilities Assets Data Store
MIL-SPEC	military specification
NALF	Naval Auxiliary Landing Field
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
ppt	parts per trillion
PWS	public water system
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RPM	Remedial Project Manager

SAP	Sampling and Analysis Plan
SI	Site Investigation
SL	Screening Level
SNUR	Significant New Use Rule
SWMU	solid waste management unit
UCMR3	Third Unregulated Contaminant Monitoring Rule
UCMR4	Fourth Unregulated Contaminant Monitoring Rule
UCMR5	Fifth Unregulated Contaminant Monitoring Rule
UFP	Uniform Federal Policy
UPI	United Press International
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VSWCB	Virginia State Water Control Board
WWTP	wastewater treatment plant

SECTION 1

Introduction

This preliminary assessment (PA) report of potential releases of per- and polyfluoroalkyl substances (PFAS) at Naval Auxiliary Landing Field (NALF) Fentress in Chesapeake, Virginia, is prepared under the Comprehensive Long-term Environmental Action, Navy (CLEAN) Contract N62470-16-D-9000, Contract Task Order (CTO) WE01.

NALF Fentress is a noncontiguous property under the command of Naval Air Station (NAS) Oceana. The PA for NAS Oceana has been prepared separately.

1.1 Preliminary Assessment Objectives

This installation-specific PA for PFAS is part of a Navy-wide installations assessment of potential historical sources of PFAS use. The objectives of this PFAS PA of NALF Fentress are to:

- Identify and catalog all potential or actual PFAS sources (see **Section 1.2.2**).
- Eliminate from further consideration those areas where there is no evidence of a PFAS release or suspected release and document the rationale for their elimination.
- Identify areas requiring further PFAS investigation.
- Identify receptors and migration pathways (both on and off the installation).
- Determine whether an expedited response effort is warranted because of current complete exposure pathways (for example, on-installation or off-installation drinking water source within 1-mile downgradient of potential release area).

To accomplish these objectives, the following activities have been completed:

- A review of existing information to identify and characterize potential PFAS releases.
- A review of existing information to identify potential off-installation receptors within 1 mile of the installation boundary.
- Interviews conducted with relevant site personnel to validate and verify data collected during the data review, and to provide supplemental information.
- A site reconnaissance of the installation to identify any evidence of PFAS releases and potential receptors and migration pathways, to identify all areas of concern (AOCs), and to fill data gaps identified in the data review and interviews.

The PA process also requires identification of the need for initiation of an expedited response drinking water investigation in accordance with Navy policy (Deputy Assistant Secretary of the Navy [DASN] June 2016). A drinking water investigation was performed in the area surrounding NALF Fentress beginning in 2016 after PFAS were detected in on-installation groundwater and drinking water and off-installation receptors were identified (CH2M, 2018a; CH2M, forthcoming). Complete exposure pathways have been addressed and investigations and actions are ongoing. During the PA, no additional potential or confirmed release areas were identified which would result in the need for additional drinking water sampling off-installation.

1.2 PFAS Background

PFAS have been identified by the United States Department of Defense (DoD) as "emerging chemicals"[1]. PFAS are of environmental concern because of their persistence in the environment and in organisms, their migration potential in aqueous systems (for example, groundwater), their historically widespread use in commercial products, and their possible health effects at low levels of exposure. PFAS are anthropogenic compounds with multiple strong carbon-fluorine bonds.

1.2.1 General Uses of PFAS

The chemical properties of PFAS make them useful for many commercial products because they are heat-resistant and can repel oil, grease, and water. PFAS have been manufactured for use in a wide variety of products including firefighting foam, nonstick cookware, fiber and fabric stain protection, food packaging, and personal care products. The pervasive use of PFAS in commercial and industrial products has led to the discovery of PFAS in soil, air, and groundwater worldwide.

1.2.2 Key PFAS Sources at Naval Installations

PFAS have been used in a variety of military applications, including as a component of certain types of aqueous film forming foam (AFFF), which was routinely used at firefighting training areas and firefighting equipment test areas.[2] In addition, current and historical AFFF storage and transfer areas are of potential concern for release to the environment. As such, identification of areas where AFFF was released to the environment, either as repeated small releases or as a significant one-time release, is key to determining potential PFAS sources to environmental media.

PFAS from AFFF used in firefighting, firefighting training, and fire suppression systems are considered to have the greatest potential for release of PFAS to the environment in terms of mass and concentration at Navy installations. Other potential sources of PFAS to the environment include operations wastes (for example, from chromium electroplating), historical onsite land disposal areas and landfills of PFAS-containing materials, and wastewater treatment sludges and effluents. Areas of interest for this PFAS PA include those where AFFF may have been applied, released, or stored. These include current and former fire-training areas, equipment test and cleanout areas, buildings with firefighting infrastructure (for example, hangars, AFFF storage and handling areas, and pump houses), unplanned release areas (such as crash sites), and fire suppression systems located at fuel storage area(s).

For these operational and waste areas, it is important to develop a conceptual site model (CSM) that considers the following to determine if a reasonable basis exists for PFAS use, and if there is potential for the PFAS to be released into the environment:

- type of operations,
- timeline of operational activity,
- material/product development and usage,
- material storage and management practices,
- quantities of material used, and
- historical information/data from similar operations in the assessment.

---

1 The most current version of DoDI 4715.18 (4 SEPT 2019) defines emerging chemicals as "Chemicals relevant to the DoD that are characterized by a perceived or real threat to human health or the environment and that have new or changing toxicity values or new or changing human health or environmental regulatory standards. Changes may be due to new science discoveries, detection capabilities, or exposure pathways.

2 AFFF is a type of Class B fire-fighting foam but is not the only type of Class B fire-fighting foam available. While AFFF contains PFAS, not all Class B foams do (ITRC, 2020).

Aqueous Film Forming Foam in Firefighting Training and Fire Suppression

AFFF containing PFAS was developed in the 1960s, for use on Class B fires (that is, fires in flammable liquids or vapors), and was put into routine use by the early 1970s. In November 1969, a military specification (MIL-SPEC) was issued that described characteristics that AFFF needed to demonstrate to be used by the military, including a requirement for formulations containing PFAS. Most AFFF used at military installations after the 1970s likely included some combination of PFAS.

Typically, AFFF concentrate was proportionally mixed into water lines using in-line eductors or other proportioning devices to create the necessary foam solution ranging from 3 to 6 percent of the concentrate. Class A firefighting foams were used to extinguish wood and grass fires and do not contain PFAS. Therefore, Class A firefighting foams are not a concern for this PA.

Electroplating

Electroplating, specifically hard chromium plating, is an industrial activity where PFAS-containing mist suppressants may have been used. Electroplating consists of creating an electrolytic cell that enables a thin layer of metal to be deposited onto an electrically conductive metal surface. PFAS were sometimes used during the chromium electroplating process as a surfactant in chromic acid baths. As a surfactant, PFAS lowered the surface tension (adhesion of materials) by creating a thin, foamy layer on the surface of the chrome bath for mist-suppression. This mist-suppressant reduced the formation of airborne chromium aerosols during the plating process, which are known to be carcinogenic and allergenic. Areas where nonchromium electroplating operations were carried out would not be expected to have used PFAS-containing mist suppressants. Although fluorinated mist suppressants were available as early as the 1950s, they were not commonly used due to problems with porosity and cracking during the plating process. Technical improvements to fluorinated mist suppressants were made in the 1980s and 1990s which made their use more common; therefore, operations that ceased before this time likely would not have included PFAS materials in plating bath solutions (USEPA, 1998).

Landfill Operations, Waste Disposal Areas, and Wastewater Treatment Plants

Historically, landfills received wastes generated from military installations, including waste streams from operational areas (such as machine shops and electroplating operations), housing areas, etc. These waste streams may contain industrial and/or consumer products that were either manufactured with PFAS or contain PFAS constituents. Additionally, for wastewater treatment plants (WWTPs) that received materials containing PFAS, waste material biosolids and sludge from WWTPs can contain PFAS.

Other Potential Sources

Because of the widespread use of PFAS, there may be activities other than the ones previously mentioned where PFAS were used. PFAS have been included in some anti-fouling and stain-resistant paint formulations. It is possible that in significant amounts, these could be sources of PFAS to the environment.

1.2.3 PFAS in the Environment

PFAS are a class of anthropogenic compounds characterized by carbon chains of varying lengths containing carbon-fluorine bonds. The strong electronegative force of the carbon-fluorine bond requires a large amount of energy to break, which makes PFAS extremely resistant to biodegradation, photo-oxidation, direct photolysis, and hydrolysis. In addition to their environmental persistence, PFAS are readily soluble in aqueous solution and therefore, have potential for migration to groundwater from soil and with groundwater flow to offsite locations. Because of their persistence and mobility, releases of PFAS to the environment present a unique set of challenges and concerns.

1.2.4 PFAS Potential Health Effects

Additional research is needed to more clearly understand the potential health effects that may be caused by exposure to PFAS. To date, there is limited information on only a few of the thousands of PFAS. Currently, there are no Tier 1 toxicity values for any PFAS. Tier 1 toxicity values are the preferred source for toxicity factors in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) assessments.

The United States Environmental Protection Agency (USEPA) Office of Research and Development released "Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3)," in April 2021 (USEPA, 2021a). This toxicity assessment provides chronic and subchronic oral reference doses (RfDs) for perfluorobutane sulfonate (PFBS) that are considered Tier 2 noncarcinogenic toxicity values for use in CERCLA investigations. The PFBS oral RfDs are based on thyroid effects (decreased thyroid hormone levels) observed in maternal and neonate mice on post-natal day 1. Due to a lack of information in the current literature on PFBS inhalation toxicity or carcinogenicity, toxicity values for inhalation exposure and cancer endpoints could not be estimated for PFBS (USEPA, 2021a) USEPA Office of Water developed an RfD for perfluorooctanoic acid (PFOA) that is based on a developmental toxicity study in mice. The critical effects included reduced ossification in parts of the hands and feet and accelerated puberty in male pups following exposure during gestation and lactation (USEPA, 2016a). USEPA Office of Water also determined that PFOA should be classified as "suggestive evidence of carcinogenic potential" and estimated an oral cancer slope factor based on tumor development in rat testes.

USEPA Office of Water estimated an RfD for perfluorooctane sulfonate (PFOS) based on a developmental toxicity study in rats; the critical effect was decreased pup body weight following exposure during gestation and lactation (USEPA, 2016b).

PFOA and PFOS are known to be transmitted to the fetus in cord blood and to the newborn in breast milk. Because the developing fetus and newborn seem particularly sensitive to PFOA- and PFOS-induced toxicity, the RfDs based on developmental effects also are protective of adverse effects in adults.

1.3 Regulatory Background and History

1.3.1 PFOA Stewardship Program

In 2006, USEPA initiated the 2010/2015 PFOA Stewardship Program in which eight major companies in the United States committed to reduce facility emissions and product contents of PFOA and related chemicals on a global basis by 95 percent no later than 2010, and to work toward eliminating emissions and product content of these chemicals by 2015. All companies have met the program goals. To meet the program goals, most companies stopped the manufacture and import of long-chained PFAS, and then transitioned to alternative chemicals. On January 21, 2015, USEPA proposed a Significant New Use Rule (SNUR) under the Toxic Substances Control Act to require manufacturers (including importers) of PFOA- and PFOA-related chemicals to notify USEPA at least 90 days before starting or resuming new uses of these chemicals in any process. This effective date of the final SNUR was September 25, 2020.

1.3.2 Unregulated Contaminant Monitoring Rule

The USEPA issued the Third Unregulated Contaminant Monitoring Rule (UCMR3)[3] in May 2012. The UCMR3 required monitoring, between 2013 and 2015, for 30 substances at all large public water systems (PWSs) serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer people. Six PFAS compounds were included in the UCMR3 contaminant list. Of these 6 PFAS, USEPA issued health advisory levels for only two, PFOA

[3] The 1996 Safe Drinking Water Act amendments require that once every 5 years, USEPA issue a new list of no more than 30 unregulated contaminants to be monitored by PWSs.

and PFOS. The UCMR3 results found each of these two chemicals was present above the reference concentration of 70 parts per trillion (ppt) in less than 1 percent of the nearly 5,000 public water systems sampled under UCMR3 (USEPA, 2017).

In December 2016, USEPA issued the Fourth Unregulated Contaminant Monitoring Rule (UCMR4). UCMR4 requires all large PWSs serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer people to sample for 30 chemicals between 2018 and 2020. There are no PFAS included on the UCMR4 list of contaminants that require sampling and analysis.

In March 2021, USEPA proposed the fifth UCMR (UCMR5). The final rule is expected to be released in late 2021. UCMR5, as proposed, would require all large PWSs serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer people to sample for 30 chemical contaminants, including 29 PFAS, from January 2023 to December 2025 (USEPA, 2021b).

1.3.3 USEPA Lifetime Health Advisories

In May 2016, USEPA Office of Water issued a drinking water lifetime health advisory for PFOA and PFOS. Health advisories are not enforceable, regulatory levels; rather, they are levels that would provide Americans, including the most sensitive populations, with a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water. The health advisory is 70 ppt for PFOA and 70 ppt for PFOS. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be compared with the 70 ppt health advisory level.

1.3.4 USEPA Action Plan

In February 2019, the USEPA issued an action plan outlining the steps the agency is taking to address PFAS and to protect public health (USEPA, 2020). The action plan identifies USEPA-led short-term actions, longer-term research, and potential regulatory approaches designed to reduce the risks associated with PFAS in the environment. The action plan notes that USEPA plans to propose a national drinking water regulatory determination for PFOA and PFOS and include PFAS analysis in the next UCMR monitoring cycle. Other steps include further research into improving analytical methods, understanding remediation options, and obtaining more information about the potential toxicity of a broader set of PFAS, along with numerous additional actions. An update to the Action Plan was issued by USEPA in February 2020 (USEPA, 2020).

1.3.5 USEPA Guidance, December 20, 2019

In December 2019, the USEPA issued Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS under federal cleanup programs. The guidance recommends using a screening level of 40 ppt to determine if PFOA and/or PFOS is present at a site and may warrant further attention. The guidance also recommends using USEPA's PFOA and PFOS drinking water lifetime health advisory of 70 ppt as the preliminary remediation goal for contaminated groundwater that is a current or potential source of drinking water, where no state or tribal maximum contaminant level or other applicable or relevant and appropriate requirements are available or sufficiently protective.

1.3.6 State-specific Action Levels

Virginia has not established any state-specific action levels for PFAS constituents.

1.4 Navy Policy

1.4.1 DASN (EI&E) Policy Memorandum, October 21, 2014

The Navy issued a policy in October 2014, requiring on-installation drinking water sampling for PFOA and PFOS for installations where groundwater was used as drinking water and PFAS could have been released nearby in the past. Installations that were not required to sample finished drinking water under UCMR3 that produce drinking

water from on-installation groundwater sources and have an identified or suspected PFAS release within approximately 1-mile upgradient to the drinking water source were required to sample their finished drinking water by December 2015.

Drinking water at NALF Fentress is supplied by two on-installation water supply wells. Under this policy, the on-installation water system was tested for PFAS in December 2015 and May 2016. On-installation water supply samples collected were analyzed for the six PFAS listed in the UCMR3. Concentrations of PFOA and PFOS in both wells exceeded the 2009 USEPA provisional health advisory and once released, the USEPA lifetime health advisory (CH2M, 2018a). Installation employees were supplied with bottled water to address the exceedances, and the on-installation potable water system was later modified to include granular-activated carbon (GAC) to address PFOA and PFOS concentrations (CH2M, 2018b). Results of this testing are provided in the PFAS SI (CH2M, 2018a).

1.4.2 Chief of Naval Operations Policy Memo, September 14, 2015

This policy memo largely echoed the requirements laid out in the October 2014 DASN (E) policy memo. However, this memo specified that if levels of PFOS and/or PFOA in drinking water exceeded the current-at-the-time USEPA health advisory (that is, 2009 provisional short-term health advisories), then alternative drinking water must be supplied until the PFOA and/or PFOS levels were reduced to below the USEPA health advisory.

1.4.3 DASN (E) Policy Memo, June 14, 2016

This policy expanded the sampling of PFOA and PFOS at all Navy installations, where such sampling was not previously completed under USEPA's UCMR3 or the Navy's October 2014 policy. This memo also specified that, for instance, where drinking water from an installation is purchased from a PWS, but was not tested under UCMR3, that the installation must sample the finished drinking water to comply with this policy. Additionally, this policy included reporting requirements to the DASN (E) office for all PFOA and/or PFOS in drinking water results. No action was required based on this policy for NALF Fentress because sampling was already completed in accordance with the October 2014 policy.

1.4.4 DASN (E) Policy Memo, June 17, 2016

This policy defines the Navy's intention to remove, dispose, and replace legacy AFFF that contains PFOS and/or PFOA, once environmentally suitable substitutes are identified and certified to meet MIL-SPEC requirements. This policy directs the following actions be taken until suitable replacements are certified:

- Immediately cease the uncontrolled environmental release of AFFF for shoreside installations, with the exception of emergency responses.
- Update and implement Navy and Marine Corps firefighting system requirements, as needed, to ensure fire and emergency service vehicles and equipment at Navy installations and facilities are tested and certified in a manner that does not allow the release of AFFF to the environment.
- By the end of Fiscal Year 2017 (FY17), remove and dispose of uninstalled PFOS-containing AFFF in drums and cans from local stored supplies for shore installations and ships to prevent future environmental releases.

1.4.5 DASN (E) Policy Memo, June 20, 2016

This policy required the Navy to identify and prioritize sites for investigation if drinking water resources, on- or off-installation, are thought to be vulnerable to PFAS contamination from past Navy and Marine Corps PFAS releases. Sites with drinking water sources within 1-mile downgradient from known or potential releases of PFAS were assigned the highest priority. This policy directed the sampling of off-installation drinking water at these high priority (Priority 1) sites within FY17.

The primary mechanism to identify potential PFAS release areas and AOCs was review of Environmental Restoration (ER), Navy records. To ensure that all potential PFAS release mechanisms were identified, installations

were directed to review the installations' activities to identify areas that are not already part of the ER, Navy program.

At the time this policy was issued, sampling of private drinking water wells surrounding NALF Fentress had already been initiated in response to exceedances of the provisional health advisory in on-installation drinking water sampled in accordance with the October 2014 Navy policy. Properties that exceeded the USEPA lifetime health advisory were immediately supplied with bottled water for drinking and cooking. The Navy has completed the sampling for all off-installation potentially impacted drinking water sources and currently known exposures have been addressed as discussed in **Section 2.3.2**.

1.4.6 Chief of Naval Operations Policy Memo, April 6, 2020

This policy clarifies that operational ranges on Navy and Marine Corps installations will not be included in installation-wide PFAS PAs but will be investigated for PFAS releases separately.

1.5 Department of Defense (DoD) Policy

1.5.1 Secretary of Defense Memo, July 23, 2019

This memo established a PFAS task force to ensure a coordinated, aggressive, and holistic approach to DoD-wide efforts to proactively address PFAS. The goals of the task force are mitigating and eliminating the use of the current AFFF, understanding the impacts of PFAS on human health, and fulfilling cleanup responsibility related to PFAS. The task force is coordinating and collaborating with other federal agencies to achieve these goals.

1.5.2 ASD Guidance Memo, October 15, 2019

This guidance memo provided clarification of toxicity values for PFOA and PFOS that can be used to estimate screening levels used in the CERCLA program to determine if further investigation is warranted or if a site can proceed to site closeout.

1.5.3 ASD Guidance Memo, October 23, 2019

This memo revised quarterly progress reporting requirements for installations with known or suspected PFAS releases.

1.5.4 ASD Guidance Memo, November 22, 2019

This memo established requirements for installation commanders to conduct community engagement with respect to PFAS issues, report on their progress in so doing, and to provide feedback on community questions and concerns.

1.5.5 ASD Guidance Memo, November 22, 2019

This memo established a consistent methodology for analysis of PFAS in media other than drinking water and requires DoD Components to use analytical methods meeting the DoD/Department of Energy (DOE) Quality Systems Manual for Environmental Laboratories, Appendix B, Table B-15.

1.5.6 ASD Guidance Memo, March 2, 2020

This memo identifies requirements for PFAS drinking water sampling on DoD installations where DoD is the drinking water purveyor. The requirements include initial and routine monitoring, actions necessary if results exceed the USEPA lifetime health advisory, laboratory analysis and record keeping requirements, and notification of results.

1.6 Report Organization

The PFAS PA Report for NALF Fentress is organized in the following sections:

1. Introduction
2. Installation Description
3. Assessment Methodology
4. Findings and Recommendations
5. Conclusions
6. References

SECTION 2

Installation Description

Installation information relevant to this PA, including installation background, regional and local environmental setting, and migration pathways and potential receptors pertinent to this PA are presented in the following subsections.

2.1 Installation Background

NALF Fentress is located in Chesapeake, Virginia, and is a noncontiguous property under the command of NAS Oceana (**Figure 2-1**). It is located approximately 10 miles southwest of NAS Oceana. Established in 1940, the installation encompasses just over 2,500 acres and approximately 8,700 acres in restrictive easements. The installation is used primarily by squadrons stationed at NAS Oceana or Naval Station Norfolk Chambers Field for field carrier landing practice and helicopter training operations. Neither storage nor maintenance of aircraft is performed at NALF Fentress. NALF Fentress is surrounded by residential, agricultural, and community-use properties with the Intracoastal Waterway to the north, the North Landing River to the northeast and east, and the Pocaty River to the south and southeast (**Figures 2-2** and **2-3**).

