FINAL PRELIMINARY ASSESSMENT AND SITE INSPECTION OF PER- AND POLYFLUOROALKYL SUBSTANCES

Fort Lee, Virginia

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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Fort Lee, Virginia

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The United States Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The PA identifies areas of potential interest (AOPIs) where PFAS-containing materials were used, stored and/or disposed, or areas where known or suspected releases to the environment occurred. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. This Fort Lee PA/SI was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense (DOD) policy and guidance.

Fort Lee is a 5,907 acre military training installation and has been utilized for training activities since World War I. Fort Lee is the current home of the Sustainment Center of Excellence, a major subordinate command of the Army Training and Doctrine Command, and is home to the Transportation Center and School, the Ordnance Center and School, the Ordnance Munitions and Electronics Maintenance School, the Army Logistics University, Transportation Management Training, the Defense Commissary Agency, the Defense Contract Management Agency, Culinary Training, and is an operating Army Base.

The Fort Lee PA identified 8 AOPIs for investigation during the SI phase. SI sampling results from the 8 AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil and/or groundwater at 7 AOPIs; however, 5 of the 7 AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The Fort Lee PA/SI identified the need for further study in a CERCLA remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or no action at this time at each AOPI.

Table ES-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at Fort Lee, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?			Recommendation
	GW	SO	SW	
Fire Station 1	Yes	Yes	NS	Future study in a remedial investigation
Fire Station 2	Yes	No	No	Future study in a remedial investigation
Firefighter Training Area (FFTA) - Helicopter Pad Site	No	No	NS	No action at this time
FFTA - South of Range Control	Yes	No	NS	Future study in a remedial investigation
FFTA - Air Strip	ND	ND	NS	No action at this time
Active and Former Fire Training Areas (FTLE-7, FTLE-30, and FTLE-31)	Yes	ND	NS	Future study in a remedial investigation
Fire Station 3	Yes	No	NS	Future study in a remedial investigation
Former Fire Station	No	NS	NS	No action at this time

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
ND – non-detect
NS – not sampled
SO – soil
SW – surface water

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580, amended by Executive Order 13016 in 1996, and is conducting the PA/SI consistent with its authority under CERCLA, 42 United States Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at Fort Lee based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA, and PFBS results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, and PFBS risk screening levels to determine whether further investigation is warranted. This report provides the PA/SI for Fort Lee and was completed in accordance with CERCLA and The National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

PFAS are a class of compounds that have been used in a wide range of industrial applications and commercial products due to their unique surface tension/leveling properties. Due to industry and regulatory concerns about the potential health effects and adverse environmental impacts, there has been a reduction in the manufacture and use of PFAS worldwide. In the U.S., significant reductions in the production, importation, and use of PFOS and PFOA (two individual compounds in the PFAS class) occurred between 2001 and 2015 (Interstate Technology Regulatory Council 2017). PFBS replaced PFOS in some applications and is currently used and manufactured in the U.S.

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016a). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water and soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels (OSD 2021). The September 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (also used to evaluate groundwater or surface water used as drinking water sources) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg) (residential) and 1.6 mg/kg (industrial/commercial).

The soil screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

This PA/SI was conducted consecutively because the results of the PA yielded AOPIs that necessitated continuing onto the SI phase in accordance with CERCLA. Consequently, this report provides the combined objectives of both PA and SI reports.

1.2.1 PA Objectives

During the PA, investigators collect readily available information and conduct site reconnaissance. This PA will evaluate and document areas where PFAS-containing materials were used, stored, and/or disposed, so the Army can distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

1.2.2 SI Objectives

An SI is conducted when the PA determines an AOPI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action.

Installation-specific data quality objectives (DQOs) and the sampling design and rationale are summarized in **Sections 6.1** and **6.2**.

1.3 PA/SI Process Description

For Fort Lee, PA/SI development followed the process as described below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for Fort Lee. The PA and SI processes are documented in the PA/SI Quality Control Checklist included as **Appendix B**.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), Fort Lee, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 14 January 2019, five weeks before the site visit, to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records research was to identify any area

on the installation that may have been a location where PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at Fort Lee.

A read-ahead package was prepared and submitted to the appropriate POCs two weeks before the site visit. The read-ahead package contains the following information:

- The Installation Management Command (IMCOM) operation order.
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**).
- The PFAS PA kickoff call minutes.
- An information paper on the PA portion of the Army's PFAS PA/SI.
- Contact information for key POCs.
- A list of the data sources requested and reviewed.
- A list of preliminary locations identified during the kickoff call and pre-site visit records review to be evaluated for use, storage, and/or disposal of PFAS-containing materials, where additional information on those areas will be collected through personnel interviews, additional document review, and site reconnaissance.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 19 February 2019. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed.

Personnel interviews were conducted with individuals having significant historical knowledge at Fort Lee. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information.

Site reconnaissance included visual surveys that assessed the points of potential use, storage, and/or disposal of PFAS-containing materials, as well as potential secondary impacts, and the migration potential from each AOPI (e.g., stormwater drains, building drains and sumps, cracks in the floor/pavement). Physical attributes of the preliminary locations were documented, including local slope and ground and floor conditions (i.e., paved, unpaved, visual staining), surface water bodies and surface flow, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling. Photo documentation of the preliminary locations was collected, and access limitations or advantages related to potential future sampling activities were noted.

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 21 February 2019 with the installation, USAEC, and USACE to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable USAEC POCs, and USACE regional POCs following the site visit. The information collected during the pre-site visit and site visit activities was compiled to develop the installation-specific PA portion of the PA/SI report (**Section 3**). Site data obtained during the PA were used to develop preliminary conceptual site models (CSMs) for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, and PFBS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff teleconference was held between the Army PA team and Fort Lee.

The objectives of the combined SI kickoff and scoping teleconference were to:

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- gauge USEPA and/or Virginia Department of Environmental Quality involvement requirements and preferences
- identify overlapping unexploded ordnance (UXO) or cultural resource areas
- confirm the plan for investigation derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics

Following development of the SI sampling technical approach, an SI scoping teleconference was held to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation. Additional discussion topics included:

- discuss USEPA and VDEQ involvement, requirements, and/or preferences
- identify overlapping unexploded ordnance (UXO) or cultural resource areas
- confirm the plan for IDW handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- provide an updated SI deliverable and field work schedule.

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (QC) activities for the SI portion for Army installations nationwide. Additionally, an installation-specific QAPP Addendum was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in

accordance with the PQAPP (Arcadis 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling. The SSHP was designed to supplement the Accident Prevention Plan (Arcadis 2018), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for Fort Lee (Arcadis 2020) in **Sections 6.1** through **6.3**.

After finalization of the QAPP Addendum and SSHP, field planning and coordination with the installation and subcontractors was completed. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the QAPP Addendum.

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

The following subsections provide general information about Fort Lee, including the location and layout, the installation mission(s) over time, a brief site history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installation, and applicable ecological receptors.

2.1 Site Location

Fort Lee is in Prince George County, Virginia, west/southwest of the City of Hopewell and northeast of Petersburg (**Figure 2-1**). Fort Lee is approximately 5,907 acres and lies within the Virginia Coastal Plain. Fort Lee is bound to the north by the Appomattox River and to the west, east, and south by residential and light commercial development and Petersburg National Battlefield Park (**Figure 2-2**). According to the U.S. Census Bureau, approximately 5,763 residents lived at Fort Lee in 2022 (World Population Review 2022). Each year, approximately 70,000 troops pass through the Fort Lee classrooms (Fort Lee Command Team 2019).

2.2 Mission and Brief Site History

Fort Lee's mission is to integrate and deliver Base Operation that enable training in support of readiness in the form of developing a professional installation workforce, conducting effective base operations, developing effective partnerships and building sustainable infrastructure and revitalization.

The installation, originally known as Camp Lee, was built in 1917 and was in use until 1924, coinciding with the end of World War I. Operations resumed in 1941, with the start of the Quartermaster Replacement Training Center, and the installation has been continuous operation since. Camp Lee obtained permanent status in 1950 and was designated as Fort Lee. In 2005 as part of Base Realignment and Closure mandates, Fort Lee was designated as the Army Sustainment Center of Excellence and became a focused training base for military supply, subsistence maintenance, munitions, and transportation. This change resulted in the construction of multiple new facilities and the modernization and revitalization of existing infrastructure.

Fort Lee is the third largest training site for the Army and is home to the Combined Arms Support Command as well as various training organizations including the Army Logistics University, the U.S. Army Ordnance School, The U.S. Army Quartermaster School, and the U.S. Army Transportation School. Other Army Headquarters divisions located at Fort Lee include Defense Contract Management Agency, Defense Commissary Agency, the Kenner Army Health Clinic (which serves as a military entrance processing station), and the Global Combat Support Systems-Army (Fort Lee Command Team 2019).

2.3 Current and Projected Land Use

This section provides a characterization of current and future site uses and identifies the potentially exposed populations at or near the site with regards to the current site conditions and potential future land use.

Current Land Use

Fort Lee is an operating Army Base. Although the perimeter of the Base is fenced, there are guarded gates allowing public access to active portions of the Base. Approximately half of the installation is developed, while the other half remains a mix of forest and residential on-post housing (Fort Lee Command Team 2019).

Future Land Use

In accordance with BRAC legislation passed in 2005, Fort Lee has undergone significant development and revitalization and construction was completed in 2011. The site is expected to continue to remain a military training installation and provide on-post residential housing for active service members and their families (Fort Lee Command Team 2019).

2.4 Climate

The installation receives an average of 43.6 inches of precipitation annually. Summer months are reported to have the highest number of days with precipitation as well as the highest average precipitation rates. Fort Lee also receives around 10.3 average inches of snowfall annually, with January having the highest averages for the year. The climate in this area is classified as humid subtropical and is characterized by hot, humid summers and mild to cool winters. The average annual temperature is 58.8 °F, with the warmest month of July and the coolest month of January (Weatherbase 2020).

2.5 Topography

Fort Lee is located near the headwaters of the James River which flows towards the east and meets with the Chesapeake Bay at the Atlantic Ocean. The terrain is gently rolling with an average elevation of 95 feet above mean sea level (amsl) (**Figure 2-3**). The highest elevations (between 150 and 160 feet amsl) are found in the family housing area east of Saratoga Drive and near the reservation boundary south of the U.S. Army Logistics Management Center. The lowest elevations (between 30 and 50 feet amsl) are found along Bailey and Cabin Creeks which flow through the central portion of the installation (United States Geological Survey 1984).

2.6 Geology

The site is located within the Virginia Coastal Plain Physiographic Province. The Virginia Coastal Plain is composed of unconsolidated clay, sand, silt, and gravel with varying amounts of shells, and is a sedimentary wedge that thins moving westward toward the Piedmont Province. These unconsolidated deposits can contain isolated areas of calcareous cementations that present locally and are underlain by basement rocks of Precambrian and Paleozoic age. The thickness of the Virginia Coastal Plain is 6,186 ft where it falls beneath the Eastern Shore Peninsula and thins westward to a thickness of zero at the Fall Line of the Virginia Coastal Plain Province and Piedmont Province. The Fall Line, which is the physiological boundary separating the two provinces, generally runs north-south through the city of Richmond. Interstate 95 closely corresponds to the general location of this Fall Line and Fort Lee is located approximately 2 miles east of Interstate 95 (Meng and Harsh 1988).

2.7 Hydrogeology

Three aquifers are present in the vicinity of Fort Lee: the surficial aquifer, the Yorktown-Eastover aquifer, and the Potomac aquifer. The surficial aquifer is unconfined and is located at depths from 5 to 40 feet below ground surface (bgs) in the vicinity of Fort Lee. The confining unit restricting flow between the surficial aquifer and the Yorktown-Eastover aquifer consists of clay and silty clay with lenses of fine sand and shell fragments. In areas of Fort Lee heavily incised by streams, the confining unit may be eroded, and the Yorktown-Eastover aquifer may crop out at the surface. The Potomac aquifer is located below the Yorktown-Eastover aquifer at depths around 100 feet bgs. Regional groundwater flow is generally towards the east, but locally the direction of surficial aquifer flow is toward the topographically low areas (Fluor Daniel 1997). The hydraulic gradient in this area is minimal at 0.009 foot per foot. Clay and silt beds have been documented as randomly distributed throughout the shallow aquifer and may cause locally perched water tables in shallow sediments (Fluor Daniel 1997).

Numerous surface water features impart complex hydrology and groundwater flow directions at Fort Lee. The water table is generally within 15 to 30 feet of the ground surface throughout the installation. Groundwater flow direction varies across the installation and is generally towards the northwest in areas to the north and west, north and east in areas located in the northeast on the installation, and south and southeast in areas located on the south and east on the installation. Groundwater flow potentially flows off post and is influenced by the surface water features that are described in **Section 2.8** (Arcadis 2020 and USGS 1984).

2.8 Surface Water Hydrology

The dominant surface water features within Fort Lee are Bailey Creek, Blackwater Swamp, Bullhill Run, and Cabin Creek. Bailey Creek is the principal natural drainage feature of Fort Lee with its headwaters near the southwest boundary of Fort Lee flowing to the northeast of the installation to the James River, approximately seven miles from Fort Lee. Bailey Creek drains approximately 2,400 acres of Fort Lee and is part of the James River Watershed. Blackwater Swamp is located to the south/southeast and drains towards the east where it eventually becomes the Blackwater River. Blackwater Swamp is part of the Blackwater Watershed. Bullhill Run and Cabin Creek are located in the northern portion of Fort Lee and drains north towards the Appomattox River. Both Bullhill Run and Cabin Creek are part of the Lower Appomattox River Watershed (Virginia Department of Conservation and Recreation 2020 and Colorado DataScapes 2020).

2.9 Relevant Utility Infrastructure

The following subsections provide general information regarding the installation's stormwater and wastewater management systems, as well as information on how the utility infrastructures may influence the fate and transport of PFAS constituents at Fort Lee.

2.9.1 Stormwater Management System Description

The stormwater management and drainage system at Fort Lee can be divided into four separate sub watersheds, each with its own respective outfall: Bailey Creek (within the James River watershed), Blackwater Swamp (within the Blackwater River watershed), Harrison Branch (within the Lower Appomattox River watershed), and Cabin Creek/Bullhill Run (also within the Lower Appomattox River watershed). Past development practices at Fort Lee have resulted in large and extensive areas of impervious surfaces and an interconnected system of stormwater drains that are capable of rapidly conveying and concentrating runoff from large portions of the land area at the installation.

Notably, there is an extensive network of culverts and storm drains within the Cantonment Area that is effective in rapidly conveying water to Bailey Creek during precipitation events. As a result of this rapid conveyance, the segment of Bailey Creek within Fort Lee has been affected by erosion, sedimentation, and nonpoint source pollution associated with the stormwater runoff from the base (Colorado DataScapes 2010).

2.9.2 Sewer System Description

The sanitary sewer collection system is privatized and is treated off-post. Wastewater treatment at the installation is provided by the Hopewell Regional Wastewater Treatment Facility, which was renamed Hopewell Water Renewal in 2016. Wastewater is conveyed to the Baileys Creek Pump Station through the 30-inch diameter Baileys Creek Trunk Sewer, which is approximately 11,000 feet in length. The trunk sewer begins outside of Fort Lee and runs northeast by gravity along Baileys Creek to south of the City of Hopewell and eventually discharges to the Hopewell Water Renewal. A contract between Fort Lee and the City of Hopewell limits the average monthly flow of sewer water from Fort Lee to Hopewell Water Renewal to 2.5 million gallons per day.

The existing on-post sewage collection system is owned and operated by Old Dominion Utility Services and is comprised of over 50 miles of gravity collection lines, including approximately 882 manholes. The sewer lines are 6 to 30 inches in diameter, consisting of materials including terra cotta, reinforced concrete, cast iron, ductile iron, and PVC. Most of the sewage collection system was constructed in the 1940s to 1950s, although a substantial portion was upgraded in 1997 (Colorado DataScapes 2010).

2.10 Potable Water Supply and Drinking Water Receptors

Since April 2001, the Fort Lee water system has been owned and operated by the Virginia American Water Company. The water supply at Fort Lee is provided through two major surface water treatment plants: Appomattox River Water Authority in Petersburg, Virginia, and Virginia American Water (VAW) in Hopewell, Virginia (VAWC 2018). The source of water for Appomattox River Water Authority is from Lake Chesdin, which is supplied by the Appomattox River and the source for VAWC withdrawals is from the Appomattox River near the confluence of the James River. During the 2013/2014 round of sampling as part of the USEPA Unregulated Contaminant Monitoring Rule, no PFOS, PFOA, and/or PFBS were detected in at concentrations greater than the OSD risk screening level from any of the public water supply systems serving Fort Lee.

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR

report was generated for Fort Lee, which along with state and county geographic information system provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). There are no known in-use drinking water wells on-installation. An off-installation drinking water well at the Red Hill Mobile Home Park which is located less than 1 mile to the west of the installation boundary (Environmental Data Resources, Inc. [EDR], 2018). This well is currently not in use and the Red Hill Mobile Home Park is connected to municipal water however this well has the potential to be used for drinking water purposes during periods of drought if necessary. Another off-installation drinking water well located approximately two miles to the southwest of the installation boundary on the Petersburg National Battlefield. This drinking water well was unable to be confirmed as existing or active, however the Petersburg National Battlefield is connected to municipal water. The EDR report providing well search results provided as **Appendix E**.

2.11 Ecological Receptors

The PA team collected information regarding ecological receptors that was available in the installation documents. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors.

Fort Lee has a variety of wildlife and has numerous terrestrial and wetland systems located throughout the installation and include various species of birds, amphibians, reptiles and mammals. The installation has established populations of deer, turkey and waterfowl. Bats are also known to be present onsite and are monitored for species that are listed on federal or state threatened and endangered lists (ECC and Arcadis 2013).