2.2 Regional and Local Setting

Topography at NALF Fentress is flat with relief varying by less than 5 feet across the entire installation (CH2M, 1992). Land surface elevations range between 10 and 15 feet above mean sea level. Surface runoff from the installation is directed to a system of drainage ditches and surface canals, which direct water north, south, and east of the installation toward the North Landing River, Pocaty River, and the surrounding marshland. The North Landing River and Pocaty River are part of the Intracoastal Waterway (**Figure 2-3**).

2.2.1 Climate

Chesapeake weather is typically very mild. This area experiences four distinct seasons with average temperatures of 77 degrees Fahrenheit (°F) in the summer, 62°F in the fall, 41°F in the winter, and 57°F in the spring. Chesapeake receives about 47 inches of precipitation annually with a trace amount of snow during winter months (City of Chesapeake, 2020).

Coastal weather events in the form of severe thunderstorms, nor'easters, and occasional hurricanes can have significant but temporary effects on weather in the area. Winds are typically blown 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 (Geo-Marine, Inc., 2001).

2.2.2 Geologic and Hydrogeologic Setting

NALF Fentress is situated 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. The sediments consist of several thousand feet of unconsolidated sand, clay, silt, and gravels and are underlain by granite basement rock. From oldest to youngest, the five principal sedimentary units are the Potomac Formation, unnamed Upper Cretaceous deposits, the Pamunkey Group, the Chesapeake Group, and the Columbia Group (USGS, 1988).

The shallow groundwater aquifer system underlying NALF Fentress is composed of the Columbia/surficial aquifer, the Yorktown confining unit, and the Yorktown aquifer (USGS, 2006). The Columbia/surficial aquifer is defined by predominantly sandy surficial deposits above the Yorktown confining unit and is generally unconfined, though local deposits of silt, clay, and peat may cause locally confined or semi-confined conditions (USGS, 1988). The top of the Columbia/surficial aquifer is the water table (USGS, 2006). The sediments of the Columbia Group comprise the surface materials and consist of interbedded gravels, sands, silts, and clays. In the vicinity of NALF Fentress,

the thickness of these sediments is less than 30 feet, and typically the depth to groundwater is relatively shallow, within 3 to 10 feet below the land surface (CH2M, 1992; CH2M, 2018a).

Regionally, a layer of silt and clay separates the underlying Yorktown aquifer from the Columbia/surficial aquifer. This clay layer has been designated as the Yorktown confining unit by Meng and Harsh (USGS, 1988). The clay layer is comprised of a series of very fine sandy to silty clay units of various colors at or near the top of the Yorktown Formation. At NALF Fentress, the Yorktown confining unit was identified as being a layer of olive-gray clay and silty clay approximately 0.5 to 15-feet thick, which was encountered at approximately 30 feet below the land surface (CH2M, 1992; CH2M, forthcoming). However, additional data has shown the Yorktown confining unit as very thin or absent in some portions of the installation, therefore the Yorktown and Columbia/surficial aquifers may act as a single, unconfined hydrogeologic unit in some areas (CH2M, 2018a; CH2M, forthcoming). North of the installation, the confining unit is sandy, which may also allow for some hydraulic connection between the Columbia/surficial and Yorktown aquifers (CH2M, 2018a).

Meng and Harsh (USGS, 1988) define the Yorktown aquifer as the predominantly sandy deposits of the Yorktown Formation and the upper part of the Eastover Formation above the confining clays of the St. Mary's Formation. The lower confining unit of the Yorktown aquifer, the St. Mary's confining unit, is a mostly muddy, very fine sand and sandy clay with silt deposits of marine origin (USGS, 2003). The Yorktown aquifer was encountered from between 30 and 50 feet below ground surface during the PFAS SI and SI Addendum well installations (CH2M, 2018a; CH2M, forthcoming). The aquifer consists primarily of gray, very fine to medium sand, and in some cases, coarse sand and gravel (CH2M, 1992; CH2M, 2018a).

Local groundwater flow in the Columbia/surficial aquifer is primarily to the north, northeast, and east from the old runwaystoward the Intracoastal Waterway and North Landing River in the northern part of the installation (**Figure 2-3**) (CH2M, 2018a). There is a smaller component of flow to the south and southeast toward the Pocaty River in the southern portion of the active runway. Yorktown aquifer flow is toward the east in the northern part of the installation. The flow is to the south at the southern end of the active runway. A downward vertical gradient exists between the Columbia/surficial and Yorktown aquifers.

2.2.3 Hydrologic Setting

Overland drainage from the installation flows through a series of drainage ditches and stormwater utility lines into unnamed streams that discharge to the Pocaty River, North Landing River, and Intracoastal Waterway (**Figure 2-3**). The North Landing River and Pocaty River are part of the Intracoastal Waterway. The Intracoastal Waterway is located less than 0.5 mile from the installation border to the north and northeast. The Intracoastal Waterway is separated from the Atlantic Ocean to the east by at least 5 miles of land. The northeastern portion of the installation and a small portion along the Pocaty River south of the active runway is located within the 1 percent annual chance flood hazard area while the rest of the installation is within the 0.2 percent annual chance flood hazard area (**Figure 2-4**) (FEMA, 2014).

2.3 Migration Pathways and Potential Receptors

This section discusses hypothetical and known exposure scenarios (that is, impacted environmental media, receptors, and exposure routes).

2.3.1 Migration Pathways

Because of their chemical structure, PFAS are chemically and biologically stable and resist typical degradation processes. As a result, PFAS persist in the environment. PFAS are water-soluble and migrate readily from soil to groundwater where they can be transported long distances (USEPA, 2014). Additionally, although PFAS are water soluble and tend to be relatively mobile in groundwater, complex partitioning mechanisms influence fate and transport. For example, a tendency for some PFAS, particularly the sulfonates, to associate with organic carbon in soil and sediment can result in persistent concentrations in these media (Navy, 2020).

Potential and/or known migration pathways for PFAS at NALF Fentress include:

- Release of PFAS to surface and/or subsurface soil.
- Overland flow of PFAS in runoff to downgradient areas including soil, drainage ditches, and unnamed streams and tributaries, potentially discharging to the Pocaty River, North Landing River, and Intracoastal Waterway.
- Direct release of PFAS to drainage ditches.
- Leaching of PFAS from soil to groundwater.
- Leaching of PFAS from landfill waste to soil and groundwater.
- Discharge of groundwater to surface water (drainage ditches, unnamed streams, Pocaty River, North Landing River, and the Intracoastal Waterway).
- Transport via advection in groundwater to downgradient areas.
- Bioaccumulation in terrestrial and aquatic biota.

2.3.2 Human Receptors

Current receptors and potential future receptors (including residents, maintenance workers, industrial workers, construction workers, and trespassers/visitors) could be exposed to PFAS if it is present in groundwater, soil, sediment, and surface water. Current and future recreational users could be exposed to PFAS if it is present in sediment, surface water, and/or biota in the Pocaty River, North Landing River, and Intracoastal Waterway.

There are 803 parcels within the City of Chesapeake and 54 parcels within the City of Virginia Beach that are within 1 mile of the boundary of NALF Fentress. There is one school and no hospitals or daycares located within 1 mile of the boundary of the installation (**Figure 2-3**) (CH2M, 2017b; EDR, 2019b).

Groundwater

Groundwater is the primary source for drinking water at NALF Fentress and for drinking water at off-installation residential areas. As mentioned in **Section 2.2.2**, there are two aquifers that are present at NALF Fentress, and the primary drinking water source at NALF Fentress is the Yorktown aquifer. A summary of NALF Fentress and off-installation drinking water sources is provided below:

- **NALF Fentress Drinking Water** – Drinking water at NALF Fentress is provided by on-installation water supply wells screened in the Yorktown aquifer. The well network consists of two production wells (**Figure 2-3**) that alternately pump groundwater to an on-installation drinking water treatment plant. As mentioned in **Section 1.4.1**, influent for this system was initially sampled and tested for six PFAS in December 2015 in order to comply with the October 2014 Navy policy. PFOA and PFOS were detected at levels in exceedance of the USEPA 2009 provisional health advisory, which was the screening value in use by the Navy at that time (CH2M, 2018a). In order to address the exceedances, installation employees were initially supplied with bottled water, and a GAC system was added to the existing treatment plant to remove PFOA and PFOS at which time bottled water was discontinued. Treatment of on-installation groundwater is now performed using a combination of greensand, permanganate, GAC, and sodium hypochlorite (CH2M, 2017a). Effluent sample results have consistently remained less than the USEPA lifetime health advisory since start-up of the GAC system (CH2M, forthcoming).
- **Off-Installation Municipal Drinking Water** – Municipal drinking water within 1 mile of NALF Fentress is provided by the City of Chesapeake. There are 88 parcels serviced by the City of Chesapeake southeast of the installation. The City of Chesapeake provides water from various sources including the Northwest River and brackish groundwater from wells located along South Battlefield Boulevard that is treated with reverse osmosis and water from Lake Gaston that is treated with low pressure ultra-filtration (City of Chesapeake, 2021). No City of Chesapeake municipal water supply wells are located within 1 mile of NALF Fentress.

- **Off-Installation Private Drinking Water** – Developed parcels in the area not connected to City of Chesapeake water use private groundwater wells to supply potable and non-potable water. The nearest connection to the City of Chesapeake water system is approximately 2.65 miles from NALF Fentress for properties north of the installation (CH2M, 2018b). Well records indicate most of these wells are screened within the Yorktown aquifer. The Navy began sampling for PFAS in private drinking water wells surrounding NALF Fentress in 2016. The initial sampling area was established as a half mile radius in all directions from on-installation exceedances of the 2009 USEPA provisional health advisory in consideration of the historical dates of releases on the installation, estimated groundwater flow velocity, and potential radial flow direction. The sampling area has since been expanded multiple times based on locations of off-installation exceedances and the change to the 2016 USEPA lifetime health advisory. During the PA, no additional potential or confirmed release areas were identified which would result in the need for additional drinking water sampling off-installation. 92 parcels fall within the designated sampling area (CH2M, 2018a). Sampling is conducted on a voluntary basis, and 65 wells on 59 parcels have been sampled. Samples from seven wells on six parcels exceeded the USEPA lifetime health advisory and properties were immediately supplied with bottled water for drinking and cooking. A treatability study was also conducted to install point of entry GAC systems at impacted wells. Details of the pilot test installation are described in the *Pilot Test Work Plan: Granular Activated Carbon System Installation on Residential Drinking Water Systems to Remove PFOA and PFOS* (CH2M, 2017b). An Engineering Evaluation and Cost Analysis (EE/CA) was finalized in November 2018 establishing connection to city water as the preferred alternative for a Non Time-Critical Removal Action to allow for a permanent solution for impacted drinking water (CH2M, 2018b). Implementation of this action is in currently in the design phase.

Current and future residents, maintenance workers, industrial workers, construction workers, and/or trespassers/visitors could be exposed to PFAS, if present in groundwater, through ingestion and dermal contact while bathing. In areas where groundwater is within the potential depth of construction activities (within about 10 to 15 feet below ground surface) construction workers could be exposed to PFAS in groundwater, if present, through dermal contact during excavation activities. Currently, there are no screening levels or other criteria for dermal contact with PFAS in groundwater. Ingestion-based SLs are available for groundwater exposure to some PFAS. SLs for PFOA and PFOS are based on an hazard quotient of 0.1 and were generated using the USEPA SL calculator as described in the Assistant Secretary of Defense (ASD) October 15, 2019 memorandum, "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program" (DoD, 2019). SLs for PFBS were generated similarly, but values were updated from those listed in the 2019 memorandum to reflect reference doses provided in "Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfunate" (USEPA, 2021a), which is consistent with the May 2021 USEPA SL table. As discussed in **Section 1.3.2**, the USEPA lifetime health advisory for PFOA and PFOS is used as an action level for groundwater used as drinking water.

Soil

Current and future residents, recreational users, maintenance workers, industrial workers, construction workers, and/or trespassers/visitors could be exposed to PFAS, if present in soil, through incidental ingestion of, dermal contact with soil, and inhalation of particulate emissions from surface and subsurface soil. Dermal and ingestion-based toxicity values are available for soil exposure to some PFAS. There are currently no regulatory risk-based screening levels for exposure to PFAS through inhalation of particulate emissions from surface and subsurface soil.

Sediment

Current and future residents, maintenance workers, industrial workers, construction workers, and/or trespassers/visitors could be exposed to PFAS, if present in sediment in drainage ditches. Current and future recreational users could be exposed to PFAS, if present in sediment in the Pocaty River, North Landing River, and/or Intracoastal Waterway through incidental ingestion of and dermal contact with sediment. Dermal and ingestion-based toxicity values are available for sediment exposure to some PFAS.

Surface Water

Surface water near NALF Fentress is not used for drinking water. Current and future residents, maintenance workers, industrial workers, construction workers, and/or trespassers/visitors could be exposed to PFAS through incidental ingestion or dermal contact, if present in surface water in drainage ditches. Current and future recreational users could be exposed to PFAS, if present in surface water in the Pocaty River, North Landing River, and Intracoastal Waterway through incidental ingestion of and dermal contact with surface water. Currently, there are no regulatory risk-based screening levels or other criteria for dermal contact with PFAS in surface water. Ingestion-based toxicity values are available for some PFAS.

Biota and Agriculture

PFAS have the potential to bioaccumulate. PFAS, if present in fish and shellfish from the Pocaty River, North Landing River, and Intracoastal Waterway may be ingested by human receptors. Additionally, humans may be exposed to PFAS through consumption of food produced (through farming) or hunted in the vicinity of the installation if these food sources contain PFAS due to root uptake, ingestion of PFAS-containing water, or ingestion of PFAS-containing plants and animals. Ingestion-based toxicity values are available for some PFAS.

2.3.3 Ecological Receptors

Given the environmental setting and the habitats present, terrestrial and wetland/aquatic ecological receptors may reside within areas of NALF Fentress. In terrestrial habitats, these receptors include terrestrial plants, soil invertebrates, reptiles, birds, and mammals (EDR, 2019a; USFWS, 2020). Some of the primary mammal species that have been observed in upland areas of NALF Fentress include the Smiths Island cottontail rabbit and the Southern rock vole (EDR, 2019a). Furthermore, some of the areas in NALF Fentress are located directly adjacent to wetland and aquatic habitats. In these wetland and aquatic habitats, receptors include aquatic and wetland plants, aquatic and benthic invertebrates, reptiles, amphibians (freshwater only), fish, birds, and mammals. Mammals that frequent wetland areas include Southern water shrew (EDR, 2019a). Possible exposure pathways for these potential receptors (terrestrial lower and upper trophic level as well as aquatic lower and upper trophic level) are described below.

Lower trophic level terrestrial ecological receptors (such as terrestrial plants and soil invertebrates) could be exposed to PFAS released to surface soil through root uptake (plants), direct contact, and/or direct ingestion. Because there is some evidence that PFAS may bioaccumulate in terrestrial food items (such as plants and invertebrates), there is the potential that upper trophic level receptors (such as birds and mammals) could be exposed to these compounds via the food chain, as well as through incidental ingestion of soil and direct ingestion of drinking water (if PFAS are released to water sources).

Lower trophic level wetland/aquatic ecological receptors (such as wetland/aquatic plants, aquatic and benthic invertebrates, fish, reptiles, and amphibians) could be exposed to PFAS released to surface water and/or sediment (either directly, or indirectly via surface runoff from terrestrial areas or through groundwater discharge) through root uptake, direct contact, and/or direct ingestion. Because there is evidence that PFAS may bioaccumulate in aquatic food items (such as fish), there is the potential that upper trophic level receptors (such as birds and mammals) could be exposed to these compounds via the food web, as well as through incidental ingestion of sediment and direct ingestion of drinking water.

Federally listed endangered species within NALF Fentress include one mammal (Northern Long-eared Bat) (USFWS, 2020). The Northern Long-eared Bat is considered a terrestrial upper trophic level receptor; as such, exposure pathways described for terrestrial upper trophic level receptors described above may apply.

Currently, no promulgated ecological screening values (ESVs) have been released by USEPA for PFAS. However, some literature-based ecological screening values are available for some PFAS (such as PFOA, PFOS, and PFBS) for soil, sediment, and/or surface water exposures. PFAS ecotoxicology is an active field of research and additional data are likely to become available in the near future. Any PFAS data collected for a specific site at NALF Fentress

will be evaluated using the best ecotoxicological information available at the time the data are evaluated, within the Navy policy framework in place at the time, for the ecological pathways appropriate for the particular site.

2.4 Site Inspection and Site Inspection Addendum

A PFAS SI was performed at NALF Fentress between December 2015 and June 2017, consisting of groundwater and soil sampling, to determine if a release of PFAS occurred on-installation (CH2M, 2018a)[4]. Field activities were conducted in accordance with Uniform Federal Policy (UFP) – Sampling and Analysis Plan (SAP) titled *Final Sampling and Analysis Plan, Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2016a) and the UFP-SAP addendum titled *Final Sampling and Analysis Plan Addendum 1, Basewide Per- and Polyfluoroalkyl Substances Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2017c). The sites investigated in the PFAS SI are as (CH2M, 2018a):

- Site 14 – Fentress Landfill: Identified in 2015 as requiring further evaluation of potential PFAS contamination as AFFF may have been disposed of in the Fentress Landfill.
- Site 17a – Former Firefighter Training Area (Site 17 Original[5]): Identified in 2015 as requiring further evaluation of potential PFAS contamination due to firefighting practices utilizing AFFF at the site.
- Site 17b – Former Firefighter Training Area (Site 17 Revised[6]): Identified as a former firefighting training area during a review of historical air photographs based on ground discoloration.
- Underground Storage Tank (UST) 20B (Petroleum Oil Lubricant Program): UST 20B monitoring wells were located and sampled to aid with characterization of the nature and extent of PFAS contamination in groundwater at NALF Fentress. The UST 20B monitoring wells are located near the former AFFF storage area.
- Crash Truck Test Area: This area was used to test AFFF spray nozzles on fire trucks by spraying AFFF directly onto the ground surface.
- Current and Former Irrigation Sprayfields: These areas were used to apply treated wastewater to the ground surface through spray irrigation. These were evaluated as secondary PFAS release areas because the water and wastewater treatment process at the installation was not designed to treat PFAS.
- Perimeter Wells: Wells on the installation perimeter were evaluated for PFAS to assess off-installation migration potential (these wells included wells previously installed by the State Water Control Board).

A PFAS SI Addendum was conducted in October 2019 to further define the lateral and vertical extent of PFAS in groundwater and soil at NALF Fentress (CH2M, forthcoming). Field activities were conducted in accordance with the UFP-SAP titled *Final Sampling and Analysis Plan, Basewide Per- and Polyfluoroalkyl Substances, Site Inspection Addendum, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* (CH2M, 2019b). The PFAS SI Addendum included groundwater, soil, surface water, and sediment sampling. Site 17c – Former Firefighter Training Area was added as a potential release area at this time based on ground discoloration identified during a review of historical air photographs. The Fire Station (Building 100), 2001 Tomcat Crash, Old Runway AFFF Release, Current Wastewater Treatment Plant, Former Wastewater Treatment Plant, and Drainage Ditch Excavated Soil Dump Site were investigated in the SI/SI Addendum due to the proximity to another potential release area or a perimeter well. Due to PFAS SL exceedances in the groundwater, soil, and/or wastewater samples, the Fire Station (Building

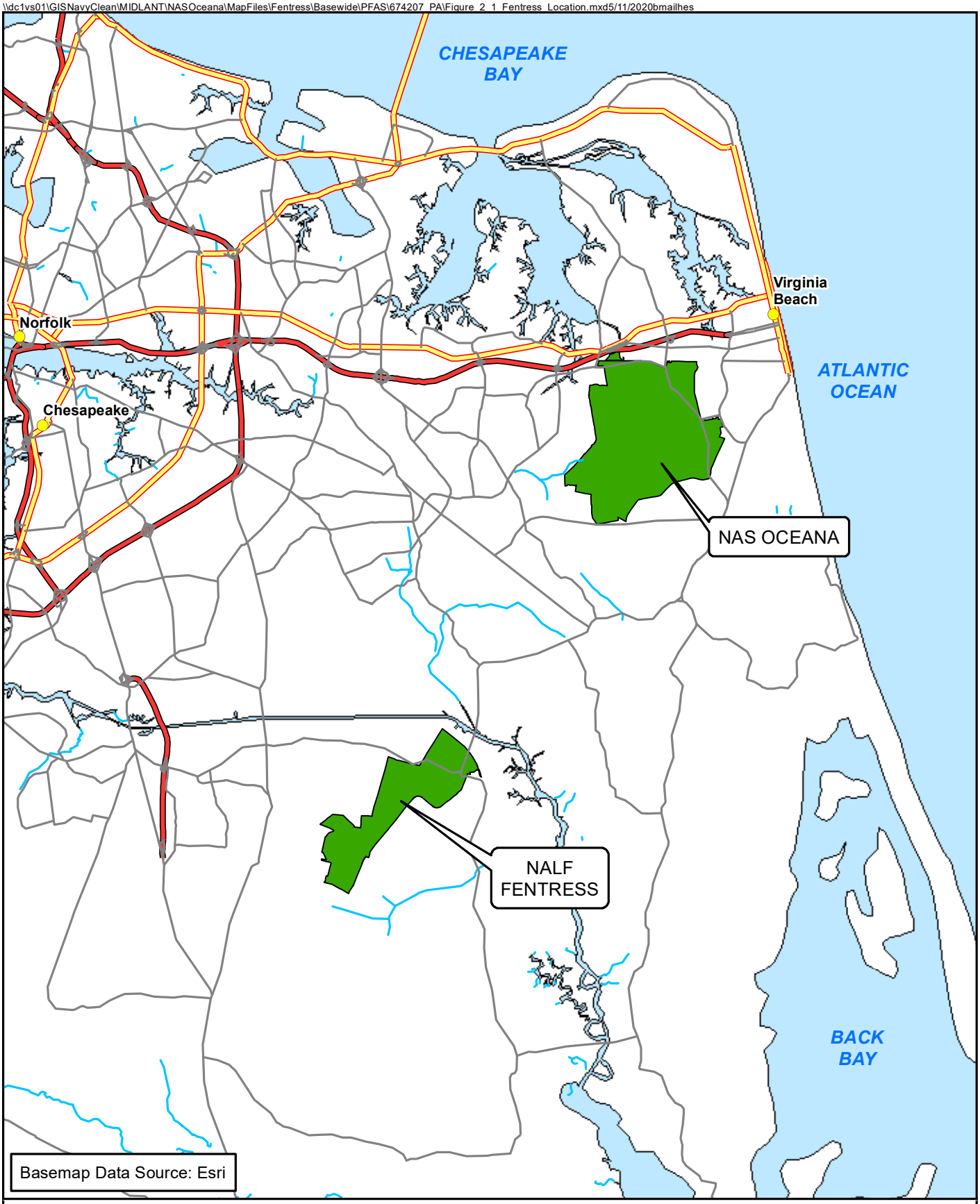
4 The PFAS SI SAP was initiated prior to the June 20, 2016 Navy policy instructing that an evaluation of all potential release areas be completed. The potential release areas investigated as part of the SI were identified through limited document review and interviews.