Two federally-listed species are believed to be present on Fort Lee and include the threatened northern long-eared bat and the endangered Indiana bat. The presence of the two bat species is believed to be limited to the Blackwater Swamp based on acoustic detector studies completed in 2017 and 2018 (Fort Lee 2020).

State-listed species include the state endangered Loggerhead shrike, however this was last observed in 1998 and has not been documented since, and both the tri-colored bat and Rafinesque's big-eared bat which were documented to be at Fort Lee in 2016 (Fort Lee 2020).

The spotted turtle is known as having a healthy population on Fort Lee; however, the U.S. Fish and Wildlife service has been petitioned to list the species for protection due to rapid declines over the past decade (Fort Lee 2020).

2.12 Previous PFAS Investigations

In 2014, PFOS and PFOA were sampled from existing monitoring wells at the Active and Former Fire Training (FTLE-7, FTLE-30, and FTLE-31) AOPI and analyzed by EPA Method 537 Modified. Information detailing the sampling procedures is not available. The results of this sampling indicated presence of PFOS at concentrations that ranged from ND (MW-01) to 8,330 ng/L (MW-06) and PFOA at concentrations that ranged from ND (MW-01) to 6,840 ng/L (MW-06), however the analytical data was not validated. Analytical data for this previous 2014 investigation is presented on **Table 2-1** and shown on **Figure 2-5**.

Also, in response to the third Unregulated Contaminant Monitoring Rule, the Virginia American Water Company water system that serves Fort Lee was tested in 2014. The results of these analyses indicated that no PFOS, PFOA, and/or PFBS was detected in the water supply for the installation.

3 SUMMARY OF PA ACTIVITIES

To document areas where any potential current and/or historical PFAS-containing materials were used, stored, and/or disposed at Fort Lee, data was collected from three principal sources of information and are described in the subsection below:

1. Records review
2. Personnel interviews
3. Site reconnaissance.

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during record review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), and site reconnaissance logs (**Appendix H**) during the PA process for Fort Lee is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented is **Section 5.1**, and further discussion regarding categorizing areas as AOPIs in presented in **Section 5.2**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program (IRP) administrative record documents, compliance documents, Fort Lee fire department documents, Fort Lee directorate of public works (DPW) documents, and geographic information system files. Internet searches were also conducted to identify publicly available and other relevant information. Additionally, an EDR report generated for Fort Lee was reviewed to obtain off-post water supply well information. A list of the specific documents reviewed for Fort Lee is provided in **Appendix F**.

3.2 Personnel Interviews

Interviews were conducted during the site visit. The list of roles for the installation personnel interviewed during the PA process for Fort Lee is presented below (affiliation is with Fort Lee unless otherwise noted).

- Environmental Chief
- Compliance Chief/Spill Response
- IRP Manager
- Natural Resource Program Manager
- Deputy Fire Chief
- Assistant Fire Chief (Training Division)
- Fire Department – Hazardous Waste Captain
- Chief, Plans & Operations

- Chief, Basic Petroleum Logistics Division

The compiled interview logs are provided in **Appendix G**.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at Fort Lee during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews. A photo log from the site reconnaissance is provided in **Appendix H**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix H**.

Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for site inspection sampling.

4 POTENTIAL PFAS USE, STORAGE AND/OR DISPOSAL AREAS

Fort Lee was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of aqueous film-forming foam (AFFF) is the most prevalent potential source of PFAS chemicals at DoD facilities. As such, this section is organized to summarize the AFFF-related uses first, and all remaining potential PFAS-containing materials in the subsequent section.

4.1 AFFF Use, Storage, and Disposal Areas at Fort Lee

AFFF was developed in the mid-1960s in response to a need for firefighting foams better suited to extinguish Class B, fuel-based fires. AFFF formulations consist of water, an organic solvent, up to 5 percent (%) hydrocarbon surfactants, and 1 to 3% PFAS (Interstate Technology Regulatory Council 2020). AFFF concentrate is designed to be diluted with water to become a 1, 3, or 6% foam. AFFF releases at DoD facilities may have occurred during firefighter training, emergency response actions, equipment testing, or accidental releases. The military still primarily uses AFFF for Class B fires; however, the current formulations of AFFF contain significantly lower amounts of PFOS, PFOA, and their precursors, and significant operational changes have been implemented to restrict uncontrolled releases and non-essential use of PFAS-containing foams. Army installations may still house AFFF, commonly stored in closed containers (e.g., 55-gallon drums, 5-gallon buckets), within designated storage buildings or at firehouses.

The current supply of PFAS-containing materials at Fort Lee is short-chained (C6) military specification (Mil-Spec) foams and is documented in the current assets file that were provided by Installation Management Command and was confirmed during site visit interviews. One hundred and ninety gallons of Mil-Spec foam are in the Fort Lee foam supply. The volume of Mil-Spec foam was not confirmed during the PA site visit.

AFFF is stored in limited volumes on fire trucks and within fire stations at FS1 and FS2. One full drum of cold weather foam was identified in FS2 (Chemguard Blizzard) and had been noted to have been purchased inadvertently. The volume of Mil-Spec foam at Fort Lee was not confirmed, as previously stated, however the number of empty drums identified at FS2 was consistent with the volume documented in the current assets. There was no indication that AFFF foams are currently stored at FS3, though PFAS-containing foams may have been in the past. A former Fire Station was located in the western portion of cantonment and ceased operations in the mid-1970s. The location of the former fire station is the parking lot of the Quartermaster and Women's Museum (Shaw 2005), and information pertaining to the use and storage of PFAS-containing materials at this former fire station are unknown. A field is located along the eastern boundary of the parking lot may have been used for fire training, however this is not confirmed. When the PA/SI process was initiated, the focus of investigation was limited to areas of PFAS-containing material releases. No record of release was identified at FS3 or the Former Fire Station, therefore FS3 and the Former Fire Station were excluded from the initial sampling plan. Once the Army provided direction to sample for PFOS, PFOA, and PFBS at any area which had

historically stored or currently stores AFFF regardless of a confirmed release, FS3 and the Former Fire Station were incorporated into the sampling plan and were subsequently sampled.

According to Fire Department personnel, no training is currently conducted with AFFF or training foam. Prior to the change from long-chain to short-chain foams, foam training and nozzle (proportioner) testing was performed at various locations throughout Fort Lee with both AFFF and training foams. According to fire department personnel, training activities were confirmed to have occurred at the Former Fire Training Area (FFTA) located at the Helicopter Pad Site in the northeast portion of cantonment, the parking lot across the street from FS1, and at the FFTA located at the Air Strip in the northern portion of the installation. Additionally, it was confirmed that fire truck foam systems were flushed on the back apron of FS2 and along the side of the FS1 building.

An inactive fire training area is in the northern portion of the site and is located south of range control which has been identified as FFTA – South of Range Control. Training maneuvers consisted of filling a 20-foot square by 25-inch deep, unlined pit with waste oil or diesel fuels, igniting the fuels and extinguishing with unknown fire suppressant foams (Fluor Daniel 1996). The FTA (South of Range Control) was closed at an unknown date, and the site has since been regraded. Large volumes of soil and the remains of the fire training pit have been excavated and removed to an unknown location (Fluor Daniel 1997).

A fire training area identified as Landfill 15 was confirmed by fire department personnel to have been constructed over former Landfill 15 (FTLE-15). Medical wastes were reportedly uncovered during construction according to fire department personnel. As a result, the project was cancelled, and the fire training site was never used.

Inactive fire training pits (FTLE-7, FTLE-30 and FTLE-31) are in the southern portion of the installation and associated with the Petroleum Logistics Division. FTLE-30 was replaced by a still-active fire training pit that is concrete line and outfitted with a propane fire system. No AFFF is used at this active fire training pit. Sodium bicarbonate is currently used as a fire suppressant at this location. During the interview with the Chief of the Petroleum Logistics Division, it was confirmed that the Active and Former Fire Training Area (FTLE-7, FTLE-30 and FTLE-31) historically used AFFF. The AFFF type, volume, and frequency of use was unknown. It was further confirmed that the foam supply was turned over to hazardous waste disposal at an unknown date that preceded the Division Chiefs tenure. A review of hazardous waste manifests documented more than 2,300 pounds of AFFF had been removed from Fort Lee in January and March of 1999 (**Appendix F**). Current fire training activities within the Petroleum Logistics Division are conducted in a concrete lined fire training pit equipped with a propane fire system and utilizing sodium bicarbonate suppression. The Division Chief also confirmed that there have been several petroleum spills that the fire department responded to but, to his knowledge, no AFFF was utilized during these events.

4.2 Other PFAS Use, Storage and/or Disposal Areas

No other potential PFAS source types were either identified at Fort Lee or prompt further research or constitute categorization as AOPIs.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at Fort Lee) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the installation that were identified during the records search and site visit consist of municipal fire stations.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage and/or disposal of PFAS-containing materials at Fort Lee were further refined during the PA process and identified either as an area not retained for further investigation or as an AOPI. In accordance with the established process for the PA/SI, eight areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

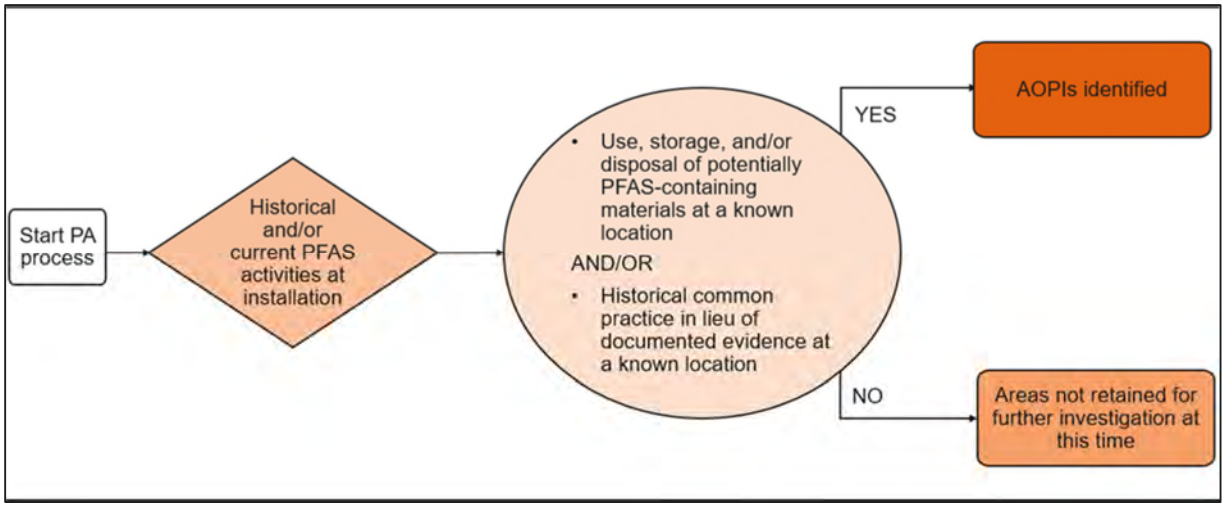

Figure 5-1: AOPI Decision Flowchart

The areas not retained for further investigation are presented in **Section 5.1**. The areas retained as AOPIs are presented in **Section 5.2**.

Data limitations for this PA/SI at Fort Lee are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

Through the evaluation of information obtained during records review, personnel interviews, and/or site reconnaissance, the areas described below were categorized as areas not retained for further investigation at this time.

A brief site history and rationale for areas not retained for further investigation are presented in **Table 5-1**, below.

Table 5-1. Installation Areas Not Retained for Further Investigation

Area Description	Dates of Operation	Relevant Site History	Rationale
Pesticide Mixing Area Main Cantonment	Early 1940s to late 1970s	Storage, mixing, and disposal of pesticides at Fort Lee were conducted at Building 6203 (FTLE-05). Building 6203 was located at the intersection of Shop Road and 19th Street in the cantonment area. Pesticides and rinse water were disposed of in an open ditch which ran behind the building. A perforated disposal tank and contaminated soil were removed in 1975, and the excavated area was backfilled and covered with a small concrete slab.	No PFAS-containing pesticides were identified.
Landfill 15/Former Fire Training Area	Mid-1990s (only used for less than one year)	Fire Training Area that was constructed and not used or used very little. Site was abandoned upon discovery of medical wastes.	No AFFF training occurred at the site.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. One of the AOPIs overlap with Fort Lee IRP sites and/or Headquarters Army Environmental System (HQAES) sites (**Figure 5-2**). The AOPI, overlapping IRP site identifier, HQAES number, and current site status are discussed within each AOPI subsection presented below. At the time of this PA, the Active and Former Fire Training Area (FTLE-7, FTLE-30, and FTLE-31) is the only IRP site to have historically been investigated or are currently being investigated for the possible presence of PFOS, PFOA, and PFBS.

5.2.1 Fire Station 1

Fire Station 1 was built in 1963 on the corner of C Avenue and 16th Street (**Figure 5-3**) and presently houses one ambulance, support vehicles, and equipment. The concrete area along the north wall of the building and the parking log on the northeast corner of C Avenue and 16th Street adjacent to Fire Station 1 have been used for system flushes and/or nozzle testing. Concrete and asphalt are prominent in the vicinity of FS1, however there is exposed ground is grassy and grades gently towards the south located behind and along the sides of FS1.

Fire Station 1 was identified as an AOPI upon a review of records that indicated historical AFFF use and reports of fire training activities in the area, specifically in the parking lot north of FS1. Site reconnaissance confirmed that a release of unknown volume occurred in the parking lot across the street from FS1, and that releases at an unknown frequency are likely to have occurred on the building apron during maintenance activities.

5.2.2 Fire Station 2

Fire Station 2 was built in 2006 near the corner of Sisisky Boulevard and A Avenue (**Figure 5-4**) and houses one engine, one ladder truck, one rescue truck, one ambulance, and several emergency response and support vehicles. The building area is flat and well-graded, with sanitary drains located within the vehicle bays. North of the station, surface water flow is to the north toward A Avenue, and south of the building, surface water flow is towards the south and southwest, where a small retention pond is located. There are several storm drains located around the Fire Station, but the drop inlets are blocked off when the system is flushed according to interviewed personnel.

Fire Station 2 was identified as an AOPI due to the storage of AFFF in trucks and in drums and the confirmed foam system flushing on the back apron of the fire station upon personnel interviews and site reconnaissance. On at least two occasions, residual AFFF in fire engine tanks was rinsed out the tanks and onto the parking lot south of FS2. Site reconnaissance and personnel interviews revealed that foam systems are regularly flushed on the southern ramp.

5.2.3 Former Firefighter Training Area (FFTA) – Helicopter Pad Site

The FFTA - Helicopter Pad Site is flat and grassy and includes one large helipad, two small helipads, and a pick-up/drop-off roundabout, with a small pinewood stand of trees located to the northeast (**Figure 5-5**). Two stormwater drop inlets are located on the east and west sides of the roundabout and small helipads.

The FFTA-Helicopter Pad Site is identified as an AOPI following records searches which indicated that fire training activities were performed at the site. A parking lot near the helipad was used for foam training of unknown frequency, volume, and product type. Proportioner testing using real foam was reportedly conducted at the helipad on numerous occasions during system tests. Site reconnaissance yielded no obvious signs of releases.

5.2.4 FFTA – South of Range Control

The FFTA – South of Range Control (**Figure 5-6**) is flat and grassy and is located immediately adjacent to a wooded area located in the northern portion of the installation and is less than 1 mile from the installation boundary.

The FFTA – South of Range Control is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to fire training activities at the location. The FFTA – South of Range Control is an unlined pit approximately 20-feet square in size and 25-inches deep. The unlined pit was used for igniting waste oil or diesel fuel and extinguishing fires with unknown fire suppressing foams. The area was reportedly used weekly for fire training activities for several years. The date that fire training activities initiated in this area are unknown but ceased around 1990.

5.2.5 FFTA – Air Strip

The FFTA – Air Strip (**Figure 5-7**) is flat and grassy with paved areas that serve as the landing strip. It is located in the northwestern portion of the installation.

The FFTA – South of Range Control is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to fire training activities in the area. The fire engines reportedly

conducted training by dispersing training foam along the air strip. Training activities occurred from at least 2005 until present.

5.2.6 Active and Former Firefighter Training Areas (FTLE-7, FTLE-30, and FTLE-31)

The Active and Former Fire Training Areas (FTLE-7, FTLE-30, and FTLE-31) are located near Hobby Avenue and 8th Street on the southern portion of the installation (**Figure 5-8**) and are also IRP sites (HQAES ID numbers 51315.1007, 51315.1030, and 51315.1031) The topography of the area is generally flat with significant forest vegetation throughout. General surface water flow direction is assumed to be towards the south. The current fire training area consists of three propane fed and concrete lined pits that are used for fire training activities. Sodium bicarbonate is currently used as a fire suppressant, but AFFF was reportedly used at the open burn bits at the former fire training areas. The site was operational from the 1960s through the early 1980s, during which time AFFF of unknown brand and composition was used.

5.2.7 Fire Station 3

Fire Station 3 was built in 1942 on the corner of A Avenue and 33rd Street (**Figure 5-9**) and houses one engine, one ambulance, a Mass Casualty Response trailer, and an ATV. The building area is flat and well-graded,

Fire Station 3 was identified as an AOPI because the fire engine stored at the station holds AFFF.

5.2.8 Former Fire Station

The Former Fire Station is located in the area of the current Quartermaster Museum at the intersection of A Avenue and 20th Street (**Figure 5-10**). The Former Fire Station was used to store firefighting chemicals from the early 1940's to early 1970's

The Former Fire Station was identified as an AOPI because of programmatic changes that led to inclusion of AFFF storage areas in the sampling plan.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at Fort Lee, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at Fort Lee at 8 AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels.

As such, an installation-specific QAPP Addendum (Arcadis 2020) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified 7 AOPIs with soil, groundwater, surface water, and/or sediment pathways as potentially complete which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in April 2020, April 2021, and October 2021 through the collection of field data and analytical samples.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2020 and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at Fort Lee. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.4**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2020), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater, soil, and surface water for PFOS, PFOA, and PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

The rationale for sampling at each AOPI is illustrated on **Figure 6-1** below.

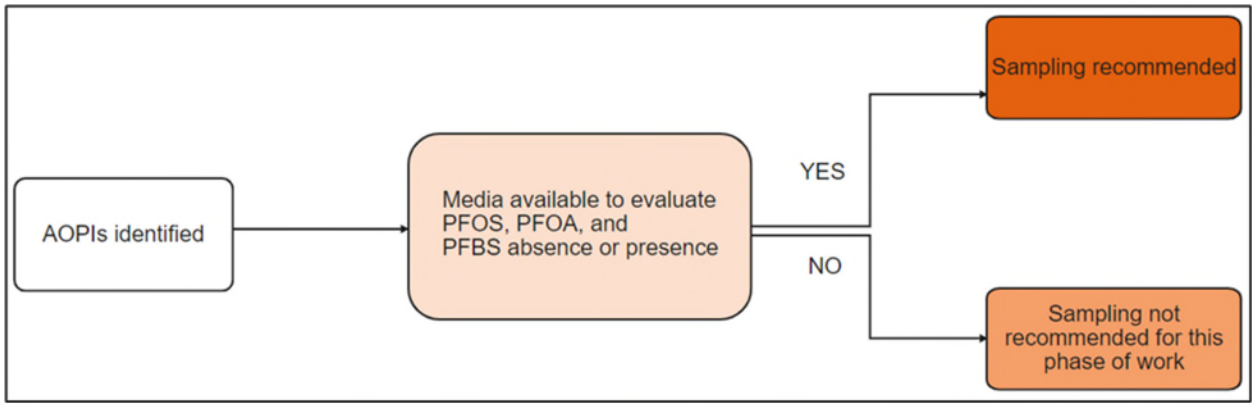

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at Fort Lee is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2020). Briefly, the areas of focus for this SI were selected based on a review of historical documents and information obtained by conducting personnel interviews during the PA site visit. Soil, groundwater, and/or surface water samples were collected from all 8 AOPIs in areas of known or suspected PFAS-containing material release or storage.

Sampling points were positioned at locations of known or suspected AFFF release areas and PFAS-containing material storage areas, locations of runoff collection, and locations downgradient of known or suspected AFFF release areas and PFAS-containing material storage areas and were determined based on specific historical evidence and surface runoff/groundwater flow conditions at each AOPI. Groundwater and soil samples were collected 8 of the 8 AOPIs, and were practicable, groundwater samples were collected from previously existing monitoring wells. One surface water sample was collected from Bailey Creek where the AOPI is located approximately one-half mile from the installation boundary.

Sampling depths at existing monitoring wells were at approximately the center of the saturated screened interval. **Table 6-1** includes the monitoring well construction details for the wells sampled during the SI.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2020), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2020). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2020). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, equipment calibration forms, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices I** and **J**, respectively.

6.3.1 Field Methods

Groundwater samples were collected using low-flow purging methods from approximately the center of the saturated screened interval at existing monitoring wells. At sampling locations where boreholes were advanced using direct push technology (DPT), dual-tube drill casing was advanced using a top-down sampling method to minimize cross-contamination at depth. Soil samples were collected in PFAS-free acetate liners; a peristaltic pump with PFAS-free disposable high-density polyethylene tubing was used to collect first encountered groundwater samples through a screen-point sampler. Surface water samples were collected using direct-fill methods just below the water surface.

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.4**.

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and QAPP Addendum provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (Ebs), source blanks for water used in the initial decontamination step for drill tooling, and field blanks for laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2020), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS only. EBs were collected for media sampled for PFOS, PFOA, and PFBS at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2020). The decontaminated reusable equipment from which EBs were collected include tubing, water level meter, screen-point samplers, drill casing and cutting shoes, hand augers, and stainless-steel trowels as applicable to the sampled media. Source blanks were collected from decontamination source. Analytical results for blank samples are discussed in **Section 7.7**.

6.3.3 Dedicated Equipment Background

No dedicated equipment was encountered during this sampling event therefore no dedicated equipment background blanks were collected.

6.3.4 Field Change Reports

In some cases, clarifications to the established scope of work may be needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. Minor modifications from and clarifications for the procedures and scope of work detailed in the QAPP

Addendum and PQAPP and that did not affect DQOs are documented in Field Change Reports included as **Appendix L** and are summarized below:

- Fire Station 2
    - FTLEE-FS2-1-SO/GW was moved approximately 200 feet west of the original proposed location. The reason this location was moved is the driveway and parking lot adjacent to Fire Station 2 was curbed with storm drains which feed a naturally lined retention pond. Any AFFF deposited on the large concrete driveways and parking areas adjacent to Fire Station 2 would have accumulated in the retention pond therefore FTLEE-FS2-1-SO/GW was moved to capture the downgradient groundwater from the retention pond. Refer to FCR-FTLEE-01 included in Appendix L. FTLEE-FS2-2-SO was moved to near the original location of FTLEE-FS2-1-SO/GW to capture the first two feet of soil from the storm drain egress within the retention pond. Furthermore, this location was inaccessible to the drill rig. Refer to FCR-FTLEE-01 included in Appendix L.
- Former Fire Training Area at Range Control
    - FTLEE-FFTARC-1-SO/GW was moved approximately 250 feet north of the original proposed location due to the uneven terrain and heavy vegetation creating accessibility issues. Refer to FCR-FTLEE-01 included in Appendix L.
- Active and Former Fire Training Areas (FTLE-7, FTLE-30, and FTLE-31)
    - FTLEE-FFTAFP-1-SO/GW was moved approximately 200 feet east of the originally proposed location due to a swamp which was encountered through the western portion of the site. Refer to FCR-FTLEE-01 included in Appendix L.
    - Two additional co-located soil borings and temporary monitoring wells (FFTAFP-SO-2/FFTAFP-GW-2 and FFTAFP-SO-3/FFTAFP-GW-3) were added to the sampling plan. The groundwater samples were collected downgradient of the Active and Former Fire Training Area AOPI because the original groundwater sampling location that was collected as part of the SI appeared to be side gradient of the AOPI upon completion of the initial SI sampling. Refer to FCR-FTLEE-02 and FCR-FTLEE-03 in Appendix L.
    - Three existing groundwater wells (FFTAFP-MW3, FFTAFP-MW4, and FFTAFP-MW-6) were added to the sampling plan due to updates to programmatic guidance from the Headquarters of the Department of the Army (HQDA) which stated that historical analytical results for PFOS, PFOA, and/or PFBS are not to be used to determine presence or absence of PFOS, PFOA and PFBS at AOPIs. Refer to FCR-FTLEE-03 in Appendix L.
- Fire Station 3
    - Fire Station 3 was added as an AOPI for sampling in the SI phase, at the direction of the Army to sample for PFOS, PFOA, PFBS at any area which had historically stored or currently stores AFFF regardless of a confirmed release documented during the course of the PA. Refer to FCR-FTLEE-02 in Appendix L.
    - Two co-located soil borings and temporary monitoring wells (FTLEE-FS3-SO-1/FTLEE-FS3-GW-1 and FTLEE-FS3-SO-2/FTLEE-FS3-GW-2) and two separate soil borings (FTLEE-FS3-

SO-3 and FTLEE-FS3-SO-4) were added to the sampling plan. Refer to FCR-FTLEE-02 in Appendix L.

- Former Fire Station
    - The Former Fire Station was added as an AOPI for sampling in the SI phase, at the request of the Army to sample for PFOS, PFOA, and PFBS at any area which had historically stored or currently stores AFFF regardless of a confirmed release documented during the course of the PA. Refer to FCR-FTLEE-02 in Appendix L.
    - Three existing groundwater wells (FTLEE-MW-21, FTLEE-MW-08, and FTLEE-MW-10) were added to the sampling plan, with two existing groundwater wells (FTLEE-MW-09 and FTLEE-MW-22) retained as alternative sample points, if needed. Refer to FCR-FTLEE-02 in Appendix L.

6.3.5 Decontamination

Non-dedicated reusable sampling equipment (e.g., stainless-steel trowels, hand augers, drill cutting shoes and casing, screen-point samplers, water-level meters) that came into direct contact with sampling media was decontaminated before first use, between sampling locations/intervals, and before demobilization in accordance with P-09, TGI – Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2019, Appendix A).

6.3.6 Investigation-Derived Waste

IDW, including soil cuttings, excess sediment, groundwater, surface water, decontamination fluids were collected and disposed on the ground at the point of collection. Disposable equipment was collected in bags and disposed in municipal waste receptacles. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and HDPE and silicon tubing) that may come in contact with sampling media.

6.4 Data Analysis

The subsections below summarize the laboratory analytical methods and the methodology used to evaluate data collected during the SI through data verification and usability assessments (as completed by a project chemist, independent of the project team).

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS, by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, and PFBS were analyzed for in groundwater, soil, and surface water using an analytical method that is ELAP-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15 in accordance with Worksheet #15 of the Fort Lee QAPP Addendum (Arcadis 2020).

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil and sediment samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2020) by the analytical method noted:

- TOC by Solid Waste Test Method 846 9060A
- Grain size analysis by American Society for Testing and Materials D422-63
- pH by Solid Waste Test Method 846 9045D.

These data are collected as they may be useful in future fate and transport studies.

The laboratory limit of detection (LOD) is defined as "the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence" (DoD 2017). The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation (LOQ; DoD 2017). Concentrations detected between the LOD and LOQ, therefore, are considered estimates and are qualified as such on laboratory analytical reports. Instrument-specific detection limits (e.g., the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99 percent confidence; DoD 2017), as provided for each analyte by the laboratory, are reported along with the LODs and LOQs in the laboratory analytical reports included in the Data Usability Summary Report (DUSR) (**Appendix K)**.

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.3 (DoD and Department of Energy 2019). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix K**. The Level IV analytical reports are included within **Appendix K** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at Fort Lee. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix K**), was prepared in accordance with the USACE Engineer Manual 200-1-10 (USACE 2005), the Final DoD General Data Validation Guidelines (DoD 2019) and the Final DoD Data Validation Guidelines Module 3: Data Validation Procedure for Per-and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD 2020), that reviewed precision, accuracy, completeness, representativeness, comparability, and sensitivity. A statement of overall data usability is included in the DUSR.

Based on the final data usability assessment, the environmental data collected at Fort Lee during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix K**), and as indicated in the full analytical tables (**Appendix M**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and Fort Lee QAPP Addendum (Arcadis 2020). Data qualifiers applied to laboratory analytical results for samples collected during the SI at Fort Lee are

provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-2**.

Table 6-2 OSD Risk Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil Using USEPA's Regional Screening Level Calculator

Chemical	Residential Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	40	0.13	1.6
PFOA	40	0.13	1.6
PFBS	600	1.9	25

Notes:

1. Risk screening levels for tap water and soil provided by the OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet below ground surface [bgs]), regardless of the current and projected land use of the AOPI. Soil samples collected from greater than 2 feet but less than 15 feet bgs will be compared to the industrial/commercial risk screening levels only, and soil samples collected from greater than 15 feet bgs will not be compared to either risk screening level.

Mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater and surface water data for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at Fort Lee are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 9**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at Fort Lee (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2020). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 through **7-3** provide a summary of the groundwater, soil and surface water analytical results for PFOS, PFOA, and PFBS. **Table 7-4** summarizes AOPIs and whether their SI results exceed the OSD risk screening level. **Appendix M** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at Fort Lee with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-9** show the PFOS, PFOA, and PFBS analytical results in groundwater, soil, and surface water for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater and surface water data collected during the SI are reported in ng/L, or parts per trillion, and soil data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging and sample collection and for surface water during sample collection are provided on the field notes (**Appendix I**) and field forms (**Appendix J**). Soil and sediment descriptions are provided on the field forms in (**Appendix J**). The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 5 to 25 feet bgs.

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No) (Y/N)
Fire Station 1	Y
Fire Station 2	Y
Former Firefighter Training Area (FFTA) – Helicopter Pad Site	N
Former Firefighter Training Area (FFTA) – South of Range Control	Y
Former Firefighter Training Area (FFTA) – Air Strip	N
Active and Former Firefighter Training Areas (FTLE-7, FTLE-30, and FTLE-31)	Yes
Fire Station 3	Yes
Former Fire Station	No

7.1 Fire Station 1

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Fire Station 1.

7.1.1 Groundwater

A grab groundwater sample was collected via DPT at first-encountered groundwater at Fire Station 1 (**Figure 7-2**). PFOS and PFOA were detected at concentrations greater than the OSD risk screening levels in FTLEE-FS2-1-GW (730 J- ng/L and 1,100 J ng/L, respectively). PFBS was detected in the groundwater sample, but the concentrations did not exceed the OSD risk screening level (430 J- ng/L). Analytical data is presented in **Table 7-1**.

7.1.2 Soil

Two soil samples were collected from 1 to 3.4 feet bgs at Fire Station 1 (**Figure 7-2**). One of the soil borings was co-located with a groundwater sample). PFOS was detected above the OSD risk screening level in FTLEE-FS1-1-SO (0.14 mg/kg). PFOS was detected in soil at FTLEE-FS1-2-SO (0.055 mg/kg) but the concentration did not exceed the OSD risk screening level. PFOA was detected in FTLEE-FS1-1-SO (0.0077 mg/kg) and was not detected in FTLEE-FS1-2-SO. PFBS was not detected in either soil sample. Analytical data is presented in **Table 7-2**.

7.2 Fire Station 2

The subsections below summarize the soil, groundwater, and surface water PFOS, PFOA, and PFBS analytical results associated with Fire Station 2.

7.2.1 Groundwater

A grab groundwater sample was collected via DPT at first-encountered groundwater at Fire Station 2 (**Figure 7-3**). PFOA was detected at a concentration greater than the OSD risk screening level in groundwater sample FTLEE-FS2-1-GW (150 J- ng/L). PFOS and PFBS were detected in groundwater samples, FTLEE-FS2-1-GW (26 J- ng/Land 5.6 J- ng/L, respectively) but the concentrations did not exceed the OSD risk screening levels. Analytical results are presented in **Table 7-1**.

7.2.2 Soil

Soil samples were collected from two boring locations at Fire Station 2 from the following depths: FTLEE-FS2-1-SO (2 to 4 feet bgs) and FTLEE-FS2-2-SO (0.5 to 2.5 feet bgs) (**Figure 7-3**). One of the two soil borings was co-located with a groundwater sample. PFOS was detected in soil sample FTLEE-FS2-1-SO (0.00092 J mg/kg) but the concentration was below the respective OSD risk screening level. PFOS was not detected in FTLEE-FS2-2-SO. PFOA was detected in FTLEE-FS2-2-SO (0.0019 mg/kg) but the concentration was below the respective OSD risk screening level. PFOA was not detected in FTLEE-FS2-1-SO. PFBS was not detected in either soil sample. Analytical results are presented in **Table 7-2**.

7.2.3 Surface Water

One surface water sample was collected in Bailey Creek downstream of Fire Station 2 (**Figure 7-3**). PFOS, PFOS, and PFBS were detected but concentrations were below respective OSD risk screening levels. PFOS was detected at 8.4-8.6 ng/L, PFOA was detected at 4.2-4.5 ng/L, and PFBS was detected at 4.2-4.4 ng/L. Analytical results are presented on **Table 7-3** and **Appendix M**.

7.3 FFTA – Helicopter Pad Site

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with the FFTA – Helicopter Pad Site.

7.3.1 Groundwater

Grab groundwater samples were collected via DPT at first-encountered groundwater at the FFTA – Helicopter Pad Site (**Figure 7-4**). PFOS, PFOA, and PFBS were detected in FTLEE-FFTAPRO-2-GW (2.6 J ng/L and 27 ng/L, and 5.1 ng/L, respectively) but concentrations were below respective OSD risk screening levels. PFBS was detected in FTLEE-FFTAPRO-3 (4.0 ng/L) but the concentration was below the OSD risk screening level. Analytical results are presented on **Table 7-1.**

7.3.2 Soil

Soil samples were collected from 0.5 to 2.5 feet bgs at three boring locations at the FFTA- Helicopter Pad Site (**Figure 7-4**). All three soil borings were co-located with groundwater samples. PFOS and PFOA were detected in soil sample FTLEE-FFTAPRO-2-SO (0.00055 J mg/kg and 0.019 mg/kg, respectively) only and concentrations were below respective OSD risk screening levels. PFBS was not detected in any soil sample. Analytical results are presented on **Table 7-2**.

7.4 FFTA – South of Range Control

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with the FFTA – South of Range Control.

7.4.1 Groundwater

Grab groundwater samples were collected via DPT at first-encountered groundwater and from existing monitoring wells at the FFTA – South of Range Control (**Figure 7-5**). PFOS was detected at concentrations above the OSD risk screening level in FTLEE-FFTARC-1-GW (130 J- ng/L), FTLEE-FFTARC-MW03 (450 ng/L), and FTLEE-FFTARC-MW1612 (590 ng/L). PFOA was detected in FTLEE-FFTARC-1-GW (38 J- ng/L), FTLEE-FFTARC-MW03 (23 ng/L), and FTLEE-FFTARC-MW1612 (34 ng/L) but concentrations were below the OSD risk screening level. PFBS were detected in FTLEE-FFTARC-1-GW (17 J- ng/L PFBS), FTLEE-FFTARC-MW03 (21 ng/L PFBS), and FTLEE-FFTARC-MW1612 (32 ng/L PFBS) but concentrations were below the OSD risk screening level. Analytical results are presented on **Table 7-1**.