5 Site 17a – Former Firefighter Training Area was referred to in the PFAS SI as Site 17 Original because it was erroneously designated as Site 17 in basewide figures from previous investigation reports. As a result, when PFAS investigations were initiated, it was initially thought to be the 1980s-1990s fire-training area at the installation. Based on subsequent aerial photograph review, it was determined this area was likely used for fire training in the 1950s and 1960s.

6 Site 17b – Former Firefighter Training Area was referred to in the PFAS SI as Site 17 Revised because this area was later determined to be the location of the 1980s-1990s fire training area (Site 17) that was previously investigated and remediated (based on current presence of wells installed and historical air photos providing evidence of the removal action).

100), 2001 Tomcat Crash, Old Runway AFFF Release, Current Wastewater Treatment Plant, Former Wastewater Treatment Plant, and Drainage Ditch Excavated Soil Dump Site were identified as confirmed PFAS release areas during the PFAS SI/SI Addendum investigation. The PFAS SI Addendum report is currently in progress.

Potential and confirmed PFAS release areas that were previously investigated during the PFAS SI and SI Addendum are included in **Tables 4-1a** to **4-1c** for completeness; however, they are not further evaluated in **Section 4** as the site-specific information can be found in the PFAS SI and SI Addendum Reports (CH2M, 2018; forthcoming).



Legend
- City
- Freeway or Other Major Road
- Major Road
- Secondary Road
- Water Body
- Base Boundary

N
W E
S

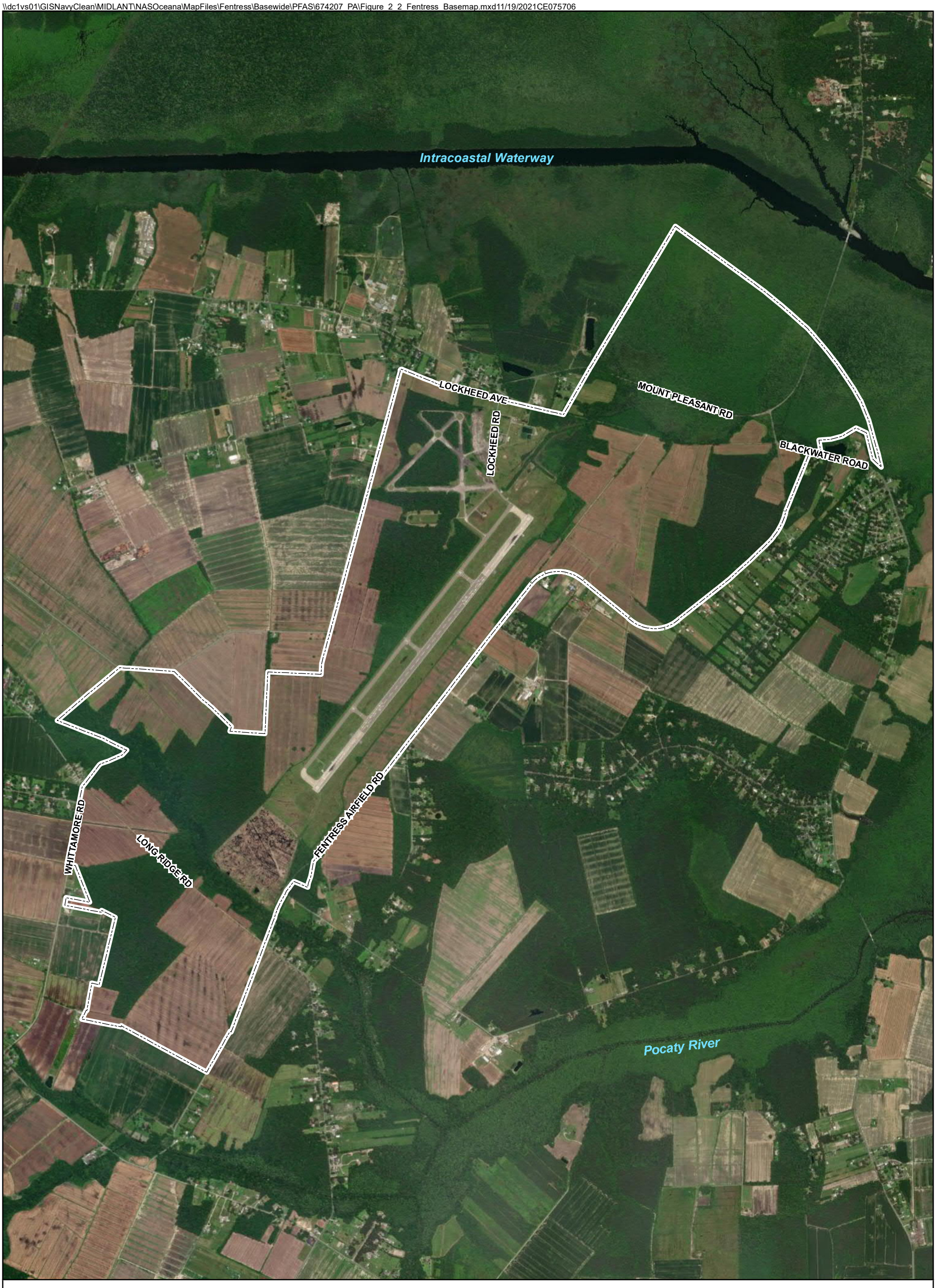
0 1.5 3 Miles

1 inch = 3 miles

Figure 2-1
Fentress Site Location Map
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\Figure_2_2_Fentress_Basemap.mxd11/19/2021CE075706



Legend

Installation Boundary

N
W E
S

0 0.2 0.4
Miles

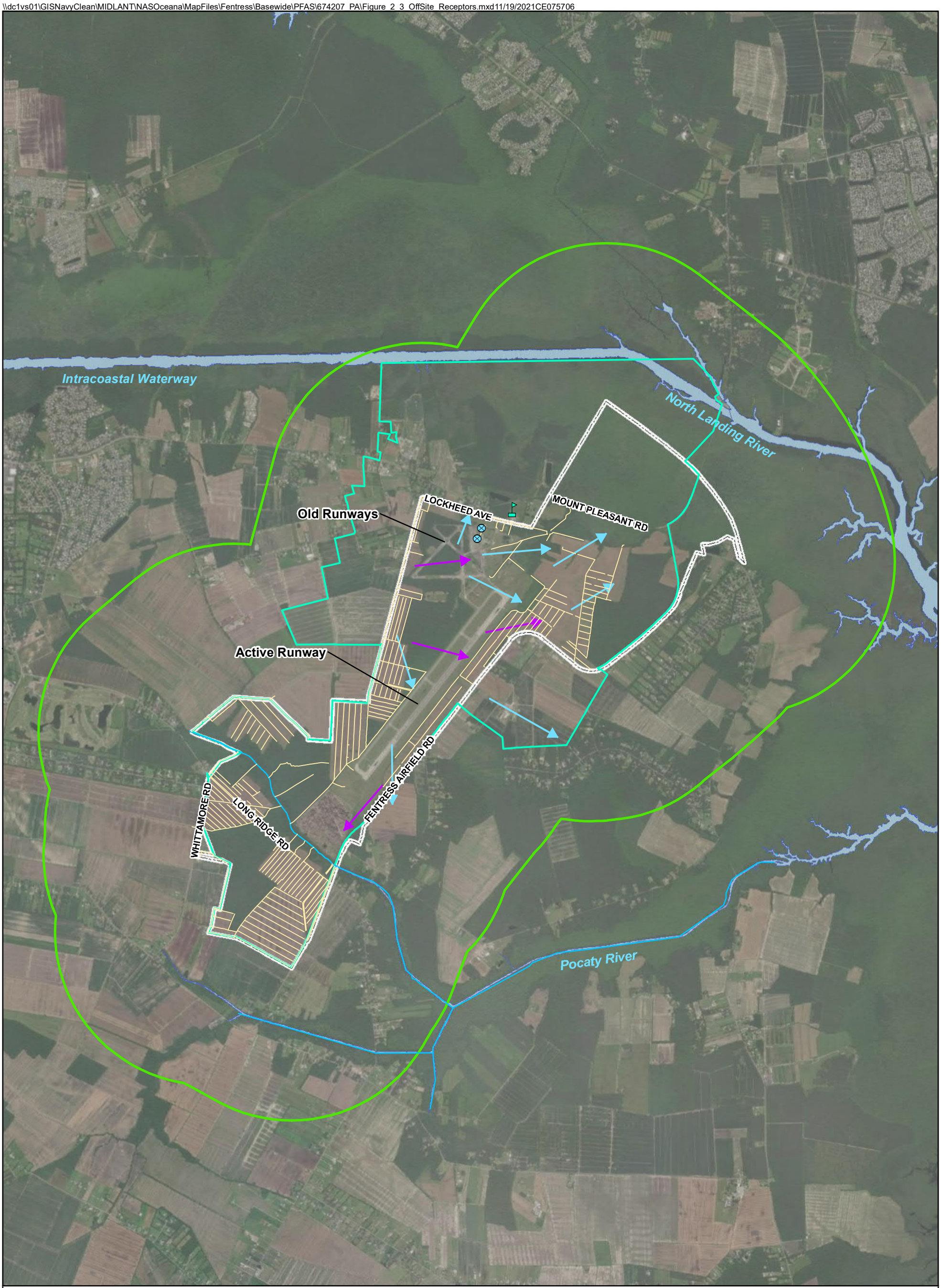
1 inch = 0.4 miles

Imagery: Esri, 2019

Figure 2-2
NALF Fentress Layout Map
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\Figure_2_3_OffSite_Receptors.mxd11/19/2021CE075706



Legend

- On-Installation Water Supply Well Location
- School Location
- Stormwater Ditch
- River/Creek Centerline
- Columbia/Surficial Groundwater Flow Direction (October 2019)
- Yorktown Groundwater Flow Direction (October 2019)
- Parcels within 0.5 mile of Exceedances
- 1 Mile Zone
- Waterbody
- Installation Boundary

N
W E
S

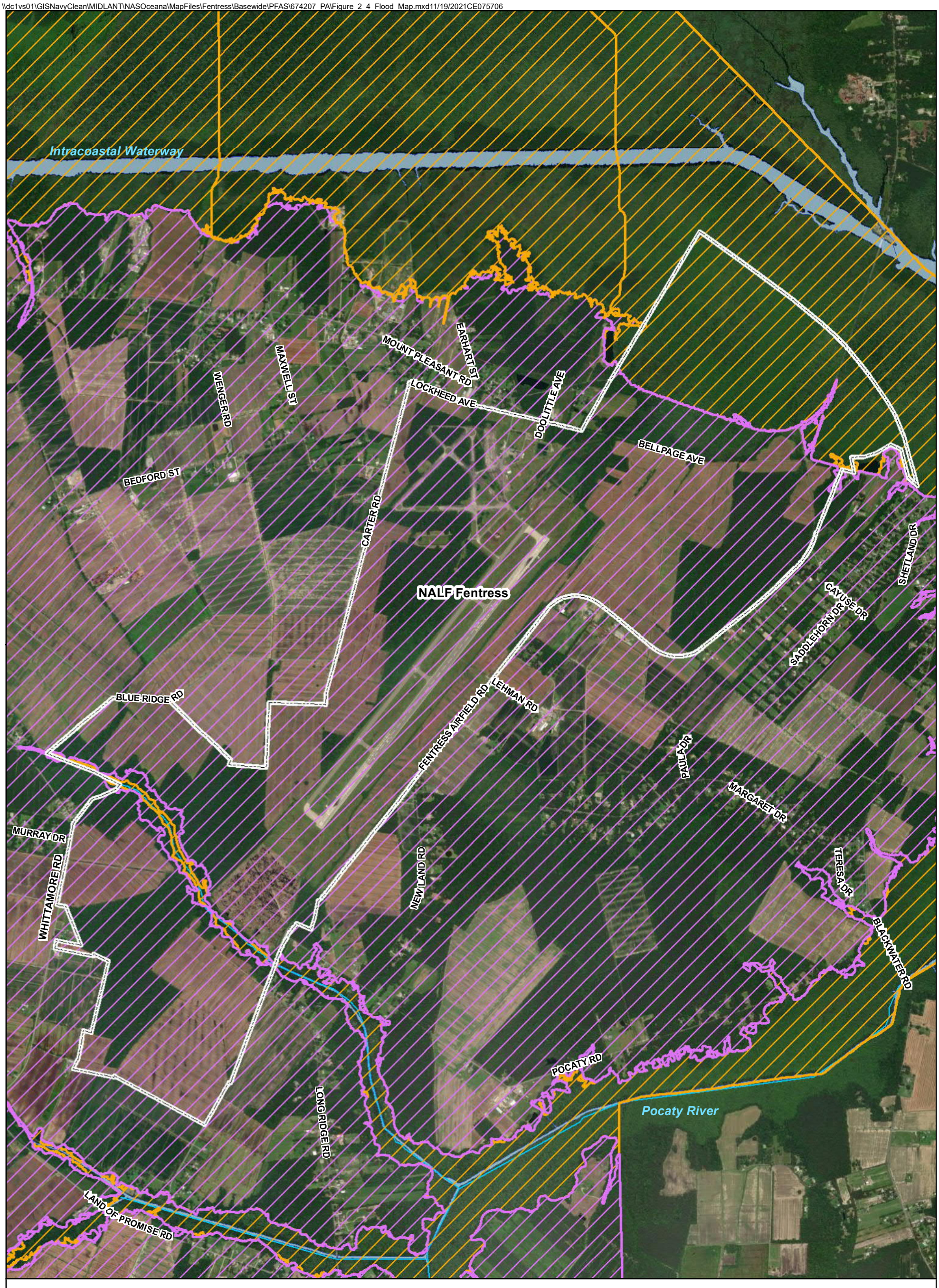
0 0.3 0.6
Miles

1 inch = 0.6 miles
Imagery: Esri, 2019

Figure 2-3
Water Use and Offsite Receptors
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m.

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\Figure_2_4_Flood_Map.mxd11/19/2021CE075706



Legend

- River/Creek Centerline
- 1% Annual Chance Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Waterbody
- Installation Boundary

N
W E
S

0 1,000 2,000
Feet

Imagery: Esri, 2019

Figure 2-4
Flood Hazard Map
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m.

SECTION 3

Assessment Methodology

The following activities were performed in support of this PA:

- Reviewed existing data to identify and characterize potential PFAS releases and identify potential off-installation receptors.
- Conducted interviews with relevant personnel to validate and verify data collected during the data review and provide supplemental information.
- Performed a site reconnaissance of the installation to identify any evidence of PFAS releases and potential receptors and contaminant migration pathways, to identify all AOCs, and fill data gaps identified in the data review and personnel interviews.

Each activity is described in the following subsections.

3.1 Data Review

Existing information was gathered and reviewed to identify and characterize locations of potential PFAS use or disposal and focus the activities to be conducted during the site reconnaissance. A summary of information reviewed is provided in **Appendix A**. The following document types were evaluated during the preliminary review.

3.1.1 Internet Records

Internet search engines were used to find supplementary records and historical information on fires and the use of AFFF at NALF Fentress. Information regarding aircraft crashes or emergency responses relevant to this PA was located during the internet record search. Documents, websites, and internet databases reviewed during this PA are listed in **Appendix A**. Where relevant, results of the searches were included in **Section 4** of this report.

3.1.2 Installation Operations Records

Additional information pertaining to installation operations such as installation master plans (historical), spill reports/databases, and hazardous waste inventory sheets, were obtained by reviewing archived historical installation records (**Appendix A**). Navy staff provided Emergency Planning and Community Right-to-Know Act (EPCRA) chemical storage inventory reports for 2001, 2003, 2004, 2008, 2011, 2012, 2013, 2015, 2016, and 2017 (**Appendix A**). These reports document the locations and quantities of hazardous chemicals that total more than 10,000 pounds or that are considered very hazardous. For trucks such as firefighting engines, the report documents the primary storage location for each truck. Relevant information from these reports is incorporated into **Section 4** of this report.

A building inventory list was obtained from the Georeadiness Center geographic information system records and was used to identify the names of buildings and facilities (**Appendix A**). Relevant information is discussed in **Section 4** of this report. A search of the internet Naval Facilities Assets Data Store (iNFADS) and Other Environmental Liabilities database was performed in January 8, 2019 (**Appendix A**). No relevant information was obtained from the iNFADS or Other Environmental Liabilities database. A Freedom of Information Act request was submitted to the Virginia Department of Environmental Quality (VDEQ) on February 22, 2019 (Request #19-464) for any information on NALF Fentress's Water Permitting and Compliance files. No relevant information was obtained from VDEQ.

3.1.3 Environmental Restoration Program Records

ER Program records from the Naval Installation Restoration Information Solution database and those provided by installation personnel were reviewed to identify potential PFAS release areas and to obtain information on

physical investigations and identification of potential pathways and receptors at those areas (**Appendix A**). Relevant information about historical operations on the installation was identified and is included in **Section 4**.

3.1.4 Environmental Data Resources Reports

The following Environmental Data Resources, Inc. (EDR) reports were obtained and reviewed for NALF Fentress and the surrounding area:

- NEPASearch Map Report (EDR, 2019a)
- Offsite Receptor Report (EDR, 2019b)

Sensitive receptor and wildlife area information was obtained from these reports and is included in **Section 2.3.3**. No information relating to PFAS storage, use, or disposal at NALF Fentress was identified in these records.

3.1.5 Maps and Aerial Photographs

Aerial photographs of NALF Fentress were reviewed for the following years: 1990, 1994, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2010, 2011, 2014, 2015, 2016, and 2018. Flood hazard area information was obtained from Federal Emergency Management Agency National Flood Insurance Program Flood Insurance Rate Maps (FEMA, 2014). Aerial photographs for 27 years from 1938 through 2016 were reviewed and analyzed in the *Aerial Photographic Analysis Report, Naval Auxiliary Landing Field Fentress Volume 1, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia* which reviewed aerial imagery from NALF Fentress historical archives, EDR reports, United States Geological Survey (USGS), and the National Agriculture Imagery Program (CH2M, 2019a). Relevant information about historical operations on the installation was identified and is included in **Section 4**.

3.1.6 National Archives Records

The National Archives Online Catalog was reviewed using the search term “Fentress”. Most of the resulting files included photos and were reviewed online. The documents did not provide information relevant to AFFF or PFAS storage, use, and/or disposal at NALF Fentress.

In March 2019, a research team visited the Naval Heritage Command to review command histories for NAS Oceana and associated properties such as NALF Fentress. Command histories for most years beginning in 1969 through 1997 were obtained and reviewed, and information regarding aircraft crashes at NALF Fentress, remediation activities, and some information regarding fire training were identified in these records. Relevant information is included in **Section 4** and a summary of information relating to PFAS-containing material storage, use, or disposal at NALF Fentress is provided in **Appendix A**.

3.2 Interviews

The installation was provided with a list of employees to interview based on Navy guidance, and the installation identified individuals to interview based on that list and availability. CH2M HILL, Inc. (CH2M) conducted interviews from May 2019 to September 2020, with current and former personnel associated with NALF Fentress, to validate and verify data collected during document and records reviews; identify additional information related to PFAS not previously found in historical documents; and to confirm and select additional locations to observe during site reconnaissance.

The interviews were conducted in person. Each interview session was logged using standardized questionnaires with supporting notes and maps. The completed questionnaires are provided in **Appendix B**. The information from the interviews was used to confirm and select additional locations to observe during visual site inspection activities. This information is referenced throughout this report.

CH2M interviewed the following personnel on the following dates:

- NAS Oceana Fire Chief – May 6, 2019
- Former NALF Fentress Water Program Managers – July 10, 2019

- Former NALF Fentress WWTP Supervisor – July 15, 2019
- NAS Oceana Public Works Department Electrician – October 10,2019
- NALF Fentress Fire Chief – November 8, 2019
- NALF Fentress Crash Captain – November 8, 2019
- NALF Fentress Firefighter – November 8, 2019
- NAS Oceana Air Operations (Air Ops) Manager – November 15, 2019
- NALF Fentress Tower Manager – September 2, 2020
- NALF Fentress Civilian Firefighter – September 3, 2020

The City of Chesapeake Fire Chief was contacted via phone on June 1, 2020, regarding the mutual aid agreement between NALF Fentress and the Chesapeake fire department. The City of Chesapeake Fire Chief reported that he did not have any information on the use of AFFF associated with the mutual aid activities in relation to Fentress (Chesapeake Fire Chief, 2020, pers. comm.). In addition, an interview with the NALF Fentress Captain and NAS Oceana Assistant Fire Chief was conducted on November 2, 2015, in support of PFAS SI SAP development to identify any additional potential AFFF release areas (CH2M, 2018a).