7.4.2 Soil

Soil samples were collected from 0.5 to 2.5 feet bgs at two boring locations at the FFTA - South of Range Control (**Figure 7-5**). One of the two soil borings was co-located with a groundwater sample. PFOS was detected in both soil samples FTLEE-FFTARC-1-SO (0.0012 J mg/kg) and FTLEE-FFTARC-2-SO (0.011 mg/kg) but concentrations were below the OSD risk screening level. PFOA and PFBS were not detected any soil sample. Analytical results are presented on **Table 7-2.**

7.5 FFTA – Air Strip

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with FFTA – Air Strip.

7.5.1 Groundwater

A grab groundwater sample was collected via DPT at first-encountered groundwater at the FFTA – Airstrip (**Figure 7-6**). PFOS, PFOA, and PFBS were not detected in any groundwater samples. Analytical data is presented in **Table 7-1**.

7.5.2 Soil

Soil samples were collected from 0.5 to 3 feet bgs at five boring locations at the FFTA - Airstrip (**Figure 7-6**). One of the soil borings was co-located with a groundwater sample. PFOS, PFOA, and PFBS were not detected in any of the soil samples. Analytical data is presented in **Table 7-2**.

7.6 Active and Former Firefighter Training Area (FTLE-7, FTLE-30, and FTLE-31)

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Active and Former Fire Training Areas (FTLE-7, FTLE-30, and FTLE-31). Groundwater and soil sampling was conducted on 09 April 2020 and additional groundwater and soil samples were collected on 02 April 2021 and 25 to 27 October 2021. Additional samples were collected in April 2021 and October 2021 due to an information gap related to the perceived groundwater flow direction and updates to programmatic guidance from the HQDA which stated that historical analytical results for PFOS, PFOA, and/or PFBS are not to be used to determine presence or absence of PFOS, PFOA and PFBS at AOPIs.

7.6.1 Groundwater

A grab groundwater sample was collected on 09 April 2020 via DPT at first-encountered groundwater at the installation boundary near the Active and Former FTAs (FTLE-7, FTLE-30, and FTLE-31) (**Figure 7-7**). PFOS and PFBS were detected at concentrations below OSD risk screening levels at FTLEE-FFTAFP-1-GW (4.8 ng/L and 6.2 ng/L, respectively). PFOA was not detected in the groundwater sample.

Additional grab groundwater samples were collected on 02 April 2021 and 25 October 2021 via DPT at first-encountered groundwater downgradient of the AOPI based on the perceived groundwater flow direction. PFOA was detected at a concentration above the OSD risk screening level in FTLEE-FFTAFP-GW-3 (91 ng/L), and at a concentration below OSD risk screening levels at FTLEE-FFTAFP-GW-2 (31 J- ng/L). PFOS was detected at concentrations below OSD risk screening levels at FTLEE-FFTAFP-GW-02 (30 J- ng/L) and FTLEE-FFTAFP-GW-3 (29 ng/L). PFBS was detected at a concentration below the OSD screening level at FTLEE-FFTAFP-GW-3 (14 ng/L). PFBS was not detected in FTLEE-FFTAFP-GW-2.

Groundwater samples were collected from three existing monitoring wells located at the Active and Former FTA (FTLE-7, FTLE-30, and FTLE-31). PFOS was detected above the OSD screening level at

concentrations that ranged from 580 ng/L (FTLEE-FFTAFP-MW-3) to 6400 J ng/L (FTLEE-FFTAFP-MW-6). PFOA was detected at above the OSD screening level at concentrations ranging from 1,900 J ng/L (FTLEE-FFTAFP-MW-03)to 8,500 J ng/L (FTLEE-FFTAFP-MW-4). PFBS was detected at concentrations above the OSD screening level at FTLEE-FFTAFP-MW-4 (950 J ng/L [950 J ng/L]) and FTLEE-FFTAFP-MW-6 (800 J ng/L) but below the OSD risk screening level at FTLEE-FFTAFP-MW-3 (260 ng/L). Analytical results are presented in **Table 7-1**.

7.6.2 Soil

Two soil sample boring locations were collocated with a groundwater sample at the installation boundary near the Active and Former FTAs (FTLE-7, FTLE-30, and FTLE-31) (**Figure 7-7**). A soil sample was collected during the 09 April 2020, 02 April 2021, and 25 October 2021 sampling mobilizations and were all collected from 0.5 to 2.5 feet bgs. PFOS, PFOA, and PFBS were not detected in all soil samples. Analytical data is presented in **Table 7-2**.

7.7 Fire Station 3

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with Fire Station 3.

7.7.1 Groundwater

A grab groundwater sample was collected via DPT at first-encountered groundwater at Fire Station 3 (**Figure 7-8**). PFOS and PFOA were detected at concentrations greater than the OSD risk screening levels at FTLEE-FS3-GW-01 (9,300 J- ng/L [10,000 J- ng/L] and 1,500 J- ng/L [1,500 J- ng/L], respectively) and FTLEE-FS3-GW-02 (260 ng/L and 67 ng/L, respectfully). PFBS was detected at concentrations below the OSD risk screening level at concentrations that ranged from 110 ng/L (FTLEE-FS3-GW-02) to 590 J+ ng/L ((FTLEE-FS3-GW-01). Analytical results are presented in **Table 7-1**.

7.7.2 Soil

Four soil samples were collected at Fire Station 3. Two soil sample boring locations were collocated with groundwater samples (FTLEE-FS3-01-SO and FTLEE-FS3-02-SO) and two separate soil sample boring locations (FTLEE-FS3-03-SO and FTLEE-FS3-04-SO) were collected at Fire Station 3 (**Figure 7-8**). PFOS was detected at concentrations below the OSD risk screening levels at FTLEE-FS3-01-SO (0.011 mg/kg) and FTLEE-FS3-02-SO (0.007 mg/kg), FTLEE-FS3-03-SO (0.00071 J mg/kg) and FTLEE-FS3-04-SO (0.0046 mg/kg [0.0049 mg/kg]). PFOA was detected but at concentrations below the OSD risk screening levels at FTLEE-FS3-01-SO (0.00051 J mg/kg) and FTLEE-FS3-02-SO (0.00054 J mg/kg). PFBS were not detected in any soil samples. Analytical data is presented in **Table 7-2**.

7.8 Former Fire Station

The subsections below summarize the soil and groundwater PFOS, PFOA, and PFBS analytical results associated with the Former Fire Station.

7.8.1 Groundwater

Grab groundwater samples were collected from three existing monitoring wells located at the Former Fire Station (**Figure 7-9**). PFOS was detected in FTLEE-MW-08 (18 ng/L) and FTLEE-MW-10 (3.5 J ng/L) but below the OSD risk screening level. PFOS was not detected in FTLEE-MW-21. PFOA was detected in FTLEE-MW-08 (22 ng/) and FTLEE-MW-10 (2.8 J ng/L) and FTLEE-MW-21 (6.7 J ng/L) but was below the OSD risk screening level. PFBS were detected in FTLEE-MW-08 (11 ng/L) but was at concentrations below OSD risk screening level. PFBS was not detected in FTLEE-MW-10 or FTLEE-MW-21. Analytical results are presented in **Table 7-1**.

7.8.2 Soil

Soil samples were not collected at the Former Fire Station because no evidence of a release of PFAS-containing materials was identified during the PA.

7.9 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, one soil sample per AOPI was analyzed for TOC, pH, moisture content, and grain size data as they may be useful in future fate and transport studies. The TOC in the soil samples ranged from 1,700 to 5,640 mg/kg. The TOC at this installation was lower than typically observed in organic soil (organic: greater than 120,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at Fort Lee ranged from 5.7 to 40.6% with an average of 22.8%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil 14.2 was typical for clay (0 to 20%). The pH of the soil was slightly acidic (average 5.6 standard units). Based on these geochemical and physical soil characteristics (i.e., high percentage of fines and TOC) observed underlying the installation during the SI, PFAS constituents are expected to be relatively less mobile at Fort Lee than in soils with lower percentages of fines and TOC.

7.10 Blank Samples

Detections of PFOS, PFOA, and PFBS constituents are summarized below for QA/QC samples. Most detected concentrations were low-level. PFOS, PFOA, and/or PFBS were not detected in any of the QA/QC samples collected during the SI work.

The full analytical results for blank samples collected during the SI are included in **Appendix M**.

7.11 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2020) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-10** through **7-13** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and thus shown on the same figure.

Based on the historical use, storage, and/or disposal of PFAS-containing materials at the AOPIs, affected media are likely to consist of soil, groundwater, surface water, and sediment.

Release and transport mechanisms include dissolution/desorption from soil to groundwater, transport via sediment carried in and dissolution to stormwater and surface water, discharge/recharge between groundwater and surface water, and adsorption/desorption between surface water and sediment. Generic categories of potential human receptors and their associated exposure scenarios that are typically evaluated in a CERCLA human health risk assessment were considered and include on-installation site workers (e.g., industrial/commercial workers, utility workers, or future construction workers who could be exposed to chemicals in soil at an AOPI or to chemicals in tap water in an industrial/commercial building), on-installation residents (e.g., adults and children who could be exposed to chemicals in tap water in a residence), and on-installation recreational users (e.g., hikers or hunters who could be exposed to chemicals in waterways at an installation). Off-installation receptor types could include drinking water receptors (i.e., commercial/industrial workers or residents) and recreational users.

Human exposure pathways are shown as “complete, “potentially complete”, or “incomplete” on the CSM figures. A complete exposure pathway consists of a constituent source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium could occur, and an exposure route at the exposure point. If any of these elements is missing, the exposure pathway is incomplete. Pathways are “potentially complete” where data are insufficient to conclude the pathway is either “complete” or “incomplete”. Additionally, the CSMs do not include ecological receptors and exposure pathways. The potential for ecological exposures to PFOS, PFOA, and PFBS may be evaluated at a future date if those pathways warrant further consideration.

Following the SI sampling, 7 of the 8 AOPIs were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**).

CSMs were developed for each individual AOPI and were combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent. The following exposure pathway determinations apply to all CSMs:

- AOPIs are not residential or recreational sites and are wholly located within the installation boundaries. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete for all AOPIs.
- Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Surface water bodies on-post are not used for drinking water. On-installation site workers and residents are not likely to otherwise contact surface water and sediment in the on-post surface water bodies; therefore, these exposure pathways are incomplete.

Additional exposure pathway descriptions for each CSM are listed below by figure.

Figure 7-10 shows the CSM for Fire Station 1, FFTA – South of Range Control, FFTA – Helicopter Pad Site, and Fire Station 3. AFFF was historically released to an unlined fire training pit at the FFTA – South of Range Control, and the FFTA – Helicopter Pad Site served as a fire training area. AFFF was

historically released to the parking lot adjacent to Fire Station 1 which was used as a fire training area and nozzle testing site. Fire Station 3 houses a fire engine that holds AFFF.

- PFOS was detected in soil at FFTA – South of Range Control and PFOS and PFOA were detected in soil at the FFTA – Helicopter Pad Site, Fire Station 1, and Fire Station 3. Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOS, PFOA, and PFBS were detected in groundwater at all four AOPIs. There are no on-post drinking water wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.
- PFOS, PFOA, and PFBS were detected in groundwater and groundwater originating at these AOPIs flows off-post through the installation's eastern or southeastern boundaries. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Groundwater associated with FFTA – South of Range Control and FFTA – Helicopter Pad Site may discharge to Cabin Creek and groundwater associated with Fire Station 1 and Fire Station 3 may discharge to Baily Creek. Recreational users could contact constituents in Cabin Creek or Bailey Creek through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete.
- Recreational users off-post could contact constituents in Cabin Creek or Bailey Creek through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-11 shows the CSM for Fire Station 2. AFFF was historically released to the parking lot behind (south) of Fire Station 2. Fire Station 2 is the current foam storage facility.

- PFOS and PFOA were detected in soil at Fire Station 2 and site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.
- PFOS, PFOA, and PFBS were detected in groundwater at Fire Station 2. There are no on-post drinking water wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater.
- PFOS, PFOA and PFBS were detected in groundwater and groundwater originating at this AOPI flows off-post through the installation's eastern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- PFOS, PFOA, and PFBS were detected in a surface water sample downgradient/downstream from this AOPI. Recreational users could contact constituents in Bailey Creek through incidental ingestion and dermal contact. Therefore, the surface water exposure pathway is complete for on-installation

recreational receptors and the sediment exposure pathway is potentially complete for on-installation recreational receptors.

- Recreational users off-post could contact constituents in Bailey Creek through incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-12 shows the CSM for FFTA – Airstrip. This area was historically used as a fire training area, but only training foam was reported to have been used if foam was used at all.

- PFOS, PFOA and PFBS were not detected in soil at the FFTA - Airstrip, therefore the soil exposure pathways for all receptors are incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater or soil that could leach to groundwater. Therefore, groundwater exposure pathways (via drinking water ingestion and dermal contact) for on and off-installation receptors are incomplete.
- PFOS, PFOA, and PFBS were not detected in groundwater or soil that could leach to groundwater and discharge to surface water. Therefore, the surface water and sediment exposure pathways (via incidental ingestion and dermal contact) for on-installation and off-installation recreational users are incomplete.

Figure 7-13 shows the CSM for Active and Former Fire Training Areas (FTLE-7, FTLE-30, and FTLE-31) and Former Fire Station. The current fire training area, situated on a portion of the Former Fire Training Area, consists of three propane-fed and concrete-lined pits used for fire training purposes. The former fire training areas were open burn pits where AFFF was reportedly used. The Former Fire Station which was used to store fire-fighting chemicals between the 1940s to the 1970s.

- Soil was sampled at one location downgradient of the Active and Former FTAs (FTLE-7, FTLE-30, and FTLE-31 and PFOS, PFOA, and PFBS were not detected. Soil was not sampled at the Former Fire Station. Site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is potentially complete.
- PFOS, PFOA, and PFBS was detected in groundwater sampled at one location downgradient of the Active and Former FTAs (FTLE-7, FTLE-30, and FTLE-31). In 2014, PFOS and PFOA were detected in four of five groundwater samples collected within the boundaries of the AOPI (presented in **Table 2-1** and **Figures 2-5** and **5-8**). PFOS, PFOA, and PFBS were detected in groundwater at the Former Fire Station. There are no on-post drinking water wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post.
- The groundwater originating at Former FTAs (FTLE-7, FTLE-30, and FTLE-31) flows off-post through the installation's southern boundary and groundwater originating at the Former Fire Station flows off-post through the installation's northeastern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.

- Groundwater associated with Former FTAs (FTLE-7, FTLE-30, and FTLE-31) may discharge to Blackwater Swamp and groundwater associated with the Former Fire Station may discharge to Bailey Creek. Recreational users could contact constituents in Blackwater Swamp or Bailey Creek through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete.
- Recreational users off-post could contact constituents in Blackwater Swamp or Bailey Creek through incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Following the SI sampling, 7 of the 8 AOPIs were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**).

8 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at Fort Lee based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release of PFOS, PFOA, and PFBS to the environment occurred.

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, and PFBS in soil (**Appendix A**). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify specific areas of suspected PFOS, PFOA, and PFBS use, storage, and/or disposal at Fort Lee. Following the evaluation, 8 AOPIs were identified.

All AOPIs were sampled during the SI at Fort Lee to identify presence or absence of PFOS, PFOA, and PFBS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the Fort Lee QAPP Addendum (Arcadis 2020).

Seven AOPIs (Fire Station 1, Fire Station 2, FFTA – Helicopter Pad, Former FFTA – South of Range Control, Active and Former Fire Training Area (FTLE-7, FTLE-30, FTLE-31) Fire Station 3, and Former Fire Station) had detections of PFOS, PFOA, and PFBS in groundwater, soil and/or surface water and 5 AOPIs (Fire Station 1, Fire Station 2, Former FFTA – South of Range Control, Active and Former Fire Training Area (FTLE-7, FTLE-30, FTLE-31), and Fire Station 3) exceeded OSD risk screening levels. Groundwater was sampled at all 8 AOPIs, soil was sampled at 7 AOPIs, and surface water was sampled at 1 AOPI. PFOS, PFOA and PFBS was detected in groundwater at 7 of the 8 AOPIs. PFOS, PFOA and/or PFBS was detected in groundwater at concentrations that exceed the OSD risk screening levels in 5 of 8 AOPIs. PFOS, PFOA, and PFBS was detected in soil in 5 of the 8 AOPIs, and PFOS, PFOA, and/or PFBS was detected at concentrations that exceed OSD risk screening levels in 1 AOPI. PFOS, PFOA, and PFBS was sampled in surface water at 1 AOPI and detected in 1 AOPI, however detections did not exceed OSD risk screening levels. The maximum PFOS, PFOA, and PFBS concentrations observed in groundwater and soil are summarized for each AOPI below:

- Fire Station 1: PFOS and PFOA were detected in groundwater above OSD risk screening levels in groundwater (730 ng/L and 1,100 ng/L, respectively). PFBS was detected (430 ng/L) but it was below the OSD risk screening level. PFOS was detected in soil (0.14 mg/kg) above the OSD risk screening level. PFOA was detected in soil (0.0077 mg/kg) but did not exceed OSD risk screening levels. PFBS was not detected in soil.
- Fire Station 2: PFOS was detected in groundwater (26 ng/L) however it did not exceed OSD risk screening levels. PFOA was detected in groundwater (150 ng/L) above OSD risk screening levels. PFBS was detected in groundwater (5.6 ng/L) but did not exceed OSD risk screening levels. PFOS and PFOA were detected in soil (0.00092 mg/kg and 00.19 mg/kg, respectively) but did not exceed the OSD risk screening levels. PFBS was not detected in soil. PFOS, PFOA, and PFBS were detected in surface water (8.4 ng/L, 4.2 ng/L, and 4.2 ng/L, respectively) but did not exceed the OSD risk screening levels.

- FFTA – Helicopter Pad Site: PFOS, PFOA and PFBS were detected in groundwater (2.6 ng/L, 27 ng/L, 5.1 ng/L, respectively) however concentrations were below the OSD risk screening levels. PFOS and PFOA were detected in soil (0.00055 ng/L and 0.019 ng/L, respectively) but did not exceed OSD risk screening levels. PFBS was not detected in soil.
- FFTA – South of Range Control: PFOS was detected in groundwater (590 ng/L) above the OSD risk screening level. PFBS and PFOA were detected in groundwater (38 ng/L and 32 ng/L, respectively) however concentrations were below OSD risk screening levels. PFOS was detected in soil (0.011 mg/kg) but did not exceed the OSD risk screening level. PFOA and PFBS were not detected in soil.
- FFTA - Airstrip: PFOA, PFOS and PFBS were not detected groundwater or soil.
- Active and Former Fire Training Area (FTLE-7, FTLE-30, and FTLE-31): PFOS, PFOA, and PFBS was detected in groundwater in samples collected during October 2021 (6400 ng/L, 8300 ng/L, and 800 ng/L respectively). PFOS, PFOA, and PFBS in groundwater exceeds OSD risk screening levels. PFOS, PFOA, and PFBS were not detected in soil.
- Fire Station 3: PFOS, PFOA, and PFBS were detected in groundwater (10,000 ng/L, 1,500 ng/L, and 590 ng/L, respectively). PFOS and PFOA in groundwater exceeds OSD risk screening levels. PFOS and PFOA was detected in soil (0.11 mg/kg and 0.00054 mg/kg, respectively) however concentrations did not exceed OSD risk screening levels. PFBS was not detected in soil.
- Former Fire Station: PFOS, PFOA, and PFBS was detected in groundwater (18 ng/L, 22 ng/L, and 11 ng/L, respectively) but concentrations did not exceed OSD risk screening levels.

Following the SI sampling, 7 out of 8 AOPIs with confirmed PFOS, PFOA, and PFBS presence were considered to have complete or potentially complete exposure pathways. The soil exposure pathway for on-installation site workers was complete at 5 AOPIs and potentially complete at 2 AOPIs. The on-post groundwater exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers and residents was potentially complete at 7 AOPIs. Due to a lack of land use controls off-installation, the groundwater exposure pathway for off-installation drinking water receptors was also potentially complete 7 AOPIs. The surface water exposure pathway (via incidental ingestion and dermal contact) for on-installation recreational users was complete at 1 AOPI and potentially complete at 6 AOPIs. The sediment exposure pathway (via incidental and dermal contact) for on-installation recreational users was potentially complete at 7 AOPIs. The surface water and sediment exposure pathways (via incidental ingestion and dermal contact) for off-installation recreational users was potentially complete at 7 AOPIs.

Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**). **Table 8-1** below summarizes the AOPIs identified at Fort Lee, PFOS, PFOA, and PFBS sampling and recommendations for each AOPI; further investigation is warranted at Fort Lee. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 8-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at Fort Lee, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?			Recommendation
	GW	SO	SW	
Fire Station 1	Yes	Yes	NS	Future study in a remedial investigation
Fire Station 2	Yes	No	No	Future study in a remedial investigation
FFTA: Helicopter Pad Site	No	No	NS	No action at this time
FFTA: South of Range Control	Yes	No	NS	Future study in a remedial investigation
FFTA: Air Strip	ND	ND	NS	No action at this time
Active and Former FTAs: FTLE-7, FTLE-30, and FTLE-31	Yes	ND	NS	Future study in a remedial investigation
Fire Station 3	Yes	No	NS	Future study in a remedial investigation
Former Fire Station	No	NS	NS	No action at this time

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
ND – non-detect
NS – not sampled
SO – soil
SW – surface water

Data collected during course of the PA (**Sections 3** through **5**) and SI (**Sections 6** through **8**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at Fort Lee are discussed below.

Records gathered for the use, storage and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use; procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-containing material) use.

A comprehensive well survey was not completed as part of this PA; therefore, the information reviewed regarding off-post wells is limited to what is contained in the off post well search results (**Appendix E**).

The searches for ecological receptors and off-post PFOS, PFOA, and PFBS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research, installation personnel interviews, and site reconnaissance.

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to analytical data collected prior and as part of this SI. Available data, including PFOS, PFOA, and PFBS, is listed in **Appendix M**, which were analyzed per the selected analytical method.

Results from this PA/SI report indicate further study in a remedial investigation is warranted at Fort Lee in accordance with the guidance provided by the OSD.

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10 ACRONYMS

%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DPT	direct-push technology
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FTA	fire training area
GW	groundwater
HDPE	high-density polyethylene
HQAES	Headquarters Army Environmental System
IDW	investigation-derived waste
IMCOM	Installation Army Environmental System
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
LOD	limit of detection
LOQ	limit of quantitation
Mil-Spec	military specification
mg/kg	milligrams per kilogram (parts per million)
ND	non-detect

ng/L	nanograms per liter (parts per trillion)
NS	not sampled
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SI	site inspection
SO	soil
SOP	standard operating procedure
SW	surface water
SSHP	Site Safety and Health Plan
TGI	technical guidance instruction
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
VAWC	Virginia American Water Company
Y	yes

TABLES

Table 2-1 - Historical PFAS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Lee, Virginia

Location		Active and Former Fire Training Area (FTLE-7, FTLE-30, and FTLE-31)					
Sample ID		MW-01	MW-02	MW-03	MW-04	MW-400[1]	MW-06
Sample Date		7/30/2014	7/30/2014	7/30/2014	7/30/2014	7/30/2014	7/30/2014
Units	OSD Risk Screening Level*	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctane sulfonate (PFOS)	40	ND	38.2	456	1,560	1,820	8,330
Perfluorooctanoic acid (PFOA)	40	ND	18.7	2,250	3,420	3,460	6,840
Perfluorobutanesulfonic acid (PFBS)	600	NA	NA	NA	NA	NA	NA

Notes and Acronyms:
Groundwater samples analyzed by Method 537 Modified.
* risk screening level for tap water. To be conservative, the OSD tap water risk screening levels will be used to compare all groundwater and potable-use surface water for this Army PFAS PA/SI program.

[1] MW-400 is duplicate sample to MW-04
NA - not analysed
ND - not detected
ng/L - nanograms per liter
OSD - Office of the Secretary of Defense

Table 6-1 - Site Inspection Sampling Location Details
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Lee, Virginia

AOPI	Matrix	Sample ID	Depth Interval	Sample Method	Analytes
Former Fire Training Area - Air Strip	Groundwater	FTLEE-FFTAAF-1-GW-040720	11-15 ft bgs	Low Flow	PFAS
Active and Former Fire Training Areas (FTLE-7, FTLE 30, and FTLE-31)	Soil	FTLEE-FFTAFP-1-SO-040920	0.5-2.5 ft bgs	HA	PFAS, TOC, pH, grain size
	Soil	FTLEE-FFTAFP-1-SO-040920	0.5-2.5 ft bgs	HA	PFAS
		FTLEE-FFTAFP-SO-02-040121	0-2 ft bgs	HA	PFAS
		FTLEE-FFTAFP-SO-03-102521	0.5-2.5 ft bgs	HA	PFAS
	Groundwater	FTLEE-FFTAFP-1-GW-040920	8-12 ft bgs	Low Flow	PFAS
		FTLEE-FFTAFP-GW-02-040221	1-5 ft bgs	Low Flow	PFAS
		FTLEE-FFTAFP-GW-03-102521	10-14 ft bgs	Low Flow	PFAS
		FTLEE-FFTAFP-MW-03-102621	25 ft bgs	Low Flow	PFAS
		FTLE-FD-1-102621 / FTLEE-FFTAFP-MW-04-102621	21 ft bgs	Low Flow	PFAS
		FTLEE-FFTAFP-MW-06-102721	25 ft bgs	Low Flow	PFAS
Former Fire Training Area – Helicopter Pad Site	Groundwater	FTLEE-DUP-1-040820_GW / FTLEE-FFTAPRO-1-GW-040820	20-24 ft bgs	Low Flow	PFAS
		FTLEE-FFTAPRO-3-GW-040820	20-24 ft bgs	Low Flow	PFAS
		FTLEE-FFTAPRO-2-GW-040820	20-28 ft bgs	Low Flow	PFAS
		FTLEE-FFTAPRO-1-GW-040820	20-24 ft bgs	Low Flow	PFAS
Former Fire Training Area – South of Range Control	Soil	FTLEE-FFTARC-2-SO-040720	0-2.2 ft bgs	HA	PFAS
		FTLEE-FFTARC-1-SO-040720	0-5 ft bgs	HA	PFAS, TOC, pH, grain size
	Groundwater	FTLEE-FFTARC-1-GW-040720	0-5 ft bgs	Low Flow	PFAS
		FTLEE-FFTARC-MW3-040720	13 ft bgs	Low Flow	PFAS
		FTLEE-FFTARC-MW1612-040720	7-10 ft bgs	Low Flow	PFAS
Fire Station 1	Soil	FTLEE-FS1-2-SO-040920	1.4-3.4 ft bgs	HA	PFAS
		FTLEE-FS1-1-SO-040920	1-3 ft bgs	HA	PFAS, TOC, pH, grain size
	Groundwater	FTLEE-FS1-1-GW-040920	16-20 ft bgs	Low Flow	PFAS
Fire Station 2	Soil	FTLEE-FS2-2-SO-040820	0.5-2.5 ft bgs	HA	PFAS
		FTLEE-FS2-1-SO-040820	2-4 ft bgs	HA	PFAS, TOC, pH, grain size
	Groundwater	FTLEE-FS2-1-GW-040820	15-19 ft bgs	Low Flow	PFAS
	Surface Water	FTLEE-DUP-2-040820 / FTLEE-FS2-1-SW-040820	N/A	Grab	PFAS
		FTLEE-FS2-1-SW-040820	N/A	Grab	PFAS
Fire Station 3	Soil	FTLEE-FS3-SO-01-040121	0.5-2.5 ft bgs	HA	PFAS, TOC, pH, grain size
		FTLEE-FS3-SO-02-040121	1-3 ft bgs	HA	PFAS
		FTLEE-FS3-SO-03-040121	0-2 ft bgs	HA	PFAS
		FTLEE-FS3-SO-04-040121	0-2 ft bgs	HA	PFAS
		FTLEE-FD-01-040121 / FTLEE-FS3-SO-04-040121	0-2 ft bgs	HA	PFAS
	Groundwater	FTLEE-FS3-GW-01-040221	21 ft bgs	Low Flow	PFAS
		FTLEE-FS3-GW-02-040221	20 ft bgs	Low Flow	PFAS
		FTLEE-FD-01-040221 / FTLEE-FS3-GW-02-040221	20 ft bgs	Low Flow	PFAS
Former Fire Station	Groundwater	FTLEE-MW-08-041621	14 ft bgs	Low Flow	PFAS
		FTLEE-MW-10-041621	12 ft bgs	Low Flow	PFAS
		FTLEE-MW-21-041621	30 ft bgs	Low Flow	PFAS

AOPI = Area of Potential Interest
HA = hand auger
ft bgs = feet below ground surface
GW = groundwater
ID = identification
N/A = not available or not applicable
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil
TOC = total organic carbon
SW = surface water

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Lee, Virginia

Associated AOPI	Location Type	Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater Risk Screening Level	40		40		600	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
Fire Station 1	Monitoring Well	FS1	FTLEE-FS1-1-GW-040920	04/09/2020	N	**730**	J-	**1,100**	J	**430**	J-
Fire Station 2	Monitoring Well	FS2	FTLEE-FS2-1-GW-040820	04/08/2020	N	**26**	J-	**150**	J-	**5.6**	J-
Former Fire Training Area - Helicopter Pad	Monitoring Well	FFTA-PRO	FTLEE-FFTAPRO-1-GW-040820	04/08/2020	N	3.6	U	3.6	U	3.6	U
			FTLEE-DUP-1-040820_GW / FTLEE-FFTAPRO-1-GW-040820	04/08/2020	FD	3.5	U	3.5	U	3.5	U
			FTLEE-FFTAPRO-2-GW-040820	04/08/2020	N	**2.6**	J	**27**		**5.1**	
			FTLEE-FFTAPRO-3-GW-040820	04/08/2020	N	3.7	U	3.7	U	**4.0**	
Former Fire Training Area - South of Range Control	Monitoring Well	FFTA-RC	FTLEE-FFTARC-1-GW-040720	04/07/2020	N	**130**	J-	**38**	J-	**17**	J-
			FTLEE-FFTARC-MW3-040720	04/07/2020	N	**450**		**23**		**21**	
			FTLEE-FFTARC-MW1612-040720	04/07/2020	N	**590**		**34**		**32**	
Former Fire Training Area - Air Strip	Monitoring Well	FFTA-AF	FTLEE-FFTAAF-1-GW-040720	04/07/2020	N	3.6	U	3.6	U	3.6	U
Active and Former Fire Training Area (FTLE-7 FTLE-30 FTLE-31)	Monitoring Well	FFTA-FP	FTLEE-FFTAFP-1-GW-040920	04/09/2020	N	**4.8**		3.5	U	**6.2**	
			FTLEE-FFTAFP-GW-02-040221	04/02/2021	N	**30**	J-	**31**	J-	5.2	UJ-
			FTLEE-FFTAFP-GW-03-102521	10/25/2021	N	**29**		**91**		14	
			FTLEE-FFTAFP-MW-03-102621	10/26/2021	N	**580**		**1900**	J	**260**	
			FTLEE-FD-1-102621 / FTLEE-FFTAFP-MW-04_102621	10/26/2021	FD	**5300**	J	**7800**	J	**970**	J
			FTLEE-FFTAFP-MW-04-102621	10/26/2021	N	**5300**	J	**8500**	J	**950**	J
			FTLEE-FFTAFP-MW-06-102721	10/27/2021	N	**6400**	J	**8300**	J	**800**	J
Fire Station 3	Monitoring Well	FS3	FTLEE-FS3-GW-01-040221	04/02/2021	N	**9,300**	J-	**1,500**	J-	**590**	J+
			FTLEE-FS3-GW-02-040221	04/02/2021	N	**260**		**67**		**110**	
			FTLEE-FD-01-040221 / FTLEE-FS3-GW-01-040221	04/02/2021	FD	**10,000**	J-	**1,500**	J-	**380**	J-
Former Fire Station	Monitoring Well	FFS	FTLEE-MW-08-041621	04/16/2021	N	**18**		**22**		**11**	
			FTLEE-MW-10-041621	04/16/2021	N	**3.5**	J	**2.8**	J	3.6	U
			FTLEE-MW-21-041621	04/16/2021	N	4.0	U	**6.7**	J	4.0	U

Notes:

1. Bolded values indicate the result was detected greater than the limit of detection
2. Grey shaded values indicate the result was detected greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.).

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

Qualifier	Description
DJ	The analyte was analyzed at dilution and the result is an estimated quantity
DJ-	Result reported from a secondary dilution. The extracted internal standard recovery was greater than 400%; result may be biased low.
J	The analyte was positively identified; however the associated numerical value is an estimated concentration only
J+	The result is an estimated quantity; the result may be biased high.
J-	The result is an estimated quantity; the result may be biased low.
U	The analyte was analyzed for but the result was not detected above thelimit of quantitation (LOQ).
UJ-	The analyte was analyzed for but was not detected. The reported limit of quantitation (LOQ) is approximate and may be inaccurate or imprecise

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Lee, Virginia

Associated AOPI	Location Type	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
					OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
					OSD Residential Risk Screening Level	0.13		0.13		1.9	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
Fire Station 1	Soil	FS1	FTLEE-FS1-1-SO-040920	04/09/2020	N	**0.14**		**0.0077**		0.0010	U
			FTLEE-FS1-2-SO-040920	04/09/2020	N	**0.055**		0.0013	U	0.0013	U
Fire Station 2	Soil	FS2	FTLEE-FS2-1-SO-040820	04/08/2020	N	**0.00092**	J	0.0013	U	0.0013	U
			FTLEE-FS2-2-SO-040820	04/08/2020	N	0.0011	U	**0.0019**		0.0011	U
Former Fire Training Area - Helicopter Pad	Soil	FFTA-PRO	FTLEE-DUP-1-040820 / FTLEE-FFTAPRO-1-SO-040820	04/08/2020	FD	0.0012	U	0.0012	U	0.0012	U
			FTLEE-FFTAPRO-1-SO-040820	04/08/2020	N	0.0012	U	0.0012	U	0.0012	U
			FTLEE-FFTAPRO-2-SO-040820	04/08/2020	N	**0.00055**	J	**0.019**		0.0011	U
			FTLEE-FFTAPRO-3-SO-040720	04/07/2020	N	0.0013	U	0.0013	U	0.0013	U
Former Fire Training Area - South Range Control	Soil	FFTA-RC	FTLEE-FFTARC-1-SO-040720	04/07/2020	N	**0.0012**	J	0.0014	U	0.0014	U
			FTLEE-FFTARC-2-SO-040720	04/07/2020	N	**0.011**		0.0010	U	0.0010	U
Former Fire Training Area - Air Strip	Soil	FFTA-AF	FTLEE-FFTAAF-1-SO-040720	04/07/2020	N	0.0010	U	0.0010	U	0.0010	U
			FTLEE-FFTAAF-2-SO-040720	04/07/2020	N	0.0011	U	0.0011	U	0.0011	U
			FTLEE-FFTAAF-3-SO-040720	04/07/2020	N	0.0011	U	0.0011	U	0.0011	U
			FTLEE-FFTAAF-4-SO-040720	04/07/2020	N	0.0013	U	0.0013	U	0.0013	U
			FTLEE-FFTAAF-5-SO-040720	04/07/2020	N	0.0012	U	0.0012	U	0.0012	U
Active and Former Fire Train Area(FTLE-7 FTLE-30 FTLE-31)	Soil	FFTA-FP	FTLEE-FFTAFP-1-SO-040920	04/09/2020	N	0.0012	U	0.0012	U	0.0012	U
			FTLEE-FFTAPP-SO-02-040121	04/01/2021	N	0.00093	U	0.00093	U	0.00093	U
			FTLEE-FFTAPP-SO-03-102521	10/25/2021	N	0.0012	U	0.0012	U	0.0012	U
Fire Station 3	Soil	FS3	FTLEE-FS3-SO-01-040121	04/01/2021	N	**0.011**		**0.00051**	J	0.00097	U
			FTLEE-FS3-SO-02-040121	04/01/2021	N	**0.0070**		**0.00054**	J	0.0010	U
			FTLEE-FS3-SO-03-040121	04/01/2021	N	**0.00071**	J	0.00098	U	0.00098	U
			FTLEE-FD-01-040121 / FTLEE-FS3-SO-04-040121	04/01/2021	FD	**0.0049**		0.0011	U	0.0011	U
			FTLEE-FS3-SO-04-040121	04/01/2021	N	**0.0046**		0.00099	U	0.00099	U

Notes:

1. Bolded values indicate the result was detected greater than the limit of detection
2. Data are compared to the 2019 Office of the Secretary of Defense (OSD) risk screening levels for the residential and commerical/industrial scenario (OSD. 2019), (Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.).
3. Grey shaded values indicate the result was detected greater than or equal to the OSD risk screening level for the residential scenario. Italicized values indicate the result was detected greater than the OSD risk screening level for the industrial/commercial and residential scenario.
4. Soil samples were not collected from the Former Fire Station AOPI.