Information relating to PFAS storage and use at NALF Fentress was identified in these interviews. Relevant information is included in **Section 4** and additional details of the listed interviews are presented in **Appendix B**.

3.3 Site Reconnaissance

Site reconnaissance events were completed on June 11, 2019, March 5, 2020, and September 2, 2020. During the site reconnaissance, accessible areas were visited to identify any evidence of PFAS use and/or disposal, fill data gaps identified in the document review and interviews, and document physical site characteristics (such as surface flow and drainage conditions) for areas with potential PFAS releases. Information gathered during the site reconnaissance is detailed in **Section 4**, and photo documentation from the site reconnaissance is provided in **Appendix C**.

SECTION 4

Findings and Recommendations

Section 4.1 provides an assessment of NALF Fentress and off-installation drinking water sources and determineswhether a potential exposure pathway exists. Due to the number of release areas, some release areas were grouped geographically in AOCs. The AOCs at NALF Fentress are as follows (**Figure 4-1**):

- AOC 1 – North Runways and Buildings Area
- AOC 2 – Wastewater Treatment Plant Area

Tables 4-1a to **4-1c** provide a list of typical PFAS release areas at Navy facilities, summarizes whether those areas are present at the AOC, and for those that are present, identifies whether evidence suggests the area is a potential PFAS release area that warrants additional consideration. **Tables 4-1a** through **4-1b** correspond to AOCs 1 and 2 and the remaining stand-alone sites that do not fall within an AOC are evaluated within **Table 4-1c**.. Areas evaluated in this PA are shown on **Figure 4-1**. Each area in the AOC, that has not been evaluated in the PFAS SI or SI Addendum, is discussed individually in **Sections 4.2.1** through **4.2.2**. The one stand-alone site identified as a PFAS release area is Site 14 – Fentress Landfill. Area-specific information including migration pathways and exposure assessment for Site 14 is discussed in the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming).

4.1 Drinking Water Exposure Assessment

An evaluation of drinking water was conducted to determine whether drinking water at NALF Fentress and off-installation properties could have been impacted by any of the potential PFAS release areas identified in **Tables 4-1a** to **4-1c** and **Figure 4-1**. Groundwater from the Yorktown aquifer is used as a drinking water source at NALF Fentress and within the vicinity of the installation boundary.

As discussed in **Section 2.3.2**, the on-installation water supply well network at NALF Fentress was sampled for PFAS during the PFAS SI, and both PFOA and PFOS were were detected at concentrations exceeding the USEPA lifetime health advisory (CH2M, 2018a; CH2M, forthcoming). The installation was initially supplied with bottled water, and a GAC treatment system was added to the existing treatment plant to remove PFOA and PFOS, at which time bottled water was discontinued. Effluent sample results have consistently remained less than the USEPA lifetime health advisory since start-up of the GAC system (CH2M, forthcoming).

As discussed in **Section 2.3.2**, the Navy began sampling for PFAS in 2016. 59 parcels, with a total of 65 private wells, have been sampled. Parcels were sampled on a voluntary basis. Seven drinking water wells on six parcels had exceedances of the USEPA lifetime health advisory, and an expedited response action was implemented. Under the expedited response action, bottled water was provided to residents whose drinking water exceeded the USEPA lifetime health advisory. In 2018, a pilot study was implemented that consisted of the installation and operation of point-of-entry GAC systems at the seven drinking water wells. An EE/CA recommended establishing connection to city water as the preferred alternative to allow for a permanent solution to provide PFAS-free drinking water to affected residents (CH2M, 2018b).

As shown on **Figure 2-3**, surficial groundwater flow in the Columbia/surficial aquifer at NALF Fentress is primarily to the north, northeast, and east in the northern part of the installation (CH2M, 2018a; CH2M, forthcoming). Groundwater flow in the Yorktown aquifer is primarily to the east in the northern part of the installation (CH2M, 2018a; CH2M, forthcoming). Private water supply wells were identified that are located downgradient of potential PFAS release areas at NALF Fentress. An estimated 92 households or businesses with potentially impacted private wells were identified within 0.5 miles of NALF Fentress. The initial sampling area was established as a half mile radius in all directions from on-installation exceedances of the 2009 USEPA provisional health advisory in consideration of the historical dates of releases on the installation, estimated groundwater flow velocity, and potential radial flow direction. The sampling area has since been expanded multiple times based on locations of off-installation exceedances and the change to the 2016 USEPA lifetime health advisory. No newly identified or

investigated potential PFAS release areas identified in this report require additional off-installation investigation outside the current sample area.

Discharge of groundwater to surface water bodies, including the Intracoastal Waterway, the North Landing River, and the Pocaty River, is likely occurring. Surface water near NALF Fentress is not used for drinking water.

Table 4-1a. Areas Evaluated for Potential PFAS Releases in North Runways and Buildings Area (AOC 1)
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Fire Training Areas and Spray Test Areas			
Site 17a	Yes	Yes	Site 17a (**Figure 4-1**), located at the northern intersection of two former runways in the northwest corner of the installation, is believed to have been used for firefighting training from approximately 1959 to the 1960s based on historical aerial imagery (CH2M, 2019a). History of firefighting training in this area is less complete than the history of Site 17b, but likely firefighting training is evident by dark staining and surface disturbances visible in aerial photos (CH2M, 2019a). The quantities of AFFF used at this site are unknown. However, the PFAS SI and SI Addendum groundwater sampling results indicate the presence of PFOA, PFOS, and PFBS in the Columbia/surficial aquifer at Site 17a at levels greater than the Tapwater SLs[7] at wells sampled at Site 17a (CH2M, 2018a; CH2M, forthcoming). The highest concentration of PFOA and PFOS detected were 466 ppt and 5,320 ppt, respectively, in monitoring well OF-MW11 (CH2M, 2018a; CH2M, forthcoming). The highest concentration of PFBS detected was 1,420 ppt in monitoring well OF-MW11 (CH2M, 2018a). Due to sampling results indicating PFOA, PFOS, and PFBS levels exceed SLs, further evaluation of Site 17a is warrented. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Site 17b	Yes	Yes	Site 17b (**Figure 4-1**), located at the southern intersection of two former runways in the northwest corner of the installation, is the location of a former firefighting training area, active from approximately 1982 to 1994 based on historical aerial imagery (CH2M, 2019a).[8] The firefighting training area included an approximately 50-foot diameter earthen berm that was roughly 18 inches high. Waste fuel and fuel contaminated absorbent and booms were ignited and burned until extinguished with AFFF. Burned residue and water was periodically pumped out of the burn pit to the surrounding soils (A.T. Kearney, 1989). Waste oil came from work performed on personal vehicles by installation personnel. The oil was stored in old tank trucks onsite and subsequently burned at the Site 17b. Approximately 10 to 20 gallons of oil were reportedly burned each month. Spilled fuel and oils covered an area of approximately 2,000 square feet. Firefighting drills were conducted weekly (Rogers, Golden & Halpern, 1984). An estimated 1,500 gallons of AFFF were used per year from 1969 to 1984 at NALF Fentress, of which, about 300 gallons were disposed on the ground, with the remainder reportedly swept into the air, but it is not clear where this occurred (Rogers, Golden & Halpern, 1984). In 1992, the ring was still active, but only water was used to extinguish fires (CH2M, 1992). The quantities of AFFF used from 1984 to 1994 are unknown. A removal action was completed at Site 17b in 1994 which included the excavation and treatment of over 5,000 cubic yards of fuel-contaminated soil to the northwest and northeast of the firefighting training ring (Foster Wheeler, 1994). Groundwater at Site 17b sampled during the PFAS SI and SI Addendum exceeded the Tapwater SLs, with the highest concentrations of PFOA and PFOAS detected at 5,174 ppt in monitoring well OF17-MW03 and 44,500 J ppt in monitoring well OF17-MW04, respectively (CH2M, 2018a; CH2M, forthcoming). The highest concentration of PFBS detected was 739 ppt in monitoring well OF17-MW03 (CH2M, 2018a). PFOS was detected in the soil in two samples exceeding the residential soil SLs. The highest concentration of PFOS detected was 746 J ppt (CH2M, forthcoming). Due to documented releases of AFFF and sampling results indicating PFOA, PFOS, and PFBS levelsexceed Tapwater and residential soil SLs, further evaluation of Site 17b is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Site 17c	Yes	Yes	Site 17c (**Figure 4-1**) was identified in 2015 by installation personnel as the location of a mobile firefighting training area that used only water for training east of the old runways (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). Additional firefighting training information, including years this area was active, was not provided. A review of historical aerial imagery shows ground discoloration at Site 17c which suggests the area was also used for firefighting training from 1961 to 1982 (CH2M, 2019a). AFFF was reportedly used at the installation during this timeframe. An estimated 1,500 gallons of AFFF were used per year from 1969 to 1984 at NALF Fentress, of which, about 300 gallons were disposed on the ground, with the remainder reportedly swept into the air (Rogers, Golden & Halpern, 1984), but it is not clear where this occurred. Groundwater at Site 17c sampled during the PFAS SI Addendum indicates the presence of PFOA and PFOS in the Columbia/surficial aquifer and Yorktown aquifer at levels greater than Tapwater SLs. The highest concentrations of PFOA and PFOS detected at Site 17c were 10,110 ppt and 4,934 ppt, respectively, in monitoring well OF17C-MW01 (CH2M, forthcoming). Due to sampling results indicating PFOA and PFOS levels exceed Tapwater SLs, further evaluation of the Site 17c is warranted. Details of releases in this area and fate and transport pathways are provided in the forthcoming PFAS SI Addendum Report (CH2M, forthcoming).
Planned Fire Training Ring Location	No	No	The Planned Fire Training Ring Location (**Figure 4-1**) was an area sited for a firefighting training ring with an oil-water separator designed to replace Site 17b, located at the southeast side of the old runways (NAVFAC, 1997). The project was cancelled in June 1992 (CH2M, 1992); however, site approval was requested again in 1997 (NAVFAC, 1997). Design documents indicate the fire training ring was planned to be a 60-foot diameter concrete ring with an aircraft mock-up, a smaller rectangular debris fire trainer off circle with mock-up, a propane storage tank and piping, and water drainage controls (NAVFAC, 1997). A review of aerial photos, site documents, and interviews with site personnel did not indicate the training ring was constructed. Because there is no evidence this potential fire training site was constructed, no further action is recommended for Planned Fire Training Ring Location.
Crash Truck Test Area	Yes	Yes	The Crash Truck Test Area (**Figure 4-1**), located south of the former runways in the northwest corner of the installation, was reportedly used to conduct spray tests from fire trucks beginning in 2010 (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). An unknown quantity of AFFF was released directly onto the ground surface during previous spray tests. The spray tests involved engaging the roof turret, pumper turret, and hand lines under the truck nozzles. The resulting AFFF stream was checked for foam consistency and for the distance and width of the spray pattern. Plans for conducting spray tests were coordinated in advance and were not conducted in the rain or within a few days prior to rain. According to installation personnel in 2019, AFFF had not been used at the installation for at least one year (NALF Fentress Firefighter, 2019, pers. comm., NALF Fentress Crash Captain, 2019, pers. comm.). Groundwater and soil samples were collected at the Crash Truck Test Area during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA, PFOS, and PFBS in the Columbia/surficial aquifer and Yorktown aquifer at Crash Truck Test Area at levels greater than the Tapwater SLs. The highest concentration of PFOA and PFOS detected at Crash Truck Test Area were 960 J ppt and 23,198 J ppt, respectively, in monitoring well OF-MW08 (CH2M, forthcoming). The highest concentration of PFBS detected was 2,792 J ppt in monitoring well OF-MW08 (CH2M, forthcoming). PFOS was detected in the soil at levels exceeding the residential soil SLs. The highest concentration of PFOS detected was 390 ppt at OF-SS05 (CH2M, 2018a). Due to documented releases of AFFF and sampling results indicating PFOA, PFOS, and PFBS levels exceed Tapwater and residential soil SLs, further evaluation of Crash Truck Test Area is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Abandoned Aircraft #1	No	No	Abandoned Aircraft #1 was identified on an aerial photograph image from May 2018 (**Figure 4-1**). Installation personnel indicated that the abandoned aircrafts were used for water-only firefighting training (NALF Fentress Tower Manager, 2020). No additional information was provided. Water used for training comes from the on-installation wells. Any fire training completed before the GAC system was installed at the on-installation water treatment plant may have used water containing PFAS exceeding SLs. Abandoned Aircraft #1 is recommended for no further action because the fire training was water only.

7 SLs appropriate for this project are the values based on a hazard quotient of 0.1 outlined in the Assistant Secretary of Defense October 15, 2019 memorandum entitled, "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program" and the USEPA toxicity values for PFBS (USEPA, 2021a).

8 Installation-wide figures from previous documents are inconsistent in depicting the Site 17b location; however, the location included in this PA was determined based on locations of monitoring wells present at the site and pre- and post-removal action aerial photographs.

Table 4-1a. Areas Evaluated for Potential PFAS Releases in North Runways and Buildings Area (AOC 1)
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Abandoned Aircraft #2	No	No	Abandoned Aircraft #2 was identified by installation personnel (**Figure 4-1**) (NALF Fentress Fire Chief, 2019, pers. comm.). Two abandoned aircrafts, an E-2 Hawkeye and F/A-18 Hornet, located on a concrete pad, were used for hose-handling training; AFFF was not used during the training exercises (NALF Fentress Fire Chief, 2019, pers. comm.; NALF Fentress Firefighter, 2018, pers. comm.). The years in which this area was used for training was not provided. Water used for fire training comes from the on-installation wells. Any fire training completed before the GAC system was installed at the on-installation water treatment plant may have used water containing PFAS exceeding SLs. Abandoned Aircraft #2 is recommended for no further action because the fire training was water only.
Fire Stations			
Fire Station (Building 100)	Yes	Yes	The Fire Station (Building 100) is an active fire station connected to the east side of Building 100 – Fire Station/All Purpose Building in the north portion of the installation (Figure 4-1). Fire trucks with AFFF tanks are stored here. Firefighting training reportedly occurs in the area behind Building 100 (exact location not provided); no AFFF is currently used during training (NALF Fentress Fire Chief, 2019, pers. comm.; NALF Fentress Firefighter, 2019, pers. comm.). Fire trucks were washed with an unknown quantity of AFFF outside the Fire Station prior to 1998 for an unknown length of time (NAS Oceana Public Works Department Electrician, 2019, pers. comm.). Equipment is currently washed behind Building 100 using soap and water (NALF Fentress Firefighter, 2019, pers. comm.; NALF Fentress Crash Captain, 2019, pers. comm.; NALF Fentress Fire Chief, 2019, pers. comm.). Fire hose handling training using only water is conducted in the area behind the Fire Station (NALF Fentress Firefighter, 2019, pers. comm.). In 2001 and 2003, three 130-gallon AFFF tanks on fire trucks were stored at the Fire Station (Jones, 2002; Jones, 2004). In 2015, installation personnel reported two 200-gallon AFFF tanks on fire trucks were stored at the Fire Station (CH2M, 2015). Groundwater and soil samples were collected at Fire Station during the PFAS SI and SI Addendum as part of the investigation for Building 20 – AFFF Storage (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA and PFOS in the Columbia/surficial aquifer and Yorktown aquifer at the Fire Station at levels greater than the Tapwater SLs. The highest concentration of PFOA and PFOS detected at Fire Station were 8,744 ppt in monitoring well OFPOL-MW-9 and 9,709 ppt in monitoring well OFPOL-MW-8, respectively (CH2M, 2018a; CH2M, forthcoming). PFOS was detected in the soil exceeding the residential soil SLs. The highest concentration of PFOS detected was 864 ppt at OFPOL-SO08 (CH2M, forthcoming). Due to documented releases of AFFF and sampling results indicating PFOA and PFOS levels exceed Tapwater and residential soil SLs, further evaluation of the Fire Station is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Potential PFAS Storage Areas			
Building 20 – AFFF Storage	Yes	Yes	Building 20 – AFFF Storage has been used to store and transfer AFFF (**Figure 4-1**) (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). In 2015, installation personnel reported crash trucks had been replenished with AFFF by hand from 5-gallon containers at Building 20 (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). Although there is no documentation that AFFF, or other PFAS-containing material, has been released, AFFF releases could have occurred during transfer. Former UST 20B is adjacent to Building 20 and is a former 1,000-gallon UST installed in 1976 to store gasoline. The former UST was removed in 1993 (Navy, 1993). UST 20B was managed under the Petroleum Oil Lubricant program (CH2M, 2018a). While use of UST 20B is not consistent with potential for PFAS releases, wells associated with the UST were sampled during the PFAS SI and SI Addendum to assess potential PFAS releases associated with Building 20. Results of sampling indicated exceedances of the Tapwater SLs for PFOA, PFOS, and PFBS (CH2M, 2018a; CH2M, forthcoming). The highest concentration of PFOA and PFOS detected at Building 20 were 5,620 ppt at monitoring well OFPOL-MW-3 and 49,300 ppt in monitoring well OFPOL-MW-7, respectively, (CH2M, 2018a). The highest concentration of PFBS detected was 840 ppt in monitoring well OFPOL-MW-7 (CH2M, 2018a). PFOS was detected in the soil exceeding the residential soil SLs. The highest concentration of PFOS detected was 280 ppt at OFPOL-SS04 (CH2M, 2018a). Due to historical site activities including the storage and transfer of AFFF and sampling results indicating PFOA, PFOS, and PFBS levels exceed Tapwater and residential soil SLs, further evaluation of Building 20 is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Building 101 - AFFF Storage	No	No	Building 101 – AFFF Storage is used to store AFFF in 5-gallon containers (**Figure 4-1**) (NALF Fentress Firefighter, 2019, pers. comm., NALF Fentress Crash Captain, 2019, pers. comm., NALF Fentress Fire Chief, 2019, pers. comm.). AFFF storage was not documented in EPCRA reports from 2001, 2003, 2004, or 2015 (Jones, 2002; Jones, 2004; Navy, 2005; Navy, 2016). Search and rescue firefighting training is conducted in areas behind Building 101 (NALF Fentress Firefighter, 2019, pers. comm.); the specific location was not provided. No AFFF use is associated with this training. While Building 101 is used to store AFFF, because there is no evidence that AFFF, or other PFAS-containing material, has been released at this location, no further action is recommended for Building 101 – AFFF Storage.
Building 106 - AFFF Storage	Yes	No	Building 106 – AFFF Storage is used to store AFFF in 5-gallon containers and AFFF-containing equipment (**Figure 4-2**) (NALF Fentress Firefighter, 2019, pers. comm.; Former NALF Fentress Water Program Managers, 2019, pers. comm.; NAS Oceana Air Ops Manager, 2019, pers. comm.; NALF Fentress Crash Captain, 2019, pers. comm.). EPCRA reports indicated there were 288 5-gallon AFFF containers (1,440 gallons total) in 2001, 215 5-gallon AFFF containers (1,075 gallons total) in 2003, an unknown quantity of AFFF in 2004, and 119 5-gallon AFFF containers (595 gallons total) in 2015 stored at Building 106 (Jones, 2002; Jones, 2004; Navy, 2005; Navy, 2016). In 2015, installation personnel stated a 200-gallon spare tank of AFFF was kept in Building 106 for fire trucks. It was also reported crash trucks were replenished with AFFF by hand from 5-gallon containers at Building 106 (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). Although there is no evidence that AFFF, or other PFAS-containing material, has been released, it is possible an AFFF release occurred during transfer. As a result, further evaluation of Building 106 – AFFF Storage is provided in **Section 4.2.1**.
Hazardous Waste Storage Areas			
SWMU 10 - Hazardous Waste Storage Area	No	No	Solid Waste Management Unit (SWMU) 10 - Hazardous Waste Storage Area was a less than 90-day storage area that consisted of drums of hazardous waste stored on pallets in an outside, unsecured area (**Figure 4-1**) (A. T. Kearney, 1989). SWMU 10 was approximately 12 feet by 25 feet, paved with concrete with a partial curb as a spill control mechanism (A.T. Kearney, Inc., 1989). The exact location of SWMU 10 is unknown, and the location identified in the RCRA Facility Assessment was not confirmed using historical aerial imagery (A.T. Kearney, Inc., 1989; CH2M, 2019a). Waste stored may have included empty oil and paint cans, paint thinner, paint remover, jet fuel, solvents, asbestos, hydraulic fluid, freon, neutralized battery acid, and electric coolant oil (A.T. Kearney, Inc., 1989). While paints and hydraulic fluids may contain PFAS, at the time of this report, paints and hydraulic fluids are not being used to characterize PFAS sites. The Navy recognizes that some paints and hydraulic fluids have been manufactured utilizing PFAS; however, information regarding paints and hydraulic fluids that contain PFAS as well as any percentage or concentration is proprietary information not available to the Navy. Groundwater samples were collected north of the assumed location of SWMU 10 at a north perimeter well during the Basewide SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). The highest concentration of PFOA and PFOS detected at SWMU 10 is 880 ppt and 4,300 ppt, respectively, at OF-MW13 (CH2M, 2018a). Though sampling results indicate PFOA and PFOS exceed Tapwater SLs, there is no evidence that AFFF, or other PFAS-containing material, stored or released at SWMU 10. The exceedance of the Tapwater SLs at SWMU 10 is likely due SWMU 10 being located downgradient to other confirmed release areas such as Building 20, Site 17c, and the Old Runway AFFF Release which will be further delineated in future investigations. Due to no evidence of AFFF, or other PFAS-containing material, being used, released, or transferred at this location, no further action is recommended for SWMU 10 – Hazardous Waste Storage Area.

Table 4-1a. Areas Evaluated for Potential PFAS Releases in North Runways and Buildings Area (AOC 1)
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Runways, Taxiways, Maintenance Ramps, and Aprons			
Old Runway AFFF Release	Yes	Yes	Old Runway AFFF Release was identified by installation personnel (**Figure 4-1**); AFFF was reportedly sprayed along the entire original runway (NAS Oceana Public Works Department Electrician, 2019, pers. comm.). The quantity of AFFF released or the date of this occurrence is unknown. Groundwater and soil samples were collected at Old Runway AFFF Release during the PFAS SI and SI Addendum as part of the investigation for Site 17a and Site 17b which are within the Old Runway AFFF Release area (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA, PFOS, and PFBS in the Columbia/surficial aquifer and the Yorktown aquifer at the Old Runway AFFF Release at levels greater than the Tapwater SLs. The highest concentration of PFOA and PFOS detected at the Old Runway AFFF Release were 151 ppt at monitoring well OF-MW10 and 2,707 ppt in monitoring well OF-MW12, respectively (CH2M,2018a; CH2M, forthcoming). The highest concentration of PFBS detected was 2,775 ppt in monitoring well OF17B-MW02D (CH2M, forthcoming). Due to reported releases of AFFF and sampling results indicating PFOA, PFOS, and PFBS levels exceed Tapwater SLs, further evaluation of the Old Runway AFFF Release is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Plane Crashes and Emergency Response Areas			
1980 F-4 Phantom Crash	No	No	On December 16, 1980, a F-4 Phantom crashed north of the active runway while landing (**Figure 4-1**) (UPI, 1980; NAS Oceana Fire Chief, 2019, pers. comm.). Due to no evidence of AFFF, or other PFAS-containing material, being used or released during this incident, no further action is recommended for the 1980 F-4 Phantom Crash.
2001 F-14 Tomcat Crash	Yes	Yes	On April 9, 2001, an F-14 Tomcat made a belly landing at the north end of the active runway during a training exercise at NALF Fentress (**Figure 4-1**) (Virginian-Pilot, 2001; Freeman, 2019). Approximately 10 gallons of AFFF were used "in response to an aircraft landing with no landing gear down" (Jones, 2002). Groundwater samples were collected downgradient of the 2001 F-14 Tomcat Crash at a perimeter well during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA in the Columbia/surficial aquifer at the 2001 F-14 Tomcat Crash site at levels greater than the Tapwater SL. The highest concentration of PFOA detected at the 2001 F-14 Tomcat Crash was 185 ppt at monitoring well OF-MW15 (CH2M, 2018a). Due to AFFF likely being used in the emergency response and sampling results indicating PFOA levels exceed Tapwater SLs, further evaluation of 2001 F-14 Tomcat Crash is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
E-2 Hawkeye on Side of Tarmac	Yes	No	Former installation personnel observed 6 to 8 feet of foam where an E-2 Hawkeye was parked on the side of the tarmac (**Figure 4-3**) (Former NALF Fentress WWTP Supervisor, 2019, pers. comm.). The date of the incident was not provided. The location of the incident was identified as current location of baseball field/SEAL training building. Due to the reported release of AFFF, further evaluation of E-2 Hawkeye on Side of Tarmac is provided in **Section 4.2.1**.
Buried Abandoned Aircraft	No	No	Buried Abandoned Aircraft was identified by installation personnel (**Figure 4-1**) (NAS Oceana Air Ops Manager, 2019, pers. comm.). An A-4 Skyhawk aircraft is reportedly buried in the woods. No additional information was provided. There is no evidence of AFFF, or other PFAS-containing materials, being used or released at this location; therefore, no further evaluation is recommended for Buried Abandoned Aircraft.
Crash Truck Waiting Areas near Runway #1 and #2	No	No	Crash Truck Waiting Areas #1 and #2 are located along the north end of the active runway (**Figure 4-1**). These areas were built between 2011 and 2014, and first appear in aerial imagery of the installation in 2014. No AFFF releases have been reported, and no known aircraft crashes that may have used AFFF have occurred on the active runway since the Crash Truck Waiting Areas were built. There is no evidence of AFFF, or other PFAS-containing materials, being used or released at this location. Groundwater samples were collected downgradient of the Crash Truck Waiting Areas #1 and #2 at perimeter wells during the PFAS SI and SI Addendum. Groundwater sampling results indicate the presence of PFOA in the Columbia/surficial aquifer downgradient of the Crash Truck Waiting Areas #1 and #2 at levels greater than the Tapwater SL. The highest concentration of PFOA detected downgradient of the Crash Truck Waiting Areas #1 and #2 was 185 ppt at monitoring well OF-MW15 (CH2M, 2018a). The exceedance of the Tapwater SLs downgradient of Crash Truck Waiting Areas #1 and #2 is likely due Crash Truck Waiting Areas #1 and #2 being located near the 2001 F-14 Tomcat Crash which is a confirmed release area which will be further delineated in future investigations. Therefore, Crash Truck Waiting Areas #1 and #2 are recommended for no further action because there is no evidence of AFFF, or other PFAS containing materials, was used or released at these locations.
Hangars and Other Structures with AFFF Suppression Systems (Including Tank Farms)			
No hangars or other structures with AFFF suppression systems (including tank farms) were identified within AOC 1.			
Wastewater Treatment Plants and Associated Areas			
No wastewater treatment plants or associated areas were identified within AOC 1.			
Landfills and Other Waste Disposal Areas			
No landfills or other waste disposal areas were identified within AOC 1.			
Specialty Paint, Cleaner, or Pesticide Use or Release			
No specialty paint, cleaner or pesticide/herbicide uses or releases were identified within AOC 1.			
Chromium Plating Shops			
No chromium plating shops were identified within AOC 1.			
Car Washes and Auto Hobby Shops			
No car washes or auto hobby shops were identified within AOC 1.			

Table 4-1b. Areas Evaluated for Potential PFAS Releases in Wastewater Treatment Plant Area (AOC 2)
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Wastewater Treatment Plants and Associated Areas			
Current Wastewater Treatment Plant	Yes	Yes	The Current Wastewater Treatment Plant (**Figure 4-1**) is an active WWTP that processes waste (effluent) from: the air control tower, fire station, offices, mess hall, galley, and barracks (Navy Public Works Center, 2001). The Current Wastewater Treatment Plant Water was built in the 1980s and consists of sewage treatment lagoons, a polishing pond, and a chlorine contact tank (CH2M, 2019a; VSWCB, 1991). In 2016, a GAC treatment system was installed to remove PFAS from the WWTP effluent prior to the wastewater entering the irrigation spray system (CH2M, 2016b). The Current Wastewater Treatment Plant was evaluated as a secondary PFAS release area in the PFAS SI and SI Addendum because the water and wastewater treatment process at the installation was not originally designed to treat PFAS. Wastewater samples were collected in 2016, and PFOA and PFOS exceeded the SLs (CH2M, 2016b). The highest concentrations of PFOA and PFOS detected in the Current Wastewater Treatment Plant were 1,400 ppt and 1,700 ppt, respectively, in the treatment lagoon. PFOA and PFOS concentrations in the chlorine contactor, the last step in the wastewater treatment process before distribution in the irrigation system, were 470 ppt and 1,100 ppt, respectively (CH2M, 2016b). Wells sampled at the Former Irrigation Sprayfields and Current Irrigation Sprayfields during the PFAS SI and SI Addendum exceeded the Tapwater SLs for PFOA and PFOS (CH2M, 2018a, CH2M, forthcoming). Due to the Current Wastewater Treatment Plant receiving waste that may have contained PFAS and sampling results indicating PFOA and PFOS levels exceed Tapwater SLs, further evaluation of the Current Wastewater Treatment Plant is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Former Wastewater Treatment Plant	Yes	Yes	The Former Wastewater Treatment Plant (**Figure 4-1**) was constructed in 1944 and was used through the 1980s when the new treatment plant was constructed. The Former Wastewater Treatment Plant consisted of a sewage treatment pumphouse, digestion tanks, biofilter, and sludge drying beds. Treated effluent was sprayed on the Former Irrigation Sprayfields (Rogers, Golden & Halpern, 1984; CH2M, 2019a). The Former Wastewater Treatment Plant was evaluated as secondary PFAS release area in the PFAS SI and SI Addendum because the water and wastewater treatment process at the installation was not designed to treat PFAS. Groundwater samples were collected downgradient of the Former Wastewater Treatment Plant during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA and PFOS in the Columbia/surficial aquifer downgradient of the Former Wastewater Treatment Plant at levels greater than the Tapwater SLs. The highest concentration of PFOA and PFOS detected downgradient at the Former Wastewater Treatment Plant were 298 ppt and 471 ppt respectively in monitoring well OF14-MW06 (CH2M, 2018a; CH2M, forthcoming). Due to the Former Wastewater Treatment Plant potentially receiving waste that may have containted PFAS and sampling results indicating PFOA and PFOS levels exceed Tapwater SLs, further evaluation of the Former Wastewater Treatment Plant is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Current Irrigation Sprayfields	Yes	Yes	The Current Irrigation Sprayfields (**Figure 4-1**) were constructed in the early 1990s (VSWCB, 1991). The Current Irrigation Sprayfields are used to apply treated wastewater from the Current Wastewater Treatment Plant to the ground surface through spray irrigation as a final tertiary treatment component (Navy Public Works Center, 2001; Navy, 2001). The Current Irrigation Sprayfields are composed of five spray fields consisting of a total irrigation area of approximately 7.5 acres including a 1.5-acre reserve spray area (Navy, 2001; Navy, 1991). The irrigation fields were designed to avoid surface runoff of the treated effluent (Navy, 2001; Navy, 1991). Because PFOA and PFOS were present at concentrations greater than SLs in groundwater used for potable and non-potable purposes on-installation prior to installation of the GAC treatment and no part of the wastewater treatment process was intended to remove these compounds, wastewater effluent also likely contained PFOA and PFOS. Wastewater samples were collected in 2016, and PFOA and PFOS results exceeded SLs (CH2M, 2016b). The highest concentrations of PFOA and PFOS detected in the Current Wastewater Treatment Plant were 1,400 ppt and 1,700 ppt, respectively, in the treatment lagoon. PFOA and PFOS concentrations in the chlorine contactor, the last step in the wastewater treatment process before distribution in the irrigation system, were 470 ppt and 1,100 ppt, respectively (CH2M, 2016b). Groundwater samples were collected at Current Irrigation Sprayfields during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOS in the Columbia/surficial aquifer at the Current Irrigation Sprayfields at levels greater than the Tapwater SLs. The highest concentration of PFOS detected at the Current Irrigation Sprayfields was 108 ppt in monitoring well OF-MW16 (CH2M, 2018a). Due to the Current Irrigation Sprayfields receiving treated effluent that may have contained PFAS from the Current Wastewater Treatment Plant and sampling results indicating PFOS levels exceed Tapwater SLs, further evaluation of the Current Irrigation Sprayfields is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Former Irrigation Sprayfields	Yes	Yes	The Former Irrigation Sprayfields (**Figure 4-1**) were used to discharge treated effluent from the Former Wastewater Treatment Plant to the ground surface through spray irrigation (Rogers, Golden & Halpern, 1984; CH2M, 2019a). Because PFOA and PFOS were present at concentrations greater than SLs in groundwater used for potable and non-potable purposes on-installation prior to installation of the GAC treatment and no part of the wastewater treatment process was intended to remove these compounds, wastewater effluent from the Former Wastewater Treatment Plant also likely contained PFOA and PFOS. Groundwater samples were collected at the Former Irrigation Sprayfields during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA and PFOS in the Columbia/surficial aquifer at the Former Irrigation Sprayfields at levels greater than the Tapwater SLs. The highest concentration of PFOA and PFOS detected at the Former Irrigation Sprayfields were 309 ppt and 3,320 ppt, respectively in monitoring well OF-MW24 (CH2M, 2018a; CH2M, forthcoming). Due to the Former Irrigation Sprayfields receiving treated effluent that may have contained PFAS from the Former Wastewater Treatment Plant and sampling results indicating PFOA and PFOS levels exceed Tapwater SLs, further evaluation of the Former Irrigation Sprayfields is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Landfills and Other Waste Disposal Areas			
Drainage Ditch Excavated Soil Dump Site	Yes	Yes	The Drainage Ditch Excavated Soil Dump Site (**Figure 4-1**) is located in the northeast corner of NALF Fentress and overlaps with the Current Irrigation Sprayfields. This site is where excavated soil from a drainage ditch that runs along the western border of the installation was disposed of when the ditch was cleaned and regraded in the early 1990s (NAVFAC, 1991b). Because of documented AFFF releases at the Old Runway AFFF Release area, it is possible the drainage ditch soils contained PFAS. Groundwater samples were collected at Drainage Ditch Excavated Soil Dump Site during the PFAS SI and SI Addendum as part of the investigation of the Current Irrigation Sprayfields (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOS in the Columbia/surficial aquifer at the Drainage Ditch Excavated Soil Dump Site at levels greater than the Tapwater SLs. The highest concentration of PFOS detected at the Drainage Ditch Excavated Soil Dump Site was 108 ppt in monitoring well OF-MW16 (CH2M, 2018a). Due to the Drainage Ditch Excavated Soil Dump Site receiving waste soil that may have contained PFAS and sampling results indicating PFOS levels exceed Tapwater SLs, further evaluation of the Drainage Ditch Excavated Soil Dump Site is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Fire Training Areas and Spray Test Areas			
No fire training areas or spray tests areas were identified within AOC 2.			

Table 4-1b. Areas Evaluated for Potential PFAS Releases in Wastewater Treatment Plant Area (AOC 2)
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Fire Stations			
No fire stations were identified within AOC 2.			
Hangars and Other Structures with AFFF Suppression Systems (Including Tank Farms)			
No hangars or other structures with AFFF suppression systems (including tank farms) were identified within AOC 2.			
Potential PFAS Storage Areas			
No potential PFAS storage areas were identified within AOC 2.			
Hazardous Waste Storage Areas			
No hazardous waste storage areas were identified within AOC 2.			
Runways, Taxiways, Maintenance Ramps, and Aprons			
No runways, taxiways, maintenance ramps, and aprons were identified within AOC 2.			
Plane Crashes and Emergency Response Areas			
No plane crashes or emergency response areas were identified within AOC 2.			
Hangars and Other Structures with AFFF Suppression Systems (Including Tank Farms)			
No hangars or other structures with AFFF suppression systems (including tank farms) were identified within AOC 2.			
Specialty Paint, Cleaner, or Pesticide Use or Release			
No specialty paint, cleaner or pesticide/herbicide uses or releases were identified within AOC 2.			
Chromium Plating Shops			
No chromium plating shops were identified within AOC 2.			
Car Washes and Auto Hobby Shops			
No car washes or auto hobby shops were identified within AOC 2.			

Table 4-1c. Areas Evaluated for Potential PFAS Releases as Stand-Alone Sites
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Fire Training Areas and Spray Test Areas			
Runway Spray Test Area	No	No	The Runway Spray Test Area (**Figure 4-1**) is the southwest portion of the active runway. The active runway has been in operation since the early 1950s (Freeman, 2019). Installation personnel report that the south end of the runway is currently used to test spray patterns, but only water from on-installation wells is used (NALF Fentress Firefighter, 2019, pers. comm.; NALF Fentress Fire Chief, 2019, pers. comm.). Any fire training completed before the GAC system was installed at the on-installation water treatment plant may have used water containing PFAS exceeding SLs. Groundwater samples were collected at perimeter wells downgradient of the Runway Spray Test Area during the PFAS SI and SI Addendum; concentrations of PFOA and PFOS did not exceed the Tapwater SLs (CH2M, 2018a; CH2M, forthcoming). Therefore, the Runway Spray Test Area is recommended for no further action because the fire training was water only and sampling results downgradient indicate PFOA and PFOS levels do not exceed SLs.
Plane Crashes and Emergency Response Areas			
1953 F4U Corsair Crash	No	No	In 1953, an F4U Corsair crashed off the south end of the active runway and traveled across irrigation ditches (**Figure 4-1**) (Freeman, 2019). This crash pre-dates AFFF use in emergency responses. Therefore, no further action is recommended for this area.
1999 F-14 Tomcat Crash	No	No	In 1999, an F-14 Tomcat made a belly landing (landing without landing gear down). The exact location of the crash is unknown but is suspected to have occurred in the southern end of the active runway (**Figure 4-1**). Installation personnel indicated that foam was not used in crash response (NAS Oceana Air Ops Manager, 2019, pers. comm.). Groundwater samples were collected at a perimeter well downgradient of the 1999 F-14 Tomcat Crash during the PFAS SI and SI Addendum; concentrations of PFOA and PFOS did not exceed the Tapwater SLs (CH2M, 2018a, CH2M, forthcoming). Therefore, the 1999 F-14 Tomcat Crash is recommended for no further action because there is no evidence AFFF, or other PFAS-containing materials, was used during the emergency response and sampling results downgradient indicate PFOA and PFOS levels do not exceed SLs.
2004 E-2 Hawkeye Crash	No	No	In 2004, an E-2 Hawkeye hit a deer on the southwest part of the active runway while taxiing at night. Installation personnel reported the crash occurred near the location of the 1999 F-14 Tomcat Crash (**Figure 4-1**) (NAS Oceana Air Ops Manager, 2019, pers. comm.). AFFF use is not suspected in the response (NAS Oceana Air Ops Manager, 2019, pers. comm.). There is no evidence of AFFF, or other PFAS-containing materials, being used or released at this location. Groundwater samples were collected at a perimeter well downgradient of the 2004 E-2 Hawkeye Crash during the PFAS SI and SI Addendum; concentrations of PFOA and PFOS did not exceed the Tapwater SLs (CH2M, 2018a, CH2M, forthcoming). Therefore, the 2004 E-2 Hawkeye Crash is recommended for no further action because there is no evidence AFFF, or other PFAS-containing materials, was used during the emergency response and sampling results down gradient indicate PFOA and PFOS levels do not exceed SLs.
Crash Truck Waiting Areas near Runway #3 and #4	No	No	Crash Truck Waiting Areas #3 and #4 are located along the southern end of the active runway (**Figure 4-1**). These areas were built between 2011 and 2014, and first appear in aerial imagery of the installation in 2014. No AFFF releases have been reported, and no known aircraft crashes that may have used AFFF have occurred on the active runway since the Crash Truck Waiting Areas were built. There is no evidence of AFFF, or other PFAS-containing materials, being used or released at these locations. Groundwater samples were collected at perimeter wells downgradient of the Crash Truck Waiting Areas #3 and #4 during the PFAS SI and SI Addendum; concentrations of PFOA and PFOS did not exceed the Tapwater SLs (CH2M, 2018a, CH2M, forthcoming). Therefore, Crash Truck Waiting Areas #3 and #4 are recommended for no further action because there is no evidence of AFFF, or other PFAS containing materials, was used at this location and sampling results down gradient indicate PFOA and PFOS levels do not exceed SLs.
Landfills and Other Waste Disposal Areas			
Site 14 – Fentress Landfill	Yes	Yes	Site 14 – Fentress Landfill (**Figure 4-1**), also identified as SWMU 23 in the RCRA Facility Assessment Revised Phase II Report (A.T. Kearney, 1989), was used from 1945 until 1970 for the disposal of solvents, conductors, pesticides, mixed municipal wastes, construction debris, and sanitary waste (Rogers, Golden & Halpern, 1984; A.T. Kearney, 1989). Sludge from the Former Wastewater Treatment Plant which may contain PFAS was disposed at Site 14 for an unknown duration (Rogers, Golden & Halpern, 1984). Additional wastes were dumped on the surface of the closed landfill and in adjacent trenches (Rogers, Golden & Halpern, 1984). Some of the waste was buried in trenches adjacent to the landfill including empty AFFF containers (Rogers, Golden & Halpern, 1984). The Initial Assessment Study (IAS) reports that 25 5-gallons empty plastic containers were generated each month for an unknown length of time and contained either AFFF or used oil from the hobby shop (Rogers, Golden & Halpern, 1984). A site visit in 2017 identified large debris including aircraft parts, washing machines, and metal containers (CH2M, 2018c). These aircraft parts may also have contained residual AFFF due to historical firefighting training with aircraft wreckage and no documented disposal of the training aircrafts. The original landfill was approximately 3 acres and unlined, but additional waste was buried in a 50- by 20- by 6-foot and 70- by 20- by 12-foot trench adjacent to the landfill in 1983 (Rogers, Golden & Halpern, 1984; A.T. Kearney, 1989). A digital geophysical mapping investigation was conducted in 2018 to establish the areal extent of Site 14 (CH2M, 2019c). Groundwater and soil samples were collected at Site 14 during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming). Groundwater sampling results indicate the presence of PFOA and PFOS in the Columbia/surficial aquifer and Yorktown aquifer at Site 14 at levels greater than the Tapwater SLs. The highest concentrations of PFOA and PFOS detected at Site 14 were 1,713 ppt in monitoring well OF14-MW08D and 994 ppt in monitoring well OF14-MW08, respectively (CH2M, 2018a; CH2M, forthcoming). PFOS was detected in the soil exceeding the residential soil SLs. The highest concentration of PFOS detected was 190 ppt (CH2M, forthcoming). Due to suspected PFAS-containing material being disposed at Site 14 and sampling results indicating PFOA and PFOS levels exceed Soil and Tapwater SLs, further evaluation of Site 14 is warranted. Details of releases in this area and fate and transport pathways are provided in the PFAS SI report and forthcoming PFAS SI Addendum Report (CH2M, 2018a; CH2M, forthcoming).
Fire Stations			
No fire stations were identified as a stand alone site.			
Hangars and Other Structures with AFFF Suppression Systems (Including Tank Farms)			
No hangars or other structures with AFFF suppression systems (including tank farms) were identified as a stand alone site.			
Potential PFAS Storage Areas			
No potential PFAS storage areas were identified as a stand alone site.			
Hazardous Waste Storage Areas			
No hazardous waste storage areas were identified as a stand alone site.			