Acronyms/Abbreviations:
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

Qualifier	Description
J	The analyte was positively identified; however the associated numerical value is an estimated concentration only
U	The analyte was analyzed for but the result was not detected above thelimit of quantitation (LOQ).

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Lee, Virginia

AOPI	Location Type	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater RiskScreening Level	40		40		600	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
Fire Station 2	Surface Water/Seep	FS2	FTLEE-FS2-1-SW-040820	04/08/2020	N	**8.4**		**4.2**		**4.2**	
	Surface Water/Seep	FS2	FTLEE-DUP-2-040820 / FTLEE-FS2-1-SW-040820	04/08/2020	FD	**8.6**		**4.5**		**4.4**	

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Grey shaded values indicate the result was detected greater than the 2019 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.).

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

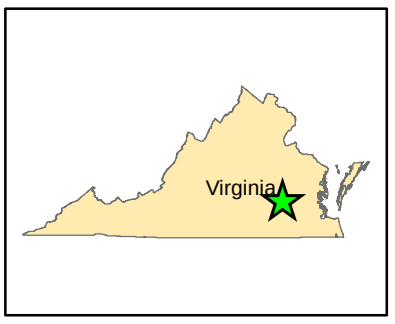
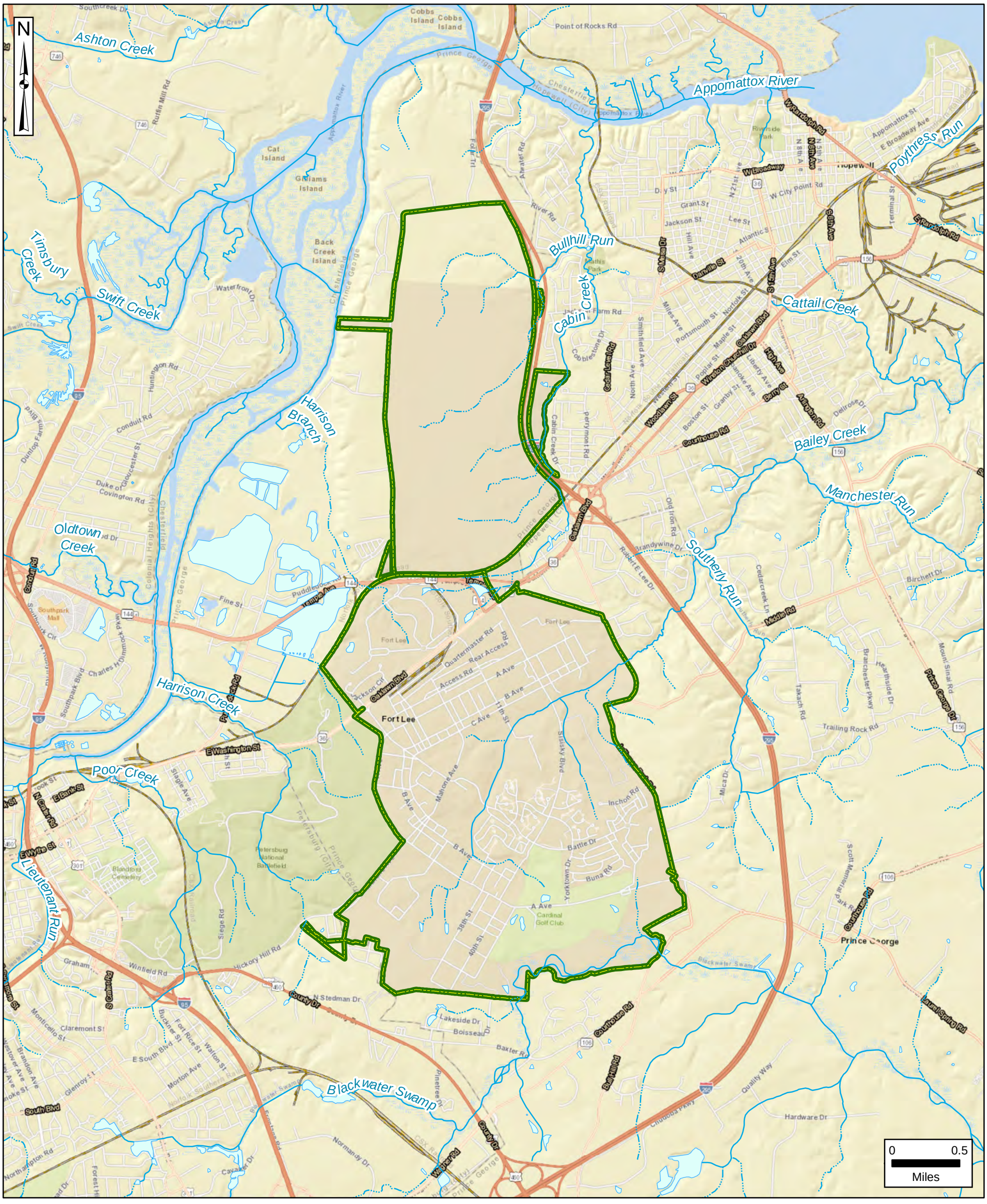


Figure 2-1
Site Location



Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Water Body

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 2-2
Site Layout

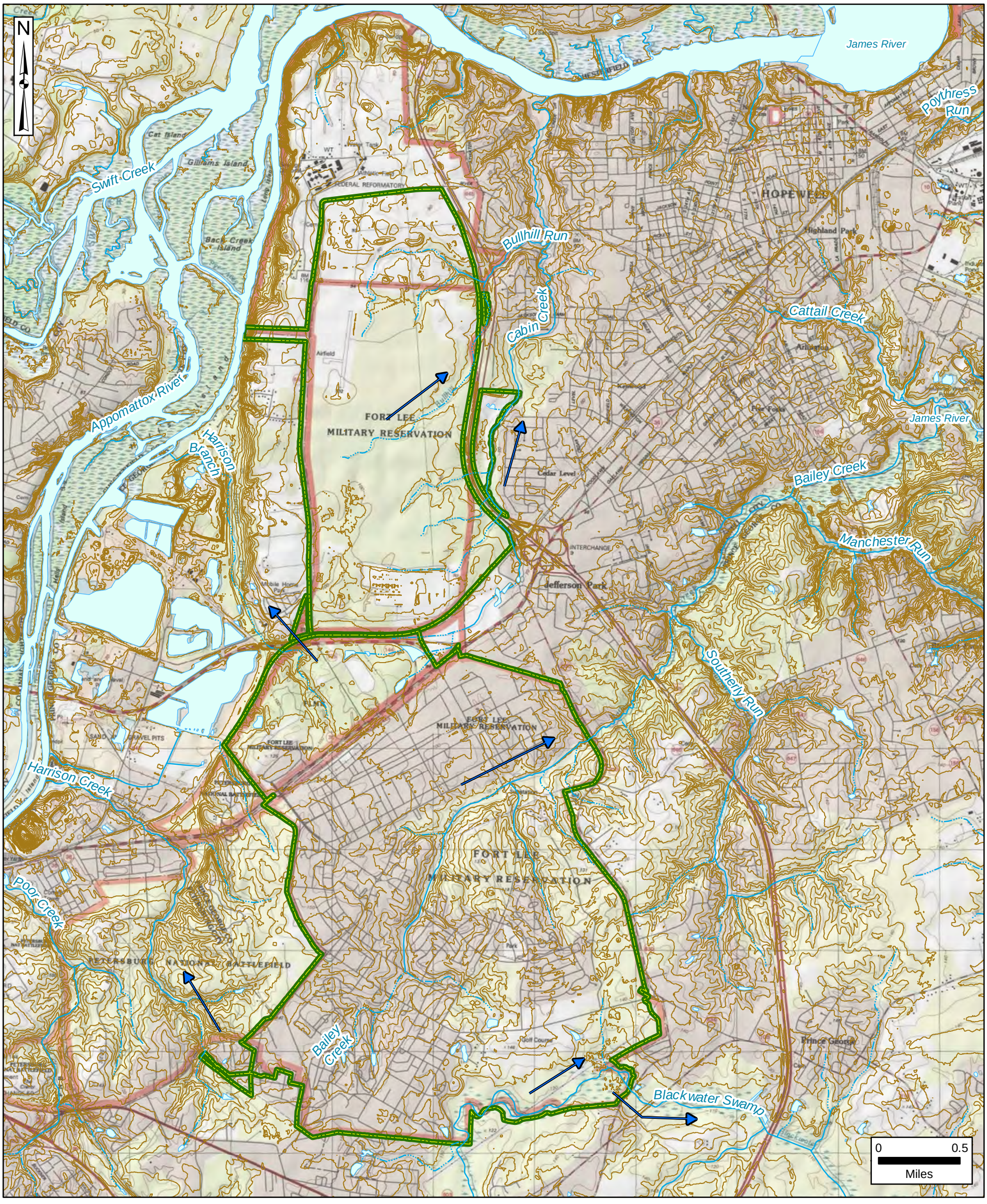
- Installation Boundary
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Drinking Water Intake

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
EDR, Well Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 2-3
Topographic Map



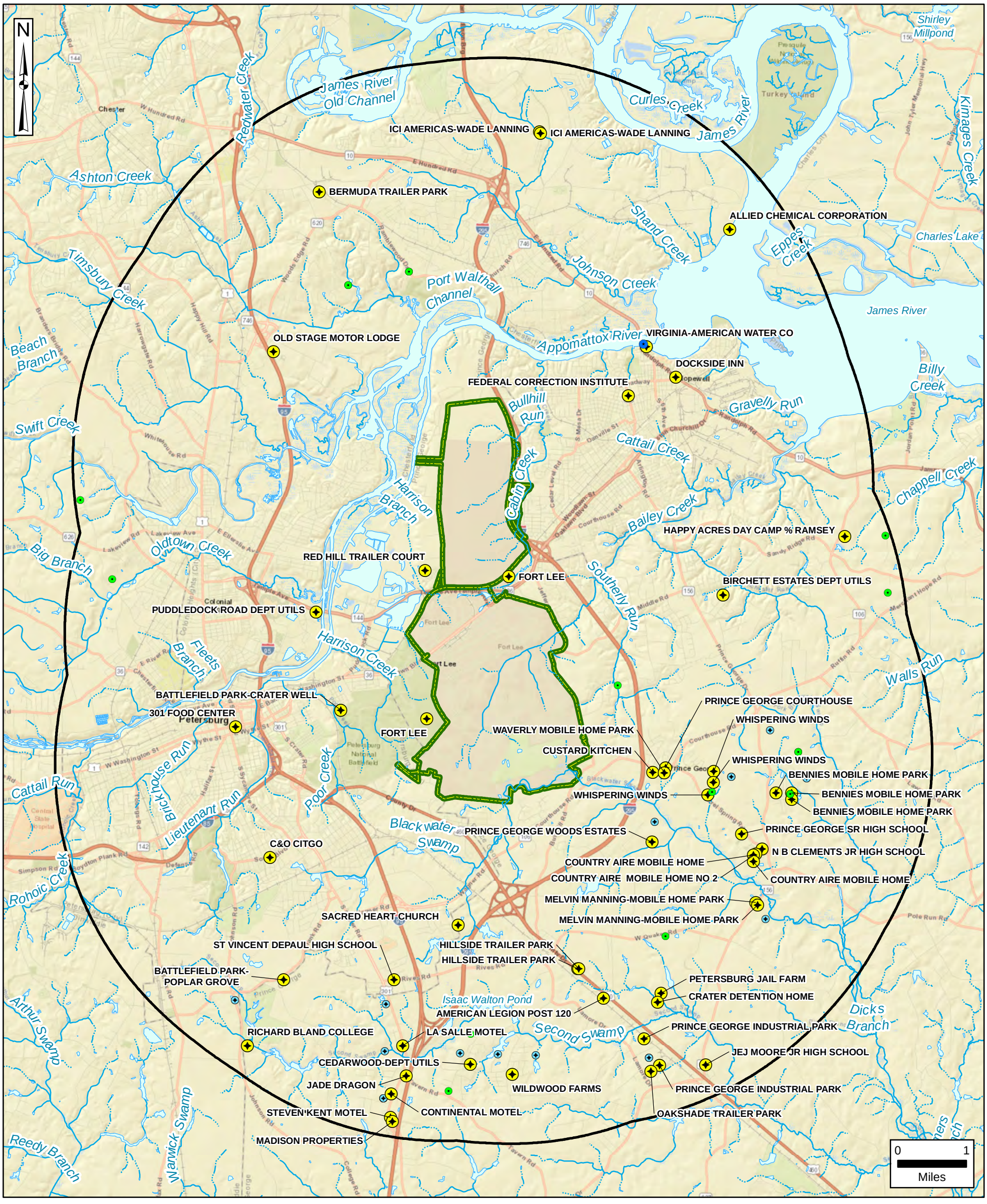
Installation Boundary
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Elevation Contour (feet)
Surface Water Flow Direction

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, USA Topo Maps

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 2-4
Off-Post Potable Wells



Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
EDR, Well Data, 2018
VDEQ, Domestic Wells, 2020
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

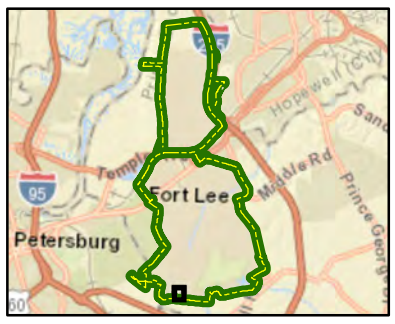


Figure 2-5
Historical PFOS, PFOA, and PFBS Analytical Results

MW-01	
Date	7/30/2014
PFOS	ND
PFOA	ND
PFBS	NA

MW-02	
Date	07/30/2014
PFOS	**38.2**
PFOA	**18.7**
PFBS	NA

MW-06	
Date	07/30/2014
PFOS	**8,330**
PFOA	**6,840**
PFBS	NA

MW-03	
Date	07/30/2014
PFOS	**456**
PFOA	**2,250**
PFBS	NA

MW5

MW-04	
Date	07/30/2014
PFOS	**1,560 [1,820]**
PFOA	**3,420 [3,460]**
PFBS	NA [NA]

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion.
2. Samples were collected by Method 537 Modified.
3. Sample results are from Technical Report for Fire Training Pit (ECC, 2014).
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L are highlighted gray.

Qualifiers:
J = Estimated result

0 100
Feet

Installation Boundary
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
Monitoring Well
Monitoring Well Destroyed

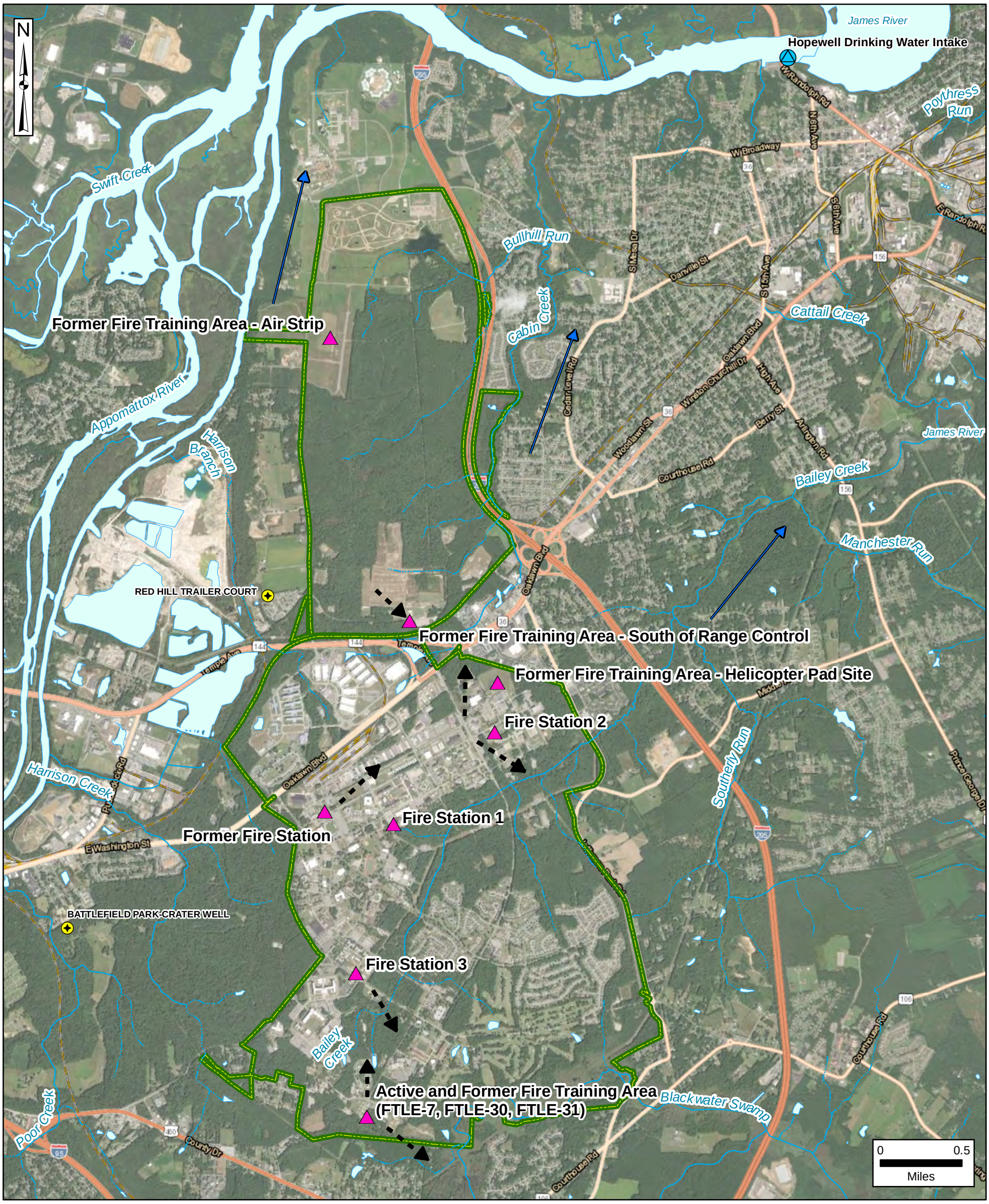
NA = not analyzed
ND = not detected
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-2
AOPI Locations



- Installation Boundary
- AOPI Location
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Inferred Groundwater Flow Direction
- Surface Water Flow Direction
- Drinking Water Intake
- Public Water Supply System Well

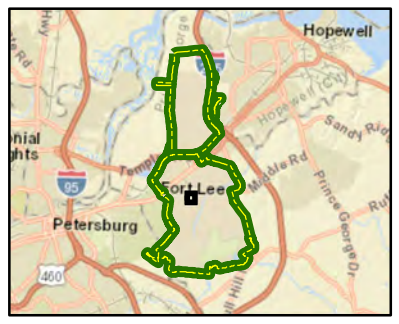
AOPI = area of potential interest
OSD = Office of the Secretary of Defense

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
EDR, Well Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-3
Aerial Photo of
Fire Station 1



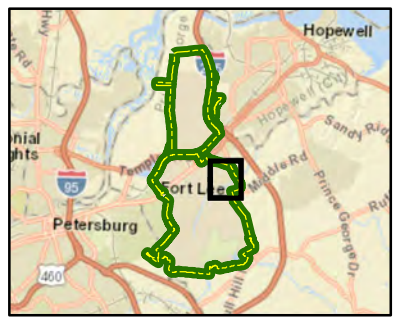
Installation Boundary
Area of Potential Interest (AOPI)
Stream (Intermittent)
Surface Water Flow Direction
Surface Runoff Flow Direction
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-4
Aerial Photo of
Fire Station 2



Installation Boundary
Area of Potential Interest (AOPI)
Surface Water Flow Direction
Surface Runoff Flow Direction
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

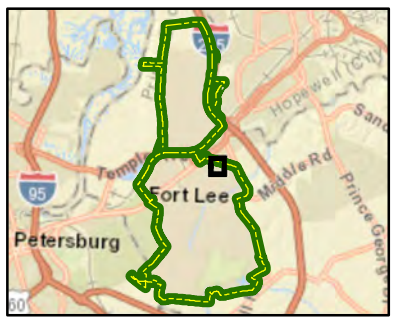
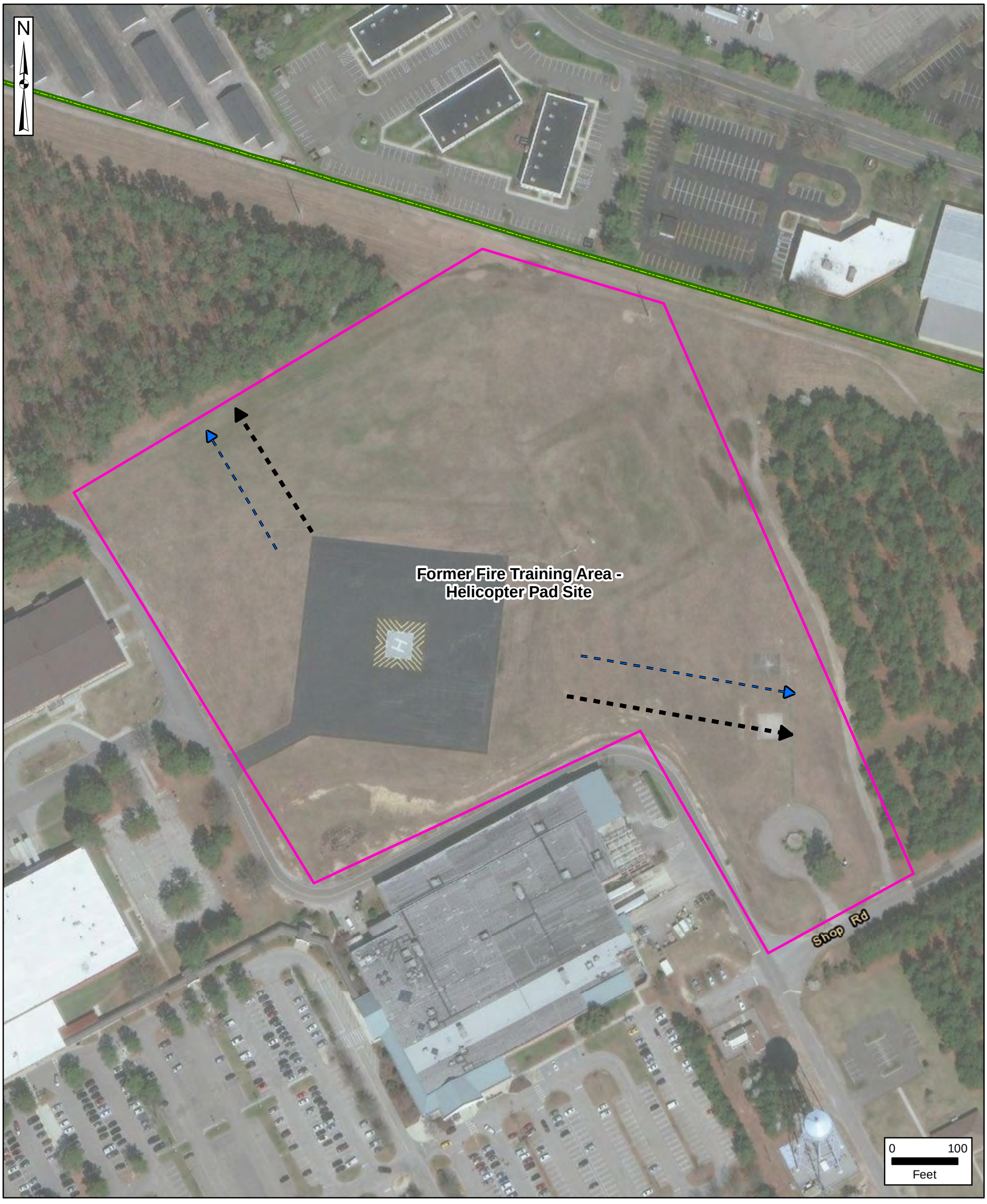


Figure 5-5
Aerial Photo of
Former Fire Training Area - Helicopter Pad Site



Installation Boundary

Area of Potential Interest (AOPI)

Inferred Unconfined Groundwater Flow Direction
Based on Surface Topography

Surface Runoff Flow Direction

Data Sources:
Fort Lee, GIS Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

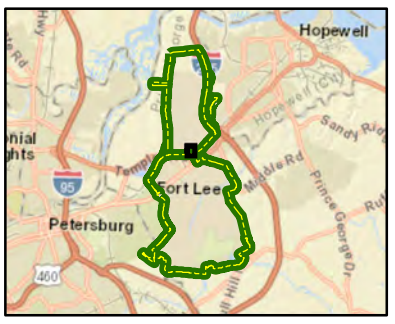
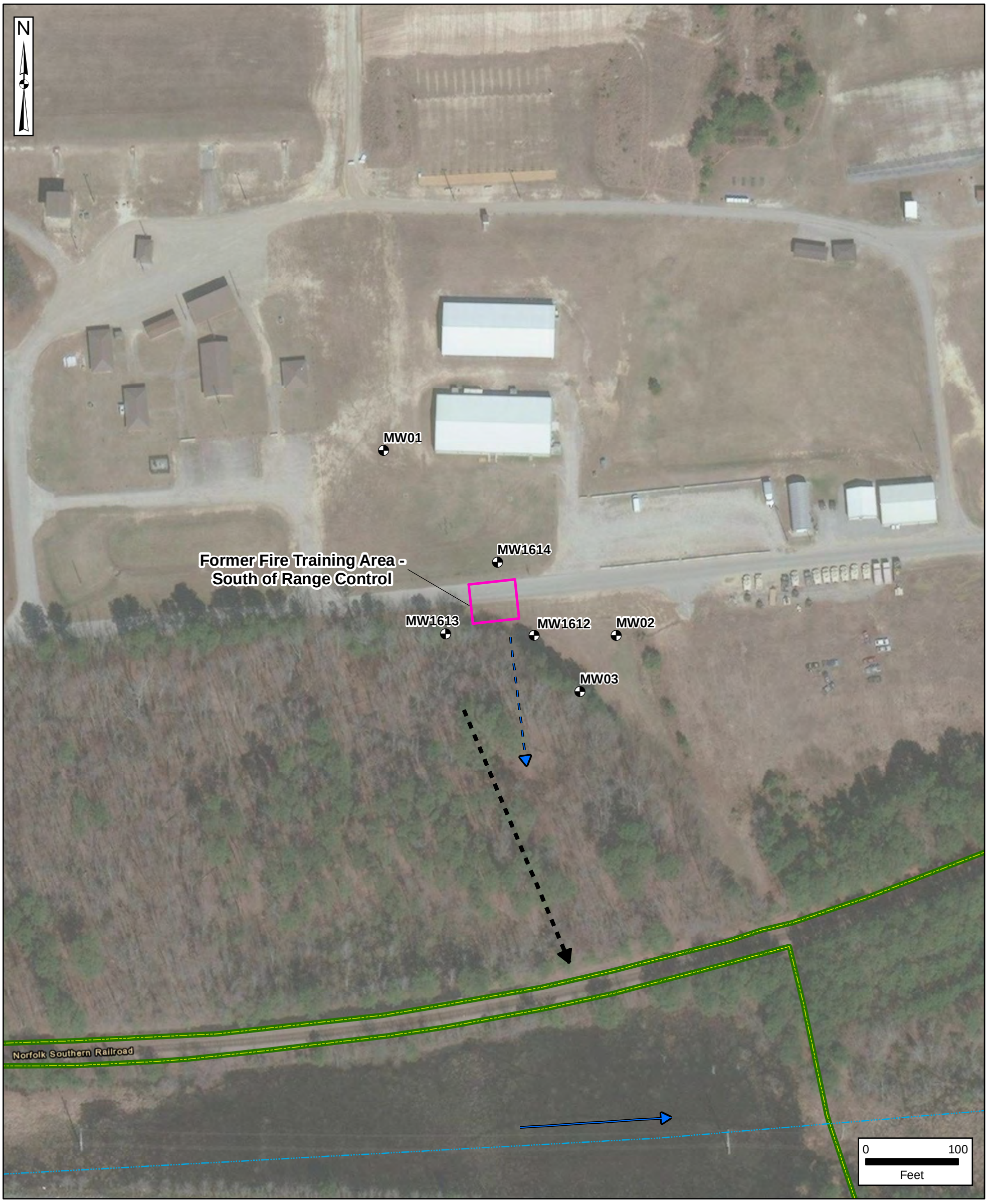


Figure 5-6
Aerial Photo of
Former Fire Training Area - South of Range Control



Installation Boundary
Area of Potential Interest (AOPI)
Stream (Intermittent)
Surface Water Flow Direction
Surface Runoff Flow Direction
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
Monitoring Well

Data Sources:
Fort Lee, GIS Data, 2019
Fluor Daniel,
Confirmation Sampling Report,
Well Locations, 1996
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

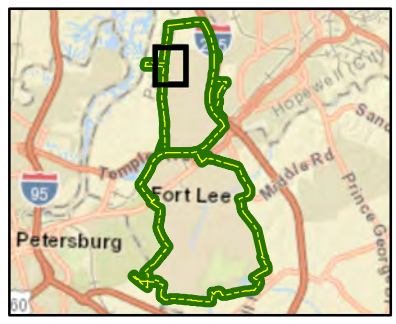


Figure 5-7
Aerial Photo of
Former Fire Training Area - Air Strip

Installation Boundary

Area of Potential Interest (AOPI)

Inferred Unconfined Groundwater Flow Direction Based on Surface Topography

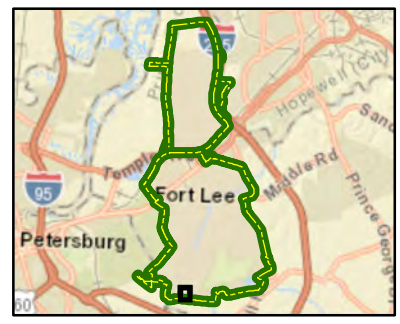
Surface Runoff Flow Direction

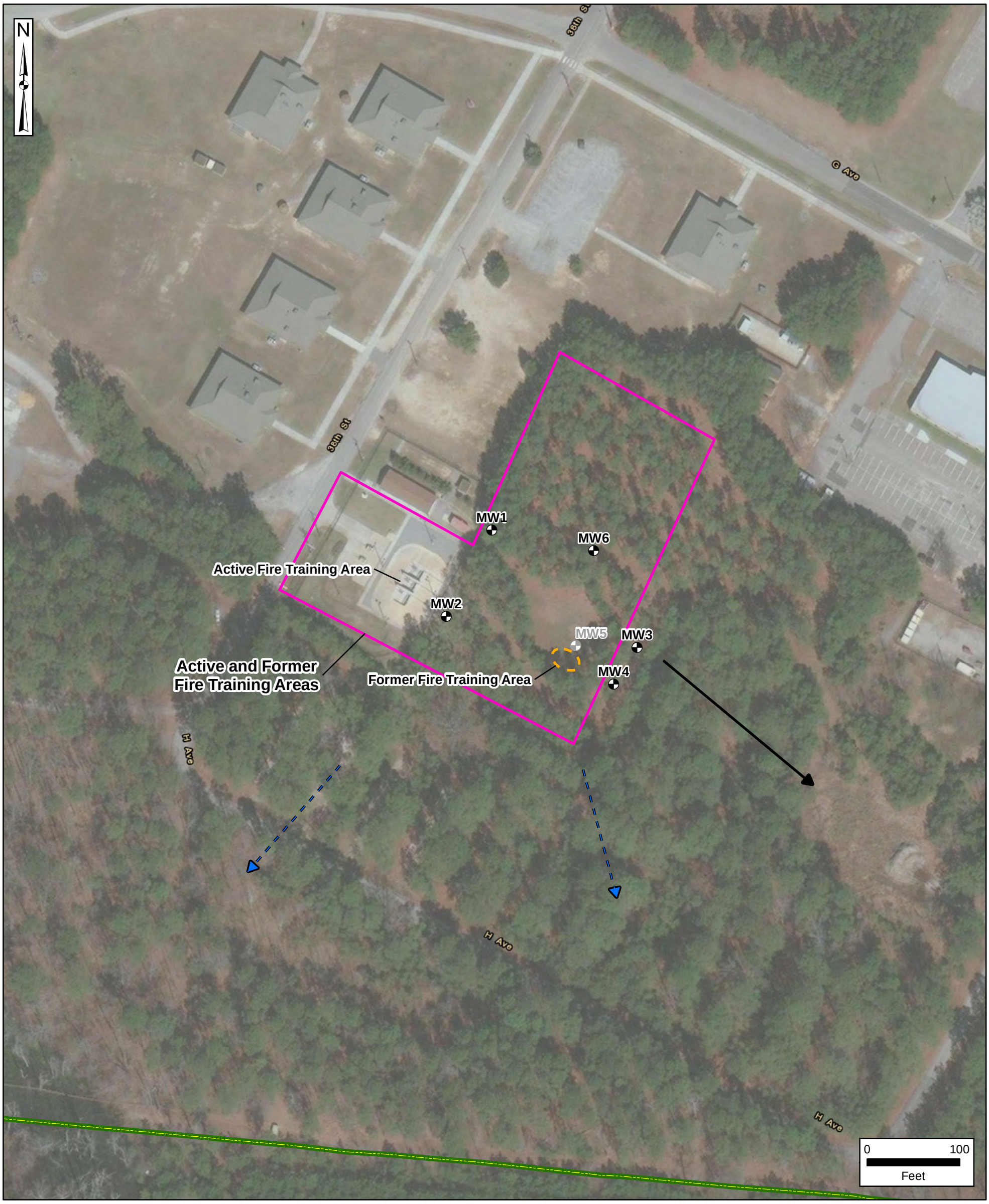
Data Sources:
Fort Lee, GIS Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-8
Aerial Photo of
Active and Former Fire Training Areas
(FTLE-7, FTLE 30, and FTLE-31)