Table 4-1c. Areas Evaluated for Potential PFAS Releases as Stand-Alone Sites
NALF Fentress, Chesapeake, VA

Area	Potential or Confirmed PFAS Release Area? (Yes/No)	Previously Investigated in PFAS SI or SI Addendum (Yes/No)	Description
Runways, Taxiways, Maintenance Ramps, and Aprons			
No runways, taxiways, maintenance ramps, and aprons were as a stand alone site.			
Wastewater Treatment Plants and Associated Areas			
No wastewater treatment plants or associated areas were identified as a stand alone site.			
Specialty Paint, Cleaner, or Pesticide Use or Release			
No specialty paint, cleaner or pesticide/herbicide uses or releases were identified as a stand alone site.			
Chromium Plating Shops			
No chromium plating shops were identified as a stand alone site.			
Car Washes and Auto Hobby Shops			
No car washes or auto hobby shops were identified as a stand alone site.			

This page is intentionally left blank

4.2 Potential PFAS Release Areas

Areas identified as potential PFAS release areas in **Tables 4-1a** to **4-1c** and **Figure 4-1** that have not been previously investigated are further evaluated in the following subsections. Area-specific information including migration pathways and exposure assessment is also provided. Detailed figures showing each area are presented as **Figures 4-2** through **4-3**.

4.2.1 PFAS AOC 1 – North Runways and Buildings Area

The North Runways and Buildings Area (AOC 1) includes the following potential release areas:

- Building 106 – AFFF Storage
- E-2 Hawkeye on Side of Tarmac

Each potential /confirmed release area, with the exception of those previously investigated during the PFAS SI and SI Addendum (CH2M, 2018a; CH2M, forthcoming), is discussed in the following subsections and the recommendations for the entire AOC are included at the end of **Section 4.2.1**.

Building 106 - AFFF Storage

Description and Operational History

Building 106 - AFFF Storage is used to store AFFF in 5-gallon containers (**Figure 4-2**) (NALF Fentress Firefighter, 2019, pers. comm.; Former NALF Fentress Water Program Managers, 2019, pers. comm.; NAS Oceana Air Ops Manager, 2019, pers. comm.; NALF Fentress Crash Captain, 2019, pers. comm.). Brush fire equipment containing AFFF was returned to the installation in late 2019 after being gone for three years; the equipment is stored in Building 106 (NALF Fentress Crash Captain, 2019, pers. comm.). It was also reported crash trucks were replenished with AFFF by hand from 5-gallon containers at Building 106 (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.). In 2019, installation personnel stated no AFFF has been handled at the installation for at least a year (NALF Fentress Firefighter, 2019, pers. comm.; NALF Fentress Crash Captain, 2019, pers. comm.).

Potential for PFAS Use or Release

Building 106 – AFFF Storage is used for storage of AFFF and equipment that contains AFFF as well as where crash trucks were replenished by hand. EPCRA reports indicated there were 288 5-gallon AFFF containers (1,440 gallons total) in 2001, 215 5-gallon AFFF containers (1,075 gallons total) in 2003, an unknown quantity of AFFF in 2004, and 119 5-gallon AFFF containers (595 gallons total) in 2015 stored at Building 106 (Jones, 2002; Jones, 2004; Navy, 2005; Navy, 2016). In 2015, installation personnel stated a 200-gallon spare tank of AFFF was kept in Building 106 for fire trucks. Building 106 is where brush fire equipment containing AFFF is stored. The 2015 EPCRA report also noted “building fire suppression is AFFF” at Building 106 (Navy, 2015); however, installation personnel reported there are no AFFF fire suppression systems on installation (NALF Fentress Crash Captain, 2019, pers. comm.; CH2M, 2018a). It was also reported crash trucks were replenished with AFFF by hand from 5-gallon containers at Building 106 (NALF Fentress Captain and NAS Oceana Assistant Fire Chief, 2015, pers. comm.), during which an unknown quantity of AFFF may have been released.

Migration Pathway and Exposure Assessment

AFFF potentially released at Building 106 was likely transported via surface runoff from paved areas to the adjacent grassy areas northeast of the building to the sewer drain that leads to the WWTP (**Figure 4-2**). PFAS that infiltrated the subsurface soil likely migrated to the underlying Columbia/surficial aquifer. Groundwater flow in the Columbia/surficial aquifer is generally to the east or northeast toward the North Landing River. The Yorktown aquifer is generally confined within the north area of NALF Fentress. Groundwater flow in the Yorktown aquifer is to the east-northeast toward the North Landing River. PFAS could be transported northeast via advection and dispersion with groundwater flow partitioning to sediment and surface water where the discharge occurs into the river.

Workers and visitors may be present at Building 106, and workers, visitors, residents, and recreational users are present within 1 mile.

Recommendation

Additional investigation, including groundwater and soil sampling, is recommended at Building 106. It is recommended that the sampling be combined with further investigations at AOC 1.

E-2 Hawkeye on Side of Tarmac

Description and Operational History

E-2 Hawkeye on Side of Tarmac was identified by installation personnel who observed 6 to 8 feet of foam where an E-2 Hawkeye was parked on the side of the tarmac (**Figure 4-3**) (Former NALF Fentress WWTP Supervisor, 2019, pers. comm.). The date of the incident was not provided. The location of the incident was identified as current location of baseball field/SEAL training building.

Potential for PFAS Use or Release

An unknown quantity of AFFF was released at the E-2 Hawkeye on Side of Tarmac resulting in 6 to 8 feet of foam.

Migration Pathway and Exposure Assessment

AFFF released at the E-2 Hawkeye on Side of Tarmac likely infiltrated the soil since the area is unpaved or was transported via surface runoff into the sewer drain in the northwest corner of the site that leads to the WWTP. Surface water flows generally radially outward from the gravel area at east side of the site and from the building at the west side of the site. Additionally, there is a sewer drain to the north of the building (**Figure 4-3**). PFAS that infiltrated the subsurface soil likely migrated to the underlying Columbia/surficial aquifer. Groundwater flow in the Columbia/surficial aquifer is generally to the east-northeast toward the North Landing River. The Yorktown aquifer is generally confined within the north area of NALF Fentress. Groundwater flow in the Yorktown aquifer is to the east-northeast toward the North Landing River. PFAS could be transported east-northeast via advection and dispersion with groundwater flow partitioning to sediment and surface water where the discharge occurs into the river. Surface water in the vicinity of the E-2 Hawkeye on Side of Tarmac can move through a series of drainage ditches east across NALF Fentress, ultimately discharging in the North Landing River.

Workers and visitors may be present at E-2 Hawkeye on Side of Tarmac, and workers, visitors, residents, and recreational users are present within 1 mile.

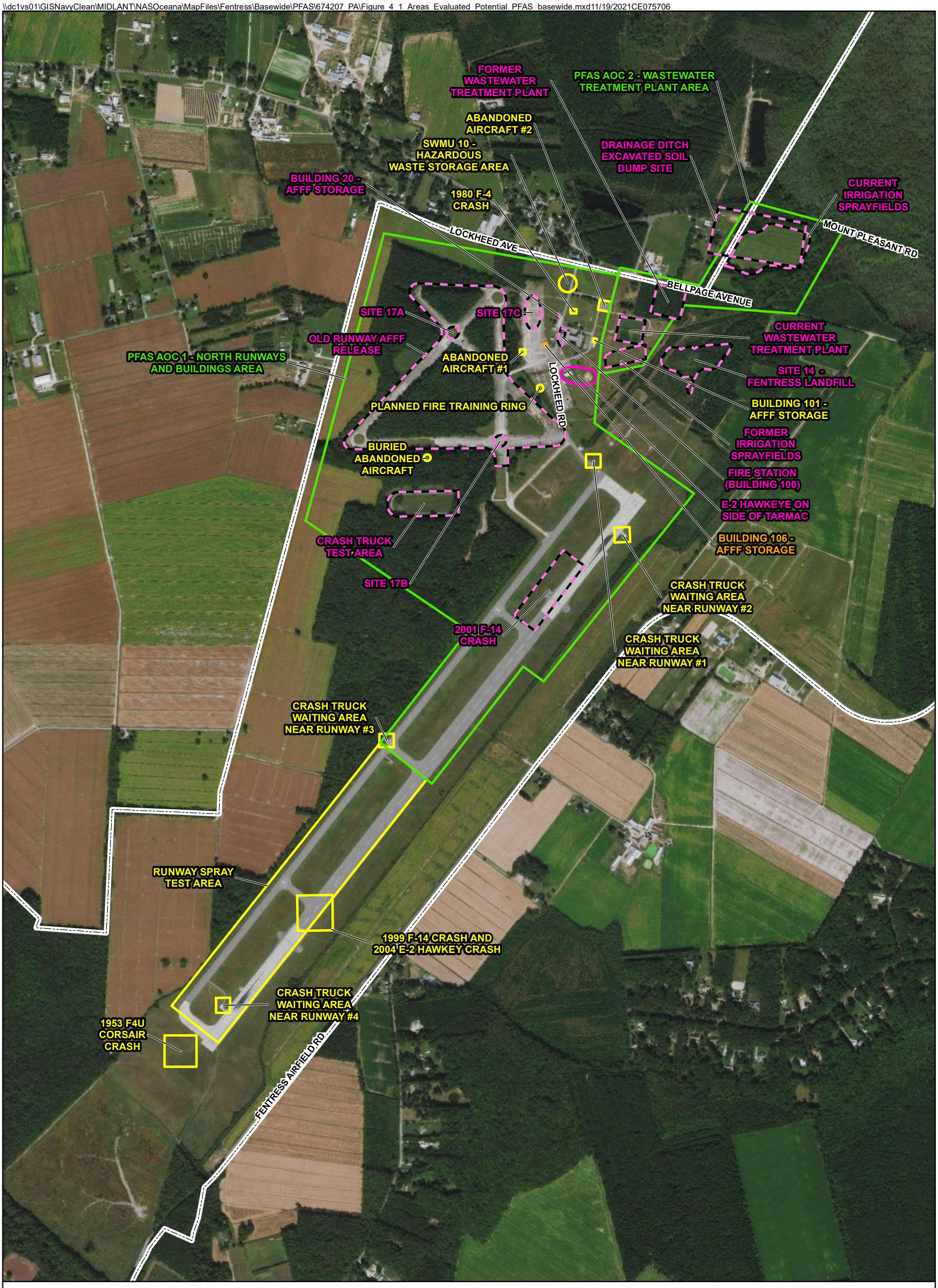
Recommendation

Additional investigation, including groundwater and soil sampling, is recommended at the E-2 Hawkeye on Side of Tarmac. It is recommended that the sampling be combined with further investigations at AOC 1.

Recommendations for AOC 1

Because AFFF was released and PFOA and PFOS have been detected above the Tapwater SLs in groundwater and above the residential soil SLs in soil at AOC 1 as documented in the PFAS SI and SI Addenndum (CH2M, 2018a; CH2M, forthcoming), additional sampling in the form of a Remedial Investigation (RI) is recommended for AOC 1 (CH2M, forthcoming).

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\Figure_4_1_Areas_Evaluated_Potential_PFAS_basewide.mxd11/19/2021CE075706



Legend

- PFAS AOC
- Confirmed PFAS Release Area Investigated in PFAS SI/SI Addendum
- Confirmed PFAS Release Area
- Potential PFAS Release Area
- No Further Action Area
- Installation Boundary

Note:
AOC = Area of Concern

N
W E
S

0 0.1 0.2
Miles

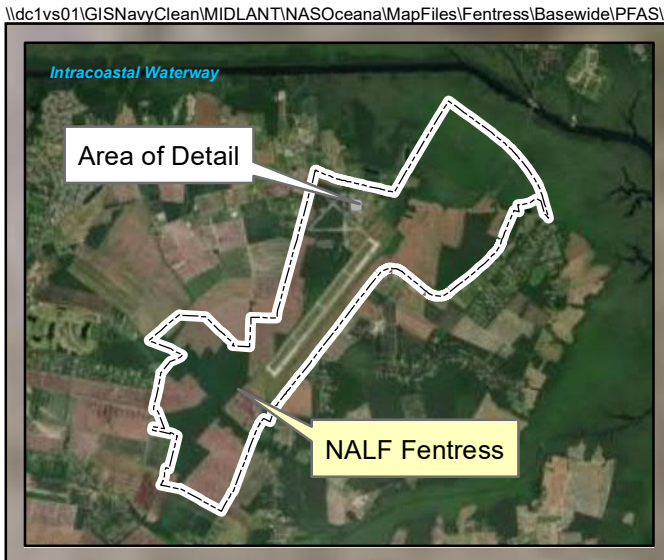
1 inch = 0.2 miles

Imagery: Esri, 2019

Figure 4-1
Areas Evaluated for Potential PFAS Releases
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m.

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\SiteFigures\Figure_4_2_Building_106_AFFF_Storage.mxd11/19/2021CE075706



BUILDING 106 -
AFFF STORAGE

LOCKHEED RD

Legend

- Sewer Drain
- Elevation Contour (2 ft Interval)
- Anticipated Overland Flow Direction
- Columbia/Surficial Groundwater Flow Direction (October 2019)
- Yorktown Groundwater Flow Direction (October 2019)
- Potential PFAS Release Area
- Installation Boundary

N
W E
S

0 7.5 15
Feet

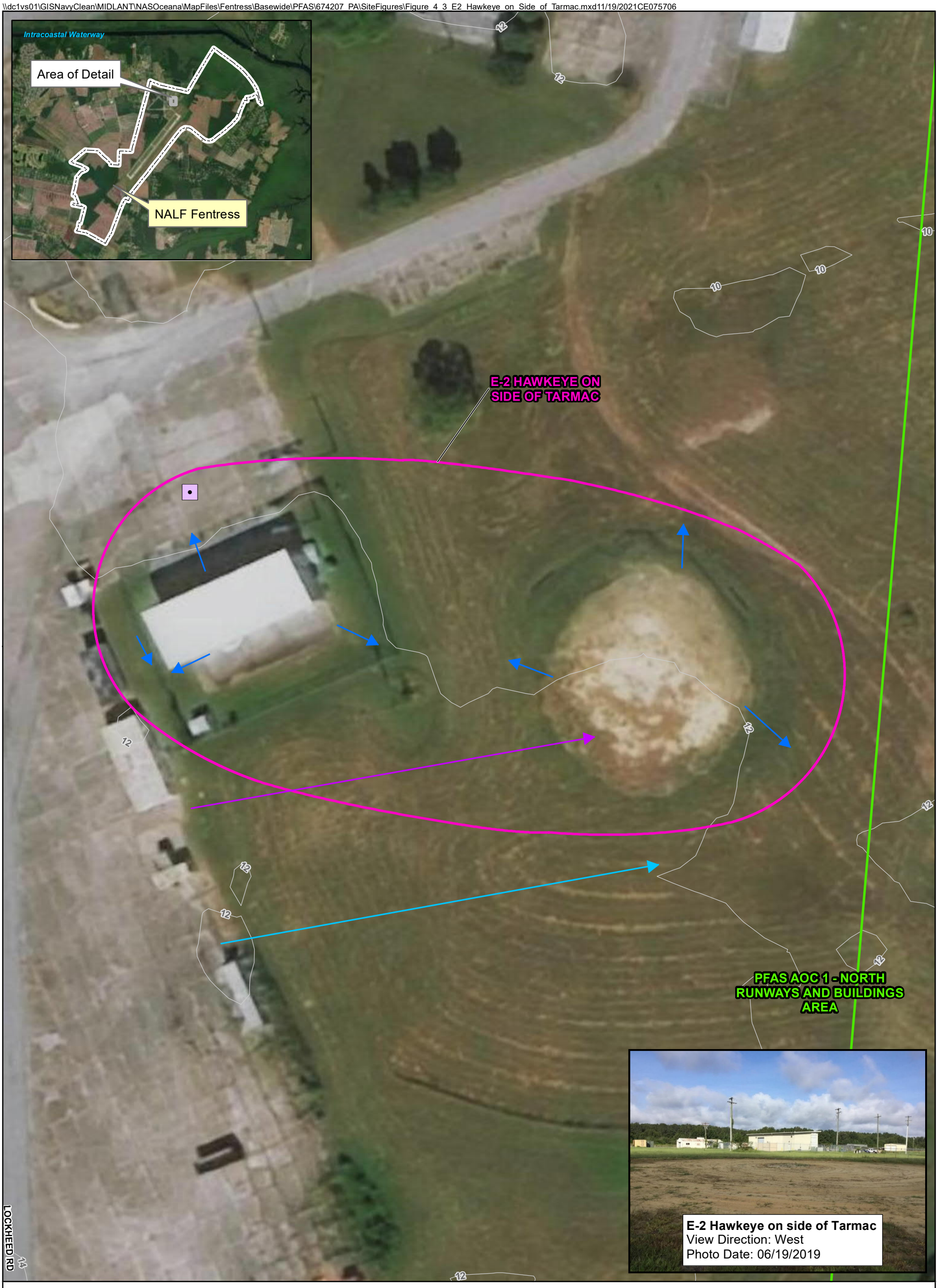
1 inch = 15 feet

Imagery: Esri, 2019

Figure 4-2
Building 106 - AFFF Storage
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m

\\dc1vs01\GISNavyClean\MIDLANT\NASOceana\MapFiles\Fentress\Basewide\PFAS\674207_PA\SiteFigures\Figure_4_3_E2_Hawkeye_on_Side_of_Tarmac.mxd11/19/2021CE075706



Legend

- Sewer Drain
- Elevation Contour (2 ft Interval)
- Anticipated Overland Flow Direction
- Columbia/Surficial Groundwater Flow Direction (October 2019)
- Yorktown Groundwater Flow Direction (October 2019)
- PFAS AOC
- Confirmed PFAS Release Area
- Installation Boundary

Note:
AOC = Area of Concern

N W E S

0 25 50 Feet

1 inch = 50 feet

Imagery: Esri, 2019

Figure 4-3
E-2 Hawkeye on Side of Tarmac
PFAS Preliminary Assessment
NALF Fentress
Chesapeake, Virginia

ch2m

SECTION 5

Conclusions

This PA evaluated the potential for PFAS release areas at NALF Fentress. **Tables 4-1a to 4-1c** includes the evaluation of 29 potential PFAS release areas. Fourteen of the potential PFAS release areas, grouped into two AOCs, have been evaluated in the PFAS SI and SI Addendum and further action will be included in the forthcoming PFAS SI Addendum Report (CH2M, forthcoming). No evidence of a PFAS release was identified for 13 areas, and no further action is recommended for these areas. Two potential PFAS release areas were further evaluated in this PA and area and are recommended for further investigation as part of the AOCs evaluated in the PFAS SI Addendum report. The rationale for further assessment of each area is provided in **Table 5-1**. Potential receptors and migration pathways for the sites with potential PFAS releases are discussed in **Section 4** or the PFAS SI and SI Addendum for sites previously investigated.

Each of these areas is located near or upgradient of private drinking water supply wells. To address on- and off-installation exceedances of the USEPA lifetime health advisory, an expedited response action was implemented. Bottled water was provided to on-installation personnel until a GAC treatment system could be installed at the on-installation water treatment plant. Off-installation properties with exceedances of the USEPA lifetime health advisory are currently included in a treatability study to determine the efficacy of GAC to remove PFAS in potable water. The Navy is continuing to provide bottled water until a long-term solution is implemented. Connection to city water was selected in the EE/CA as a long-term solution.

DoD Instruction 4715.18, *Emerging Chemicals (EC)* (September 2019), requires that teams: "Identify ECs; assess the likelihood and severity of impacts associated with ECs to people, the environment, and DoD mission, programs, and resources enterprise-wide; and take management actions to reduce these impacts." Additionally, the Navy *Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update* recommends additional investigation if the CSM described in the PA indicates there is evidence of a potential release of a known PFAS-containing substance or if there is a documented release of AFFF where the formulation of the AFFF is unknown (Navy, 2020).

This PA has identified locations where AFFF releases are documented or suspected, triggering the need for further investigation to determine whether a release to the environment occurred that resulted in impacts to soil, sediment, surface water, or groundwater at levels that warrant remedial actions.

Table 5-1. Areas Not Previously Investigated Recommended for Additional Investigation
NALF Fentress, Chesapeake, VA

Area Assessed	Rationale for Further Investigation
AOC 1 – North Runways and Buildings Area	
Building 106 – AFFF Storage	AFFF has been stored and transferred at Building 106.
E-2 Hawkeye on Side of Tarmac	Installation personnel reported that 6 to 8 feet of foam was observed where an E-2 Hawkeye was parked on the side of the tarmac.

SECTION 6

References

A.T. Kearney, Inc. (A.T. Kearney). 1989. *RCRA Facility Assessment Revised Phase II Report, Oceana Naval Air Station, Virginia Beach, Virginia*. March.

CH2M. 1992. *Environmental Investigation of the Landfill and Firefighting Training Area, Naval Auxiliary Landing Fentress, Chesapeake, Virginia.* June.

CH2M. 2016a. *Sampling and Analysis Plan, Basewide Perfluorinated Compound Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* Final. August.

CH2M. 2016b. *Basis of Design Memorandum for Upgrades to Wastewater System, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* Final. September.

CH2M. 2016c. *Granular Activated Carbon Treatment Systems to Remove PFOA and PFOS – Design Testing Work Plan Potable Water and Wastewater Systems, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*. June.

CH2M. 2017a. *Preliminary Engineering Report for Potable Water System Improvements, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*. January 19.

CH2M. 2017b. *Pilot Test Work Plan: Granular Activated Carbon System Installation on Residential Drinking Water Systems to Remove PFOA and PFOS, Naval Auxiliary Landing Field, Chesapeake, Virginia.* August.

CH2M. 2017c. *Sampling and Analysis Plan Addendum 1, Basewide Per-and Polyfluoroalkyl Substances Site Investigation, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*. Final. April.

CH2M. 2018a. *Basewide Per- and Polyfluoroalkyl Substances Site Inspection Report, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*. Final. October.

CH2M. 2018b. *Engineering Evaluation and Cost Analysis for Drinking Water, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* Final. November.

CH2M. 2018c. *Geophysical Investigation and Test Pitting Work Plan, Site 14 (SWMU 23) – Fentress Landfill, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia*. Final. August.

CH2M. 2019a. *Aerial Photographic Analysis of Naval Auxiliary Landing Field Fentress Volume 1, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* Final. March.

CH2M. 2019b. *Sampling and Analysis Plan, Basewide Per- and Polyfluoroalkyl Substances, Site Investigation Addendum, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* Final. July.

CH2M. 2019c. *Geophysical and Test Pitting Investigation Results, Site 14 (SWMU 23) – Fentress Landfill, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.* April.

CH2M. Forthcoming. *Pre-draft Basewide Per- and Polyfluoroalkyl Substances Site Investigation Addendum, Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia.*

City of Chesapeake. 2020. Parks, Recreation & Tourism division. http://www.visitchesapeake.com/visitors/weather/. Accessed February 2020.

City of Chesapeake. 2021. Chesapeake's Water Treatment Plants and Sources. https://www.cityofchesapeake.net/government/city-departments/departments/Public-Utilities-Department/chesapeake-water/northwest-river-water-treatment-plant.htm. Accessed April 1.

Chesapeake Fire Chief. 2020. Personal communication (phone call with CH2M). June 1.

Department of Defense (DoD). 2019. Assistant Secretary of Defense Memorandum, *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program*. October 15.

Department of Navy (Navy). 1991. *Description, Operation and Control of Wastewater Treatment Facilities*.

Navy. 1993. *Tank Removal at Fentress Air Station, Building 20.* October 14.

Navy. 2001. *Virginia Pollution Abatement Permit Application*.

Navy. 2005. *Naval Auxiliary Landing Field Fentress Emergency Planning and Community Right-to-Know Act Database Output. Tier II Forms. Reporting Year 2004.* February 28.

Navy. 2010. *Naval Auxiliary Landing Field (NALF) Fentress, VPA Permit #VPA01003, 5 Day Letter of Notification*. October 26.

Navy. 2011. *Naval A, uxiliary Landing Field (NALF) Fentress, VPA Permit #VPA01003, 5 Day Letter of Notification*. January 7.

Navy. 2016. *Naval Auxiliary Landing Field Fentress Emergency Planning and Community Right-to-Know Act Database Output. Section 312 Hazardous Chemical Threshold Summary. Reporting Year 2015.*

Navy. 2020. *Navy Interim Per- and Polyfluoroalkyl Substances (PFAS) Site Guidance for NAVFAC Remedial Project Managers (RPMs)/November 2020 Update. 5090 Ser EV3/012. November 24.Navy. 2018. Naval Air Station Oceana NALF Fentress Spill Report NRC ID#1217910; DEQ ID# 141233*. July 13.

Environmental Data Resources, Inc. (EDR). 2019a. *EDR NEPASearch Map Report – NALF Fentress - PFAS.* Inquiry Number 5536576.3s. January 16.

EDR. 2019b. *EDR Offsite Receptor Report – NALF Fentress - PFAS*. Inquiry Number 5537592.3s. January 17.

Federal Emergency Management Agency (FEMA). 2014. *National Flood Insurance Program Flood Insurance Rate Map. Map Numbers 5100340053D, 5100340054D, 5100340055D, 5100340067D, and 5100340068D.* December.

Former NALF Fentress Wastewater Treatment Plant (WWTP) Supervisor. 2019. Personal communication (meeting with CH2M). July 15.

Former NALF Fentress Water Program Managers. 2019. Personal communication (meeting with CH2M). July 10.

Foster Wheeler. 1994. *Decision Document, Site 17 – Firefighting Training Area, Naval Auxiliary Landing Field, Fentress, Virginia*. July.

Freeman, Paul. 2019. *Abandoned & Little-Known Airfields: Virginia: Virginia Beach*. December 14. Accessed February 5, 2019.

Geo-Marine, Inc. 2001. *Integrated Natural Resources Management Plan, Naval Air Station Oceana, Dam Neck Annex, South Virginia Beach Annex (Camp Pendleton).*

Interstate Technology and Regulatory Council (ITRC), 2020. *Aqueous Film-Forming Foam Fact Sheet.* April.

Jones Technologies, Inc. (Jones). 02. *Final Report: Study for CMAR Regional EPCRA Tier II and TRI Reporting, Reporting Year 2001*. August 1.

Jones. 2004. *Final Report: Study for CMAR Regional EPCRA Tier II and TRI Reporting, Reporting Year 2003*. August 20.

Naval Air Station (NAS) Oceana Air Operations (Air Ops) Manager. 2019. Personal communication (meeting with CH2M). November 15.

NAS Oceana Fire Chief. 2019. Personal communication (meeting with CH2M). May 6.

NAS Oceana Public Works Department Electrician. 2019. Personal communication (meeting with CH2M). October 10.

Naval Auxiliary Landing Field (NALF) Fentress Captain and NAS Oceana Assistant Fire Chief. 2015. Personal communication (meeting with CH2M). November 2.

NALF Fentress Crash Captain. 2019. Personal communication (meeting with CH2M). November 8.

NALF Fentress Fire Chief. 2019. Personal communication (meeting with CH2M). November 8.

NALF Fentress Firefighter. 2019. Personal communication (meeting with CH2M). November 8.

NALF Fentress Civilian Firefighter. 2020. Personal communication (meeting with CH2M). September 3.

NALF Fentress Tower Manager. 2020. Personal communication (meeting with CH2M). September 2.

Naval Facilities Engineering Command (NAVFAC), Atlantic Division. 1991a. *Firefighting Training Ring, Naval Auxiliary Landing Field, Fentress, Chesapeake, Virginia*. July 26.

NAVFAC. 1991b. *Agricultural Outfall Drainage Improvements, NALF Fentress, Chesapeake, VA*. July 15.

NAVFAC, Atlantic Division. 1997. *Site Approval for Fire Fighting Training Area at NALF Fentress*. October 31.

Navy Public Works Center. 2001. *Nutrient Management Plan*. January 11.

Public Works Department NAS Oceana. 1988. *Operation and Maintenance Manual for Wastewater Pumping and Lagoon System at NALF Fentress*. June.

Rogers, Golden & Halpern. 1984. *Initial Assessment Study of Naval Air Station, Oceana, Virginia Beach, Virginia*. December.

United Press International (UPI). 1980. *A jet from Oceana Naval Air Station crashed today…* UPI Archives. December 16.

United States Environmental Protection Agency (USEPA). 1998. *Capsule Report, Hard Chrome Fume Suppressants and Control Technologies*. EPA/625/R-98/002. Office of Research and Development. December.

USEPA. 2014. *Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonate (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3)*. Superfund Health Risk Technical Support Center, National Center for Environmental Assessment, Office of Research and Development. July 17.

USEPA. 2016a. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).* EPA 822-R-16-005. Office of Water. May.

USEPA. 2016b. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS).* EPA 822-R-16-004. Office of Water. May.

USEPA. 2017. *The Third Unregulated Contaminant Monitoring Rule (UCMR 3) Data Summary*. January.

USEPA. 2019a. *Development of the Proposed Unregulated Contaminant Monitoring Rule for the Fifth Monitoring Cycle (UCMR 5): Public Meeting and Webinar.* EPA 815-A-19-001. July 16.

USEPA. 2020. EPA PFAS Action Plan: Program Update. February.

USEPA. 2021a. Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfonate. EPA/690/R-21/001F. April.

USEPA. 2021b. The Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) Summary. March.

United States Fish and Wildlife Service (USFWS). 2020. Information for Planning and Consultation. NALF Fentress. https://ecos.fws.gov/ipac/location. Accessed September 1, 2020.

United States Geological Survey (USGS). 1988. Hydrogeologic Framework of the Virginia Coastal Plain.

USGS. 2006. *The Virginia Coastal Plain Hydrogeologic Framework*. May.

Virginia State Water Control Board (VSWCB). 1991. *Reissuance of Virginia Pollution Abatement Permit No. VPA01003, Department of the Navy, Naval Auxiliary Landing Field-Fentress*. March 5.

Virginian-Pilot. 2001. *F-14 lands without gear down at Fentress; no one gets hurt*. April 10.

Appendix A
Summary of Records Reviewed

Appendix A. Summary of Records Reviewed

NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Internet Records					
Newspaper Article	Ledger Star	NA	Jet Crash Check Delivered	12/20/1969	F-4 Supersonic Phantom II jet fighter blew a tire and crashed into a home when trying to land at Fentress.
Newspaper Article	Virginian-Pilot	NA	2 in Jet Bail Out; House Destroyed	12/20/1969	Took 20 minutes to get the flames under control for 1969 F-4 crash.
Newspaper Article	Virginian-Pilot	NA	Jet Hits Chesapeake Home	12/20/1969	Continuation of "2 in Jet Bail Out; House Destroyed" article.
Newspaper Article	Virginian-Pilot	NA	Navy Jet Believed Down in Chesapeake	6/29/1972	F4B Phantom jet went missing about 5 miles south of Great Bridge Wednesday night during routine carrier landing practice at Fentress Field. Witness states he saw two planes circling and then one went down and explode, search team covered an area approximately 2 miles long and 0.75 miles wide.
Newspaper Article	Ledger Star	NA	2 Navy fliers die in crash	6/29/1972	Article describing offsite crash that occurred at the 1700 block of Battlefield Blvd.
Newspaper Article	Virginian-Pilot	NA	Pilots' bodies found	6/30/1972	Radar intercept officer identified, other recent crashes mentioned.
Newspaper Article	Ledger Star	NA	Dead pilot's identification still withheld	6/30/1972	Provided no new information.
Newspaper Article	Virginian-Pilot	NA	Pilot of Fighter was from Ohio	7/1/1972	Identifies pilot's identity from 1972 crash.
Newspaper Article	Virginian-Pilot	NA	Phantom Crashes, 2 Unhurt	7/3/1972	F-4J Phantom crashes into wooded area off of West Neck Road during field carrier landing exercise at Fentress Field.
Newspaper Article	Ledger Star	NA	Jet crash probed	5/16/1973	A6 intruder crashed about 2 miles south of Fentress Airfield into foggy corn field.
Newspaper Article	Virginian-Pilot	NA	F-14 lands without gear down at Fentress; no one gets hurt	4/10/2001	F-14 lands without gear at Fentress - no one hurt.
Newspaper Article	Virginian-Pilot	NA	F-14 makes belly landing during training exercise at Fentress Field	4/11/2001	F-14 lands without gear at Fentress; looks as if they forgot to put their gear down.
Facility Operations Records					
Table	NALF Fentress Captain	NA	3.1.4 Fire Extinguishing Agent Supply Requirements	9/23/2015	AFFF storage quantities for Oceana and Fentress. Indicates 108 5-gallon containers of Chemguard and 400 gallons of foam, 450 dry powder, and 500 Halon stored on vehicles.
Interview Record	CH2M	NA	Interview to Evaluate Use of Aqueous Film-Forming Foam Use at NALF Fentress	11/2/2015	Indicates current locations and quantities of AFFF storage onsite. Spray tests (with foam) are conducted at current crash truck equipment test area. No foam has been used for emergencies in past 20 years.
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1969 Command History (Report OPNAV 5750-1)	1970	Dec 19 – Two VF-84 men escaped injury when their F-4 Phantom blew a tire while trying to land at Fentress Air Field. The plane bounced into and badly burned a home.
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1974 Command History (Report OPNAV 5750-1)	4/16/1975	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1976 Command History (Report OPNAV 5750-1)	3/1/1977	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1977 Command History (Report OPNAV 5750-1)	3/8/1978	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1979 Command History (Report OPNAV 5750-1)	4/28/1980	Notes that 11 crashes occurred between 1975 and 1979. Unclear how many of these were associated with Fentress.
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1986 Command History (Report OPNAV 5750-1)	4/8/1987	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1987 Command History (Report OPNAV 5750-1)	7/1/1998	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1989 Command History (Report OPNAV 5750-1)	5/31/1990	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1990 Command History (Report OPNAV 5750-1)	8/5/1991	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1991 Command History (Report OPNAV 5750-1)	1/25/1993	Reviewed; no relevant information

Appendix A. Summary of Records Reviewed

NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1992 Command History (Report OPNAV 5750-1)	4/28/1993	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1993 Command History (Report OPNAV 5750-1)	3/11/1994	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1994 Command History (Report OPNAV 5750-1)	2/28/1995	Notes that AFFF is to be used in emergencies only.
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1995 Command History (Report OPNAV 5750-1)	3/27/1996	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1996 Command History (Report OPNAV 5750-1)	3/10/1997	Reviewed; no relevant information
Command Chronology Report	Commanding Officer NAS Oceana	Chief of Naval Operations	January through December 1997 Command History (Report OPNAV 5750-1)	3/23/1998	Reviewed; no relevant information
Report	Navy	Virginia Emergency Response Council	EPCRA Section 311 Update and 312 Notification, Reporting Year 2011	2/28/2012	Reviewed; no relevant information
Report	Navy	Virginia Emergency Response Council	EPCRA Section 311 Update and 312 Notification, Reporting Year 2017	2/23/2018	Reviewed; no relevant information
Report	Navy	Virginia Emergency Response Council	EPCRA Section 311 Update and 312 Notification, Reporting Year 2016	2/22/2017	Reviewed; no relevant information
Report	Navy	Virginia Emergency Response Council	EPCRA Section 311 Update and 312 Notification, Reporting Year 2013	2/26/2014	Reviewed; no relevant information
Report	Navy	Virginia Emergency Response Council	EPCRA Section 311 Update and 312 Notification, Reporting Year 2012	2/28/2013	Reviewed; no relevant information
Report	Navy	NA	Tier Two Emergency and Hazardous Chemical Inventory	2/29/2016	Reviewed; no relevant information
Report	Navy	NA	EPCRA Section 312 Hazardous Chemical Threshold Summary Reporting Year 2015	2015	EPCRA reporting threshold table; lists 595 gallons of 3% AFFF in Building 106 - work center; also notes that the building fire suppression is AFFF.
Report	Navy	NA	Tier Two Emergency and Hazardous Chemical Inventory	2/23/2009	Reviewed; no relevant information
Report	Navy	NA	EPCRA Section 312 Notification, Reporting Year 2004	2/28/2005	EPCRA report from RY 2004; lists AFFF storage at Fentress at Building 100 and Building 106 with the inventory code of "04" which is a weight range of 10,000 - 99,999 lbs.
Report	Navy	NA	Tier Two Emergency and Hazardous Chemical Inventory	2/15/2017	Reviewed; no relevant information
Report	Jones Technologies, Inc. and Shaw Environmental and Infrastructure	NAVFAC	Final Study for CMAR Regional EPCRA Tier II and TRI Reporting, Reporting Year 2001	8/1/2002	EPCRA forms; lists of hazardous chemicals at Fentress above reporting minimum reporting limits; lists 15,260 lbs. of AFFF (firefighting foam) onsite; listed AFFF storage as approximately 288 containers in 5-gallon containers in Building 106 as well as 130 gallons in each of the three fire trucks stationed at Fentress. Approximately 10 gallons of AFFF was used during RY01 in response to an aircraft landing with no landing gear down. This was the only response in 2001 and no training exercises occurred at Fentress that year.
Report	Jones Technologies, Inc. and Shaw Environmental and Infrastructure	NAVFAC	Final Study for CNRMA Regional EPCRA Tier II and TRI Reporting, Reporting Year 2003	8/20/2004	EPCRA forms; lists of hazardous chemicals at Fentress above reporting minimum reporting limits; lists 11,342 lbs. (1,360 gal) of AFFF (firefighting foam) onsite; listed AFFF storage as approximately 215 containers in 5-gallon containers in Building 106 as well as 130 gallons in each of the three fire trucks stationed at Fentress.
Database	Navy	NA	iNFADS database search	7/24/2018	iNFADS database search for NAS Oceana; no relevant information
Database	Navy	NA	OEL database search	7/24/2018	OEL database search for NAS Oceana; no relevant information
Report	Navy	DEQ	Naval Air Station Ocean NALF Fentress Spill Report NRC ID# 1217910; DEQ ID#141233	7/9/2018	847,000 gallons of water were spilled from the WWTP in 2018 due to a ruptured hose on an external pump.

Appendix A. Summary of Records Reviewed
NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Environmental Restoration Program Records					
Report	CH2M	NAVFAC	Supplemental Site Inspection Report; Site 14, Site 17, and Underground Storage Tank 20B	12/1/2018	Reviewed; no relevant information
Report	CH2M	NAVFAC	Environmental Investigation of the Landfill and Firefighting Training Area, NALF, Fentress, Chesapeake, Virginia	Jun-92	Includes background information for Site 14 Fentress Landfill which has contained asbestos, solvents, oils, pesticide residue, and PCBs. Site 17 background information mentions that the Fentress firefighting training area was active at the time of investigation with jet fuel burned and put out with water used to teach firefighting skills. Visibly stained soil at Site 17.
Report	Rogers, Golden, and Halpern	NEESA	Initial Assessment Study of Naval Air Station, Oceana, Virginia Beach, Virginia	Dec-84	Recommends the Fentress Landfill Site 14 have confirmation study; concerned contaminants from landfill would move with groundwater to the drainage ditch which flows off-base to join the Pocaty River. Lists waste generation as NAS Oceana and NALF Fentress including AFFF (300 gal/year from 1969-1984, disposed of in the ground. Contains background information for landfill, water supply wells and wastewater treatment. AFFF has been used for firefighting exercises since 1969 and old AFFF containers have been burned in a ditch adjacent to old landfill.
Report	CH2M	NAVFAC	RCRA Facility Investigation Final Report - Phase I - Naval Air Station Oceana, Virginia Beach, Virginia	Dec-93	Reviewed; no relevant information
Report	A. T. Kearney, Inc.	USEPA	RCRA Facility Investigation Revised Phase II Report - Oceana Naval Air Station, Virginia Beach, Virginia	Mar-89	Discusses sites recommended for confirmation studies including Fentress landfill for materials released such as solvents, pesticides, construction debris, transformers, mixed municipal wastes, and unknowns. Landfill is unlined and was active from 1945-1970. Lists out SWMUs for Oceana NAS and Fentress including Fentress landfill (SWMU 23), old burn pits for firefighter training areas (SWMU 64), waste fuel storage tanks (SWMU 76 and 77), and the hazardous waste storage area (SWMU 10). The Fentress Burn Pit was surrounded with an earthen burn and used to contain waste fuel and fuel contaminated absorbent and booms that were ignited and burned until extinguished with AFFF foam. Burned residue and water was periodically pumped out of the pit to the surrounding soils. Waste fuel for the Fentress Burn Pit was stored in the waste fuel storage tanks (SWMU 76 and 77) in Fentress Tank A and Fentress Tank B. The RFA reports that both tanks were leaking with heavily stained soil and concrete observed and had no release controls such as berms around the tanks. The RFA also identifies the Fuel Storage Tank Building 20 as an area of concern due to the ground under the ~200-gallon AST being heavily stained with oil. There is a material storage area listed as Building 20 that stored motor oil, AFFF, and hydraulic fluid.
Report	CH2M	NAVFAC	RCRA Facility Investigation Final Work Plan - Naval Air Station Oceana, Virginia Beach, Virginia	Jun-92	RFI for NAS Oceana. Lists out the previously defined RFA SWMU site no. and the new RFI SWMU site no. Explains why the Fentress sites were not carried forward to the RFI because they were not contiguous or subject to Virginia UST regulations.
Report	Foster Wheeler Environmental Services	NAVFAC	Final Decision Document Site 17 - Firefighting Training Area, NALF, Fentress, Virginia	7/29/1994	Describes proposed removal action for Site 17 The Firefighting Training Area at Fentress. Site is at the intersection of two abandoned aircraft runways. Reports groundwater moves primarily to the west. Describes surface water runoff as being managed by "a system of drainage ditches and surface channels, which direct runoff north and east of the facility toward the Intracoastal Waterway."
Report	Foster Wheeler Enviresponse, Inc.	NAVFAC	Final Site Inspection Report, Site 14 - Fentress Landfill, Site 17 - Firefighting Training Area, NALF, Fentress, Virginia	7/31/1992	Site investigation performed at Site 14 Fentress Landfill and Site 17 Firefighting Training Area. Based on results, the landfill did not need further environmental investigations and high TPH concentrations were detected at Site 17.
Report	Foster Wheeler Environmental Services	NAVFAC	Final Supplemental Site Investigation Report, Site 14 - Fentress Landfill, Site 17 - Firefighting Training Area, NALF, Fentress, Virginia	10/1/1993	Confirmed the results of the initial SI and provided the results of a water level survey.
Report	CH2M	NAVFAC	Sampling and Analysis Plan Addendum 1 Basewide Per- and Polyfluoroalkyl Substances Site Investigation, NALF, Fentress, Virginia	Apr-17	SAP for additional off-base PFAS drinking water sampling
Report	CH2M	NAVFAC	Final Action Memorandum for Former Machine Gun Boresight Range, NALF, Fentress, Virginia	Aug-17	Action memo for EECA for MGBR which had metals in the surface and subsurface.

Appendix A. Summary of Records Reviewed

NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Report	CH2M	NAVFAC	Final Engineering Evaluation/Cost Analysis Former Machine Gun Boresight Range, NALF, Fentress, Virginia	Aug-17	EECA for MGBR which had metals in the surface and subsurface.
Report	CH2M	NAVFAC	Final Engineering Evaluation/Cost Analysis for Drinking Water, NALF, Fentress, Virginia	Nov-18	EECA for PFAS in drinking water on and off base.
Report	CH2M	NAVFAC	Final Geophysical Investigation and Test Pitting Work Plan Site 14 (SWMU 23) - Fentress Landfill, NALF, Fentress, Virginia	Aug-18	Work plan for investigating the landfill using digital geophysical mapping and test pitting. The contaminants detected historically include metals, methylene chloride, and chloroform.
Report	CH2M	NAVFAC	Final Supplemental Site Inspection Report Site 14, Site 17, and Underground Storage Tank 20B, NALF, Fentress, Virginia	Dec-18	Data and conclusions from field activities conducted in 2017 to address data gaps at Site 14 Fentress Landfill and Site 17 Former Firefighting Training Area and UST 20B. Investigation was focused on non-PFAS compounds in the water.
Report	CH2M	NAVFAC	Final Basewide Per- and Polyfluoroalkyl Substances Site Investigation Addendum Sampling and Analysis Plan, NALF, Fentress, Virginia	Jul-19	SAP for PFAS drinking water investigation
Report	CH2M	NAVFAC	Final Site Management Plan Fiscal Years 2020 - 2024, NALF, Fentress, Virginia	Sep-19	SMP for Fentress includes Environmental Restoration History for the different Fentress sites, mostly limited to Site 14 Fentress Landfill and Site 17 Firefighting Training Area Burn Pit.
Environmental Data Resources Reports					
Report	EDR	NA	EDR NEPASearch Map Report	1/16/2019	EDR NEPASearch Map Report
Report	EDR	NA	EDR Offsite Receptor Report	1/17/2019	EDR Offsite Receptor Report
Report	EDR	NA	EDR Historical Topo Map Report	1/17/2019	EDR Historical Topo Maps from 1902, 1907, 1939, 1946, 1954, 1971, 1979, 1981, 2013
Maps and Aerial Photographs					
Google Earth	NA	NA	Historical Aerial Photographs	2019	Aerial photographs from 1990, 1994, 2002, 2003-2008, 2010-2011, 2014-2016, 2018
Site Plan	Giffels & Vallet, Inc.	NA	Naval Air Center Hampton Roads, Headquarters, US Naval Air Station, Norfolk, VA, Auxiliary Air Station, Fentress, VA, Detail Plot Plan	11/14/1942	Detailed drawings of base including drainage
Site Plan	NAVFAC	NA	NALF Fentress Agricultural Outfall Drainage Improvements	7/15/1991	Drainage and regrading plans for current liquid wastewater irrigation field
Site Plan	Public Works Office	NA	Naval Auxiliary Air Station - Fentress, VA. Aviation Gasoline and Jet Fuel Storage	6/2/1952	Drawings of fuel storage tanks and transfer systems
Site Plan	Department of the Navy Bureau of Yards and Docks	NA	Master Shore Station Development Plan Part II Section 2 General Development Plan US NALF - Fentress, VA.	10/23/1962	Drawings of plans for current aircraft landing strip and cross runway that was not built
Site Plan	Shoecraft, Drury, and McNamee Consulting Civil Engineers	NA	US Naval Operation Base Norfolk, VA, Location Maps for Sewers and Sewage Treatment Plants at Creeds, Dover, Fentress, and Pungo Airfield	10/27/1942	Drawing showing proposed sewage treatment plant and existing borrow pit
Site Plan	Navy Public Works Center	NA	Storm Sewer Utility Maps	NA	Drawings showing storm sewers at Fentress
Site Plan	NAVFAC	NA	TPH Contaminated Soil Removal - Site 17, NALF Fentress, Chesapeake, VA	12/20/1994	Drawings showing soil removal areas at original Site 17 location
Site Plan	PHR&A	NA	Repairs to Wastewater Treatment Facilities	1/28/1990	Drawings for WWTP upgrades
Site Plan	Navy Public Works Center	NA	Holding Lagoon Vegetation Removal	NA	Site map of holding lagoon with some photos
Site Plan	Giffels & Vallet, Inc.	NA	Naval Air Center Hampton Roads, Headquarters, US Naval Air Station, Norfolk, VA, Auxiliary Air Station, Fentress, VA, Plot Plan General	7/9/1942	Historic site plan of Fentress
Site Plan	Giffels & Vallet, Inc.	NA	Naval Air Center Hampton Roads, Headquarters, US Naval Air Station, Norfolk, VA, Auxiliary Air Station, Fentress, VA, General Service Plan	12/15/1942	Historic site plan with gasoline storage area

Appendix A. Summary of Records Reviewed

NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Site Plan	NAVFAC	NA	All Purpose Building ALF Fentress Chesapeake, Virginia, Plans, Sections, and Details	9/14/1982	Historic plumbing, solar system, sewage, and irrigation system schematic
Site Plan	NAVFAC	NA	Naval Aux. Landing Field Fentress, Virginia, General Development Map Existing & Planned Pre-M Day	8/30/1962	Historic site plan with agricultural lots shown, drainage ditches, roads
Site Plan	Giffels & Vallet, Inc.	NA	Naval Air Center Hampton Roads, Headquarters, US Naval Air Station, Norfolk, VA, Auxiliary Air Station, Fentress, VA, Runway Drainage	12/3/1942	Historic site plan with old runway drainage
Aerial Photo	Records of the Office of the Secretary of Defense, 1921 - 2008	NA	Combined Military Service Digital Photographic Files, 1982 - 2007; An aerial view of Fentress Auxiliary Landing Field, 6/21/1974	6/21/1974	Historic aerial view of Fentress from 1974 with no obvious signs of a crash or fire
Aerial Photo	Records of the Office of the Secretary of Defense, 1921 - 2008	NA	Combined Military Service Digital Photographic Files, 1982 - 2007; An aerial view of Naval Auxiliary Landing Facility, Fentress. (SUBSTANDARD), 5/25/1979	5/25/1979	Historic aerial view of Fentress from 1979 with no obvious signs of a crash or fire
Other					
Report	USGS	NA	Ground-Water Flow and Saline Water in the Shallow Aquifer System of the Southern Watersheds of Virginia Beach, Virginia	2003	Groundwater flow potentiometric surface maps, descriptions of aquifer systems, groundwater/saline water intrusion
Report	USGS	NA	Conceptual Hydrogeological Framework of the Shallow Aquifer System at Virginia Beach, Virginia	2002	Geologic and hydrogeologic data
Report	USGS	NA	Simulated Changes in Water Levels Caused by Potential Changes in Pumping from Shallow Aquifers of Virginia Beach, Virginia	2005	Geologic and hydrogeologic data
Memo	Director of Energy and Environmental Readiness	Commander, Navy Installation Command	Navy Drinking Water Sampling Policy for Perfluorochemicals Perfluorooctane Sulfonate and Perfluoroocatonoic acid	9/14/2015	Reviewed; no relevant information
Permit	DEQ Virginia	NAVFAC	Authorization to Manage Pollutants under the Virginia Pollution Abatement Permit and the Virginia State Water Control Law	6/14/2011	Reviewed; no relevant information
Cover letter	Director of Water and Wastewater Compliance	DEQ Virginia	Subject: NALF Fentress, VPA Permit #VPA01003, 5 Day Letter of Notification	10/26/2010	Letter of notification for sludge disposal from NALF Fentress WWTP holding lagoon
Permit	Navy	State Water Control Board	Revisions to Application to Discharge Wastewater	7/18/1991	EPA wastewater discharge permit for Oceana and Fentress. Lists out wastewater treatment locations and quantities for both sites; VPDES
Permit	Navy	State Water Control Board	Reissuance of Virginia Pollution Abatement Permit No. VPA01003 Department of the Navy NALF-Fentress	3/5/1991	Permit to authorize the operation of the WWTP at Fentress
Permit	Navy	NA	Virginia Pollution Abatement Permit Application Facility Name: U.S. NALF, Fentress, VA	2001	Description of the WWTP at Fentress
Permit	Navy	NA	Application for No-Discharge Certificate	5/26/1989	Contains details regarding the WWTP including location maps, and details regarding topography, soils, hydrology
Letter	NAVFAC	DEQ Virginia	Subject: NALF Fentress, VPA Permit #VPA01003, 5 Day Letter of Notification Warning Letter	1/7/2011	Letter of notification for sludge disposal from NALF Fentress WWTP holding lagoon and results from TCLP sampling, improper disposal
Letter	Route 168, Inc.	Suburban Grading and Utilities, Inc.	Confirmation of Delivery of Soil from Fentress Air Field to Route 168, Inc. borrow pit	10/15/2010	Letter regarding soil disposed at Route 168, Inc. from Fentress
Letter	NAVFAC	DEQ Virginia	Subject: NALF Fentress, VPA Permit #VPA01003, 5 Day Letter of Notification Delivery Tickets	2/9/2011	Reviewed; no relevant information
Manual	Public Works Department NAS Oceana	NA	Operation and Maintenance Manual for Wastewater Pumping and Lagoon System at NALF Fentress	Jun-88	O&M manual for WWTP pumping and lagoon system at Fentress; no mention of AFFF
Plan	Hoggard/Eure Associates	NAVFAC	Firefighting Training Ring plan 35% submittal	7/9/1991	Stamped plans for building firefighting training ring
Letter	Base Civil Engineer Officer	NAVFAC	Site Approval for Fire Fighting Training Area at NALF Fentress	10/31/1997	Correspondences regarding proposed firefighting training ring and open burning
Manual	Navy	NA	Description, operation and control of wastewater treatment facilities	1991	Subsection of a manual for WWTP operations. This chapter is "Description, operation and control of wastewater treatment facilities" and contains details about the WWTP

Appendix A. Summary of Records Reviewed

NALF Fentress, Chesapeake, Virginia

Document Type	From	To	Document Name/Regarding	Date	Description
Manual	Navy	NA	Description, operation and control of wastewater treatment facilities	1991	Subsection of a manual for WWTP operations. This section is "Type of treatment and treatment requirements/effluent limitations" contains details about the WWTP
Design Document	Hoggard/Eure Associates	NAVFAC	Basis of Design and Outline Specifications Fire Fighting Training Ring NALF Fentress, Virginia	NA	Basis of design and specifications for air stripper unit for new firefighting training ring
Map	FEMA	NA	FEMA National Flood Hazard Layer FIRMette	12/12/2019	FEMA maps evaluating the risk of flooding; the majority of Fentress is in an area of minimal flood hazard, with flood risks increasing for areas near the Pocaty River in the south and North Landing River in the north.

Notes:

AFFF = aqueous film-forming foam
CH2M = CH2M HILL, Inc.
CMAR = Commander Mid Atlantic Region
CNRMA = Commander, Navy Region Mid Atlantic
DEQ = Department of Environmental Quality
EDR = Environmental Data Resources, Inc.
EECA = Engineering Evaluation/Cost Analysis
EPCRA = Emergency Planning and Community Right-to-Know Act
FEMA = Federal Emergency Management Agency
ID = identification
iNFADS = internet Navy Facilities Asset Store
lbs. = pounds
MGBR = Machine Gun Boresight Range
NA = not applicable
NALF = Naval Auxiliary Landing Field
NAS = Naval Air Station
NAVFAC = Naval Facilities Engineering Command, Atlantic Division
Navy = Department of the Navy
NEESA = Naval Energy and Environmental Support Activity
NEPA = National Environmental Policy Act
NRC = National Response Center
O&M = Operation and Maintenance
OEL = Other Environmental Liabilities
OPNAV = Office of Chief of Naval Operations
PA = preliminary assessment
PCBs = polychlorinated biphenyls
PFAS = Per and Polyfluoroalkyl Substances
PHR&A = Patton Harris Rust & Associates
RCRA = Resource Conservation and Recovery Act
RFA = RCRA Facility Assessment
RFI = RCRA Facility Investigation
RY = reporting year
SAP = sampling and analysis plan
SMP = site management plan
SWMU = solid waste management unit
TCLP = toxicity characteristic leaching procedure
TPH - total petroleum hydrocarbon
TRI = Toxic Release Inventory
USEPA = United States Environmental Protection Agency
USGS = United States Geological Survey
UST = Underground Storage Tank
VA = Virginia
VPA = Virginia Pollution Abatement
VPDES = Virginia Pollution Discharge Elimination System
WWTP = wastewater treatment plant

Appendix B
Interview Record


Final
Preliminary Assessment for
Per- and Polyfluoroalkyl Substances
Naval Auxiliary Landing Field Fentress
Chesapeake, Virginia

NOTIFICATION: APPENDIX B CONTAINS SENSITIVE BUT UNCLASSIFIED INFORMATION WHICH IS PROTECTED BY THE FREEDOM OF INFORMATION ACT

FOIA Exemption 6 (5 USC 552(b)(6))
Personal Information Affecting an Individual's Privacy

TO REQUEST A COPY OF THE DOCUMENT

PLEASE CONTACT

Department of the Navy
Freedom of Information Act Office

http://www.secnav.navy.mil/foia/Pages/default.aspx

Distribute to U. S. Government Agencies Only

Appendix C
Photo Documentation

Photo 1: Site 17A, a former firefighting training area
View Direction: Facing north, June 19, 2019

Photo 2: Site 17B, a former firefighting training area; area is gravel
View Direction: Facing east, September 3, 2020

Photo 3: Firefighting training area Site 17C
View Direction: Facing north, June 19, 2019

Photo 4: Planned Fire Training Ring area
View Direction: Facing east, September 3, 2020

Photo 5: Crash Truck Test Area and site boundary
View Direction: Facing west, September 3, 2020

Photo 6: Crash Truck Test Area
View Direction: Facing north-northeast, March 5, 2020

Photo 7: Runway Spray Test Area
View Direction: Facing southwest, June 19, 2019

Photo 8:The southwestern side of the Fire Station (Building 100)
View Direction: Facing northeast, June 19, 2019

Photo 9: The southwest side of the Fire Station (Building 100); there is a sewer drain in the grassy area of the photo
View Direction: Facing north, September 3, 2020

Photo 10: View outside of the northeast bay doors of the Fire Station (Building 100)
View Direction: Facing north, June 19, 2019

Photo 11: Location of drains near the west side of the Fire Station (Building 100)
View Direction: Facing north, September 3, 2020

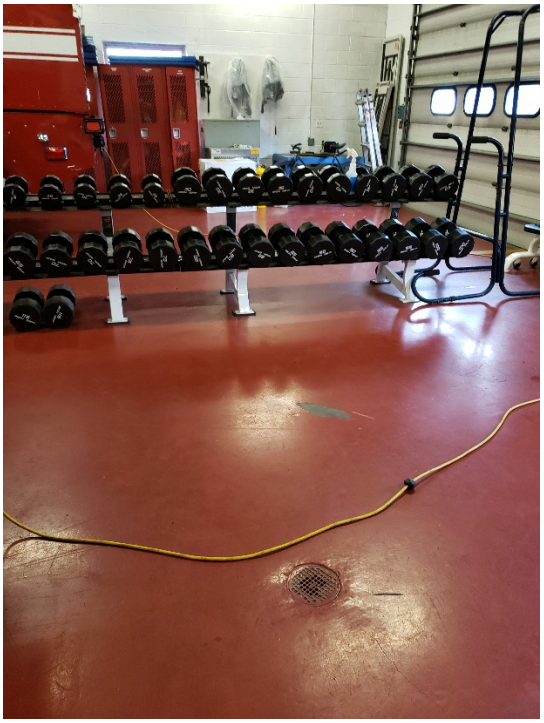


Photo 12: View of inside the Fire Station (Building 100)
View Direction: Facing the northwest corner of the building, June 19, 2019

Photo 13: View of inside the Fire Station (Building 100)
View Direction: Facing the back bay doors (south) of the building, June 19, 2019

Photo 14: The east side of Building 20 – AFFF Storage
View Direction: Facing west, June 19, 2019

Photo 15: Location of former UST 20B, south of Building 20 – AFFF Storage
View Direction: Facing north-northeast, June 19, 2019

Photo 16: Drainage ditch to the west of Building 20 – AFFF Storage
View Direction: Facing north, June 19, 2019

Photo 17: Drainage ditch to the west of Building 20 – AFFF Storage and northeast corner of Building 20
View Direction: Facing east, September 3, 2020

Photo 18: Drainage ditch to the west of Building 20 – AFFF Storage with Building 106 – AFFF Storage in the distance
View Direction: Facing south, June 19, 2019

Photo 19: Building 101; current AFFF storage and transfer area
View Direction: Facing northeast, June 19, 2019

Photo 20: The west side of Building 101 – AFFF Storage
View Direction: Facing north-northeast, March 5, 2020

Photo 21: West side of Building 101 – AFFF Storage
View Direction: Facing east, September 3, 2020

Photo 22: AFFF stored in Building 101 – AFFF Storage
View Direction: Facing east, June 19, 2019

Photo 23: Northeast corner of the AFFF storage in Building 101 – AFFF Storage
View Direction: Facing east-southeast, June 19, 2019

Photo 24: Building 106; former AFFF storage and transfer area
View Direction: Facing west, June 19, 2019

Photo 25: Northwestern corner inside Building 106 – AFFF Storage
View Direction: Facing northwest, June 19, 2019

Photo 26: Northeastern corner inside Building 106 – AFFF Storage
View Direction: Facing northeast, June 19, 2019

Photo 27: Northwestern side of Building 106 – AFFF Storage
View Direction: Facing northeast, June 19, 2019

Photo 28: Southeastern corner of Building 106 – AFFF Storage
View Direction: Facing northwest, June 19, 2019

Photo 29: The on-base drinking water wells, north of Building 106 – AFFF Storage
View Direction: Facing north-northeast, June 19, 2019

Photo 30: View of the Old Runway AFFF Release area
View Direction: Facing northwest, June 19, 2019

Photo 31: 1980 F-4 Phantom Crash location; sewer drain is obscured by tall grass
View Direction: Facing north, September 3, 2020

Photo 32: The 1999 F-14 Tomcat Crash site
View Direction: Facing east-southeast, March 5, 2020

Photo 33: The 1999 F-14 Tomcat Crash site
View Direction: Facing northeast, March 5, 2020

Photo 34: The 2001 F-14 Tomcat Crash location
View Direction: Facing northeast, June 19, 2019

Photo 35: The 2001 F-14 Tomcat Crash location
View Direction: Facing west, September 3, 2020

Photo 36: The sewer drain to the west of the 2001 F-14 Tomcat Crash location where water on the runway drains
View Direction: Facing east, September 3, 2020

Photo 37: Abandoned Aircraft #2 location
View Direction: Facing north, March 5, 2020

Photo 38: Abandoned Aircraft #2 location
View Direction: Facing north-northeast, March 5, 2020

Photo 39: The approximate former location of the E-2 Hawkeye on Side of Tarmac
View Direction: Facing west, September 3, 2020

Photo 40: The approximate former location of the E-2 Hawkeye on Side of Tarmac
View Direction: Facing south, March 5, 2020

Photo 41: Buried Abandoned Aircraft location
View Direction: Facing north, March 5, 2020

Photo 42: Close up of Buried Abandoned Aircraft
View Direction: Facing south, March 5, 2020

Photo 43: Crash Truck Waiting Area near Runway #1 location
View Direction: Facing north, June 19, 2019

Photo 44: The north end of the current runway, near the Crash Truck Waiting Area Near Runway #1
View Direction: Facing northeast, March 5, 2020

Photo 45: Crash Truck Waiting Area near Runway #2 location
View Direction: Facing south-southwest, March 5, 2020

Photo 46: Crash Truck Waiting Area Near Runway #3 location
View Direction: Facing southeast, March 5, 2020

Photo 47: Crash Truck Waiting Area Near Runway #4 location
View Direction: Facing north-northeast, March 5, 2020

Photo 48: The southwestern end of the current runway, near the Crash Truck Waiting Area Near Runway #4 and the 1953 F4U Corsair Crash
View Direction: Facing southwest, March 5, 2020

Photo 49: The Current Wastewater Treatment Plant
View Direction: Facing east, March 5, 2020

Photo 50: The Current Wastewater Treatment Plant holding pond
View Direction: Facing south-southwest, June 19, 2019

Photo 51: The east side of the Current Wastewater Treatment Plant and the berm and ditch that control surface water flow within the site
View Direction: Facing west, September 3, 2020

Photo 52: Photo of the Former Wastewater Treatment Plant
View Direction: Facing east-northeast, March 5, 2020

Photo 53: The Former Wastewater Treatment Plant
View Direction: Facing south, March 5, 2020

Photo 54: The Current Irrigation Sprayfields and the Drainage Ditch Excavated Soil Dump Site with the sprinklers that occupy the sprayfields
View Direction: Facing northeast, June 19, 2019

Photo 55: The Current Irrigation Sprayfields and the Drainage Ditch Excavated Soil Dump Site with the sprinklers that occupy the sprayfields
View Direction: Facing south, September 3, 2020

Photo 56: The Former Irrigation Sprayfields which is now an open field with minimal topographic changes
View Direction: Facing south, September 3, 2020

Photo 57: Site 14 – Fentress Landfill which is now covered in thick vegetation that limits access
View Direction: Facing east, September 3, 2020

Photo 58: Site 14 – Fentress Landfill which is now covered in thick vegetation that limits access
View Direction: Facing north, September 3, 2020

Photo 59: Site 14 – Fentress Landfill which is now covered in thick vegetation that limits access
View Direction: Facing southeast, September 3, 2020