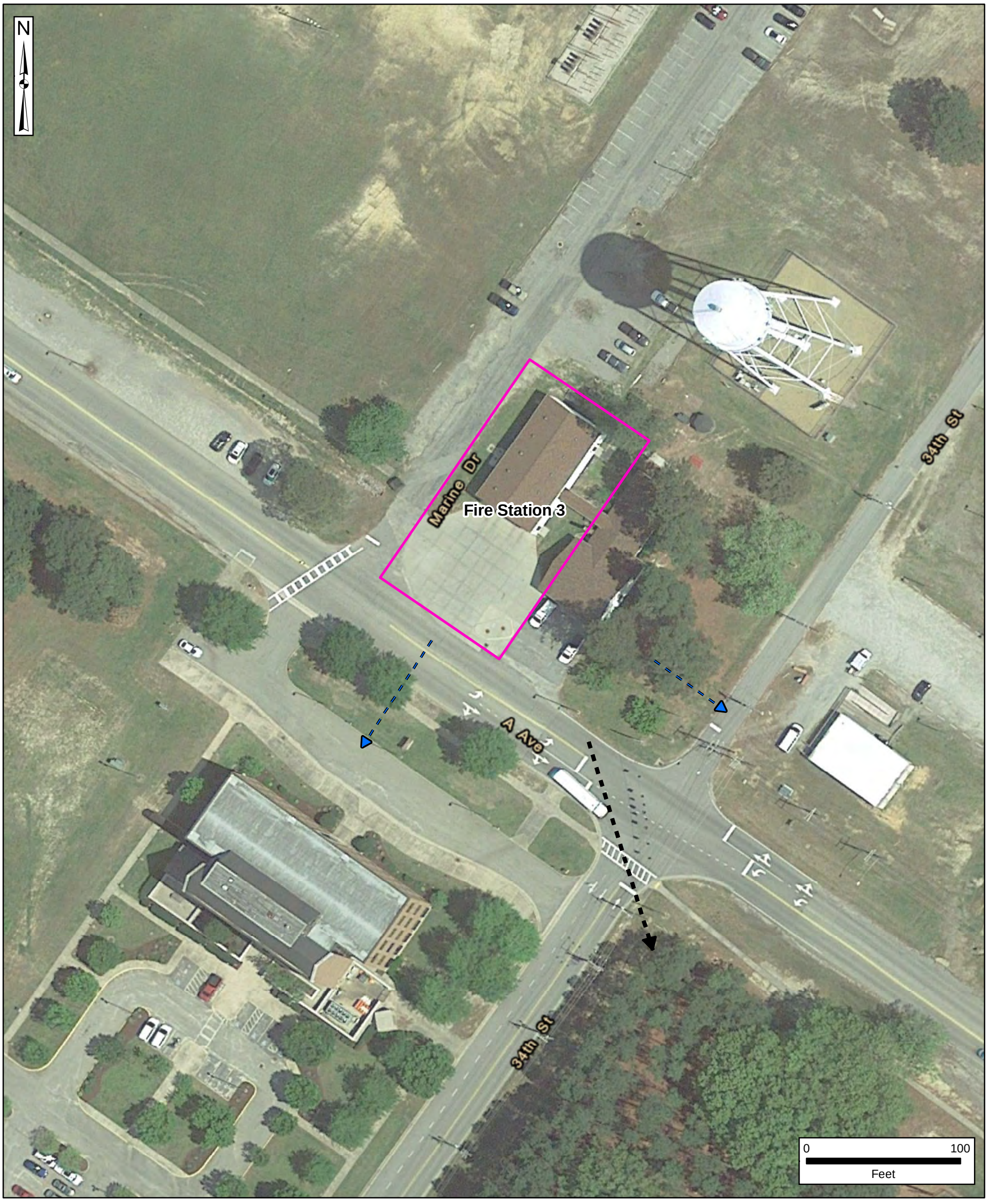
Installation Boundary
Area of Potential Interest (AOPI)
Former Fire Training Area Location
Groundwater Flow Direction
Surface Runoff Flow Direction
Monitoring Well
Monitoring Well Destroyed

Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-9
Aerial Photo of
Fire Station 3



Installation Boundary

Area of Potential Interest (AOPI)

Inferred Unconfined Groundwater Flow Direction Based on Surface Topography

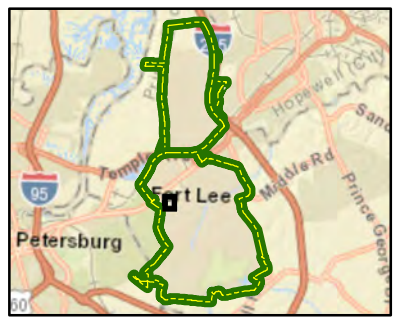
Surface Runoff Flow Direction

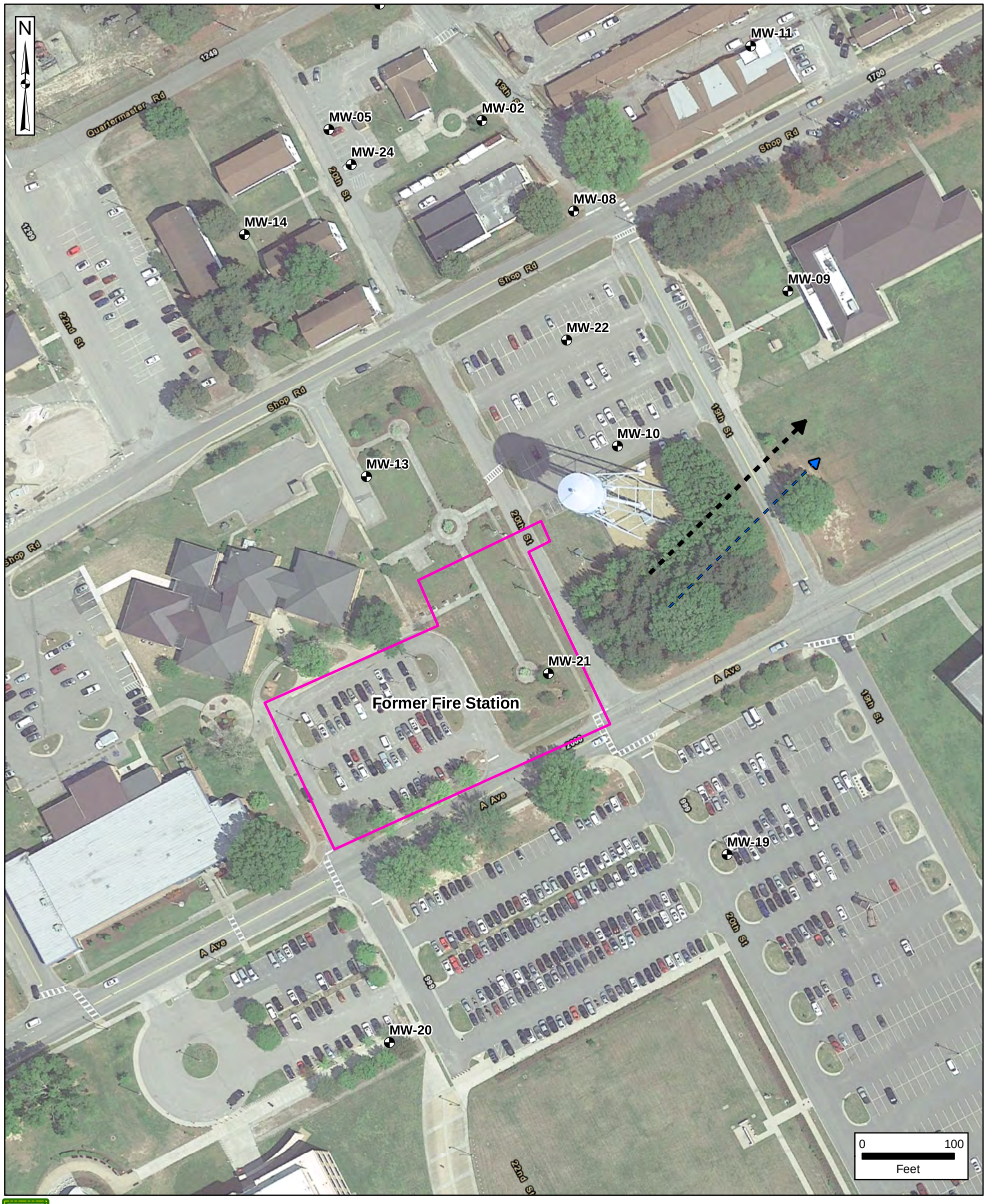
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 5-10
Aerial Photo of
Fire Station 3





Installation Boundary

Area of Potential Interest (AOPI)

Inferred Unconfined Groundwater Flow Direction Based on Surface Topography

Surface Runoff Flow Direction

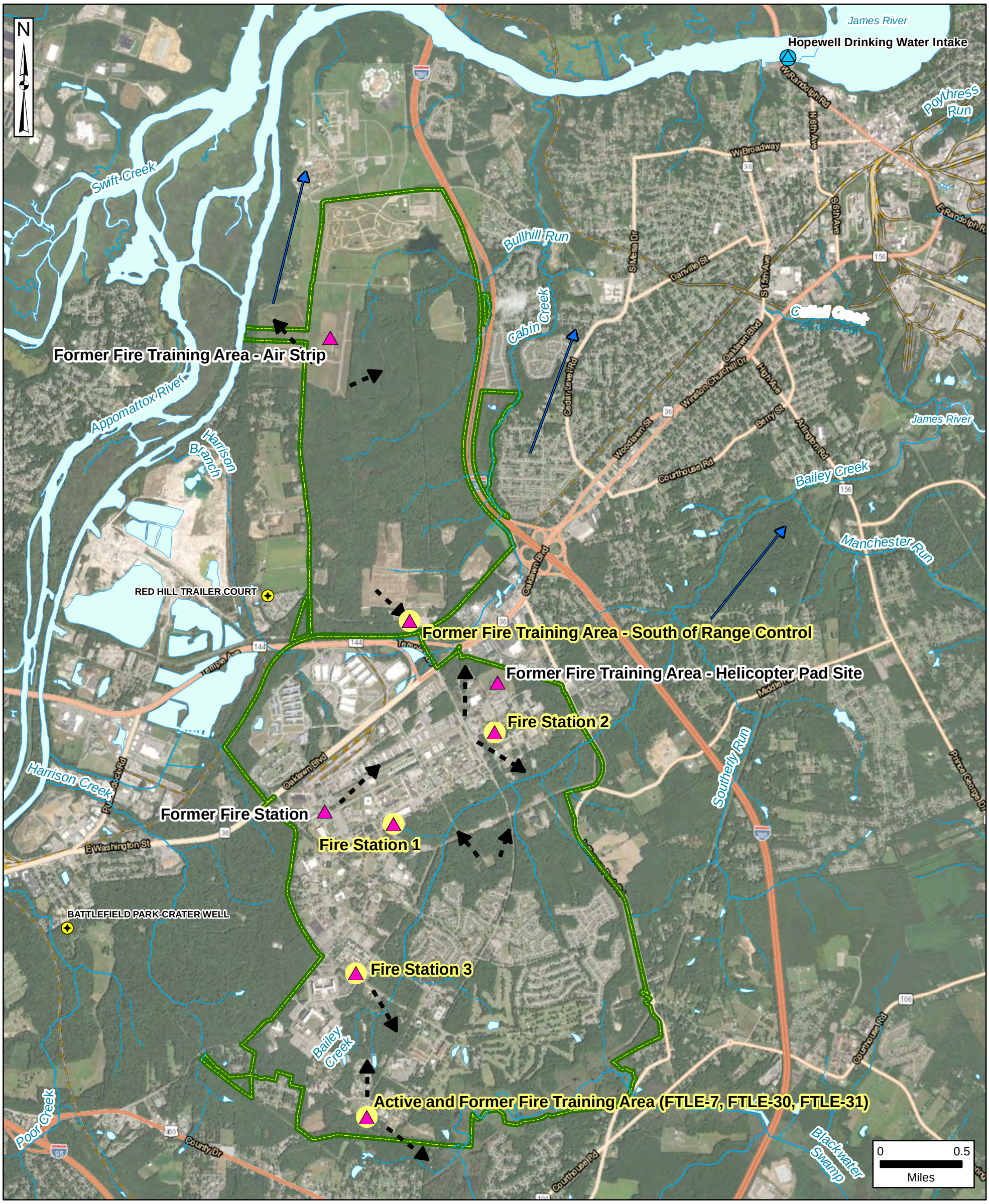
Monitoring Well

Data Sources:
Fort Lee, GIS Data, 2019
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-1
AOPI Locations and
OSD Risk Screening Level Exceedances



- Installation Boundary
- AOPI Location
- AOPI with OSD Risk Screening Level Exceedance during PA/SI
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Inferred Groundwater Flow Direction
- Surface Water Flow Direction
- Drinking Water Intake
- Public Water Supply System Well

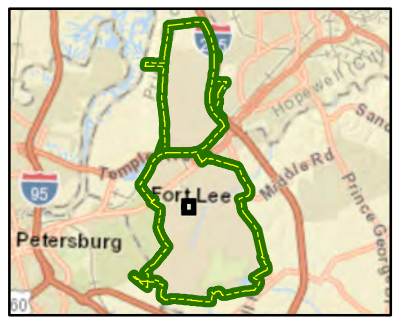
AOPI = area of potential interest
OSD = Office of the Secretary of Defense

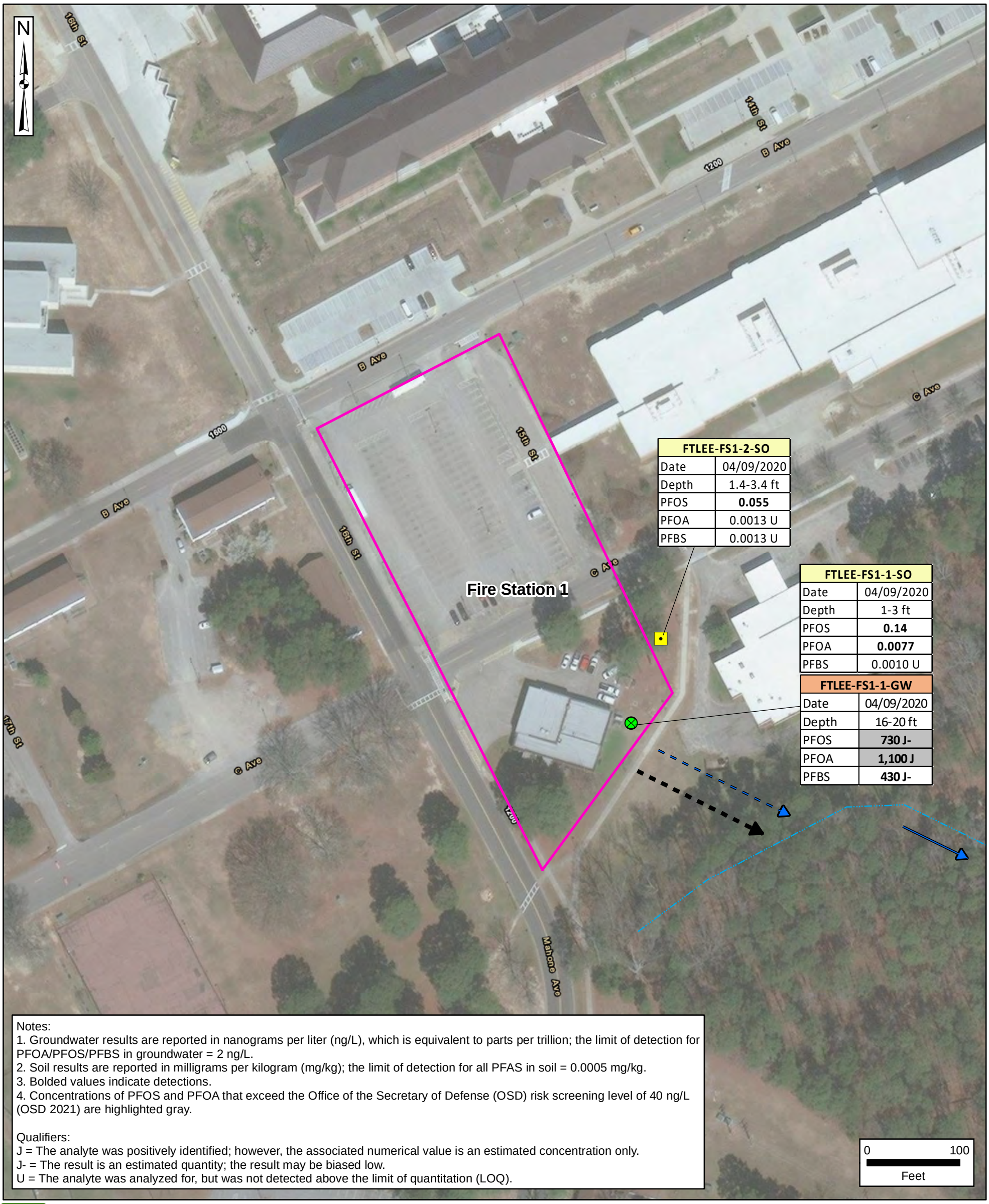
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
EDR, Well Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-2
Fire Station 1
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Area of Potential Interest (AOPI)
- Stream (Intermittent)
- Surface Water Flow Direction
- Surface Runoff Flow Direction
- Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
- Shallow Soil Sampling Location
- Soil and Groundwater Sampling Location

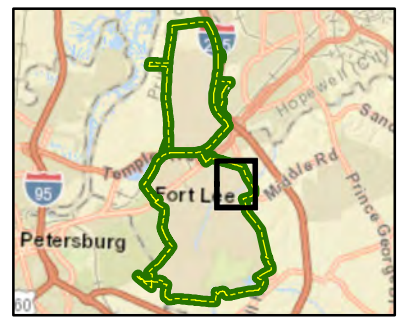
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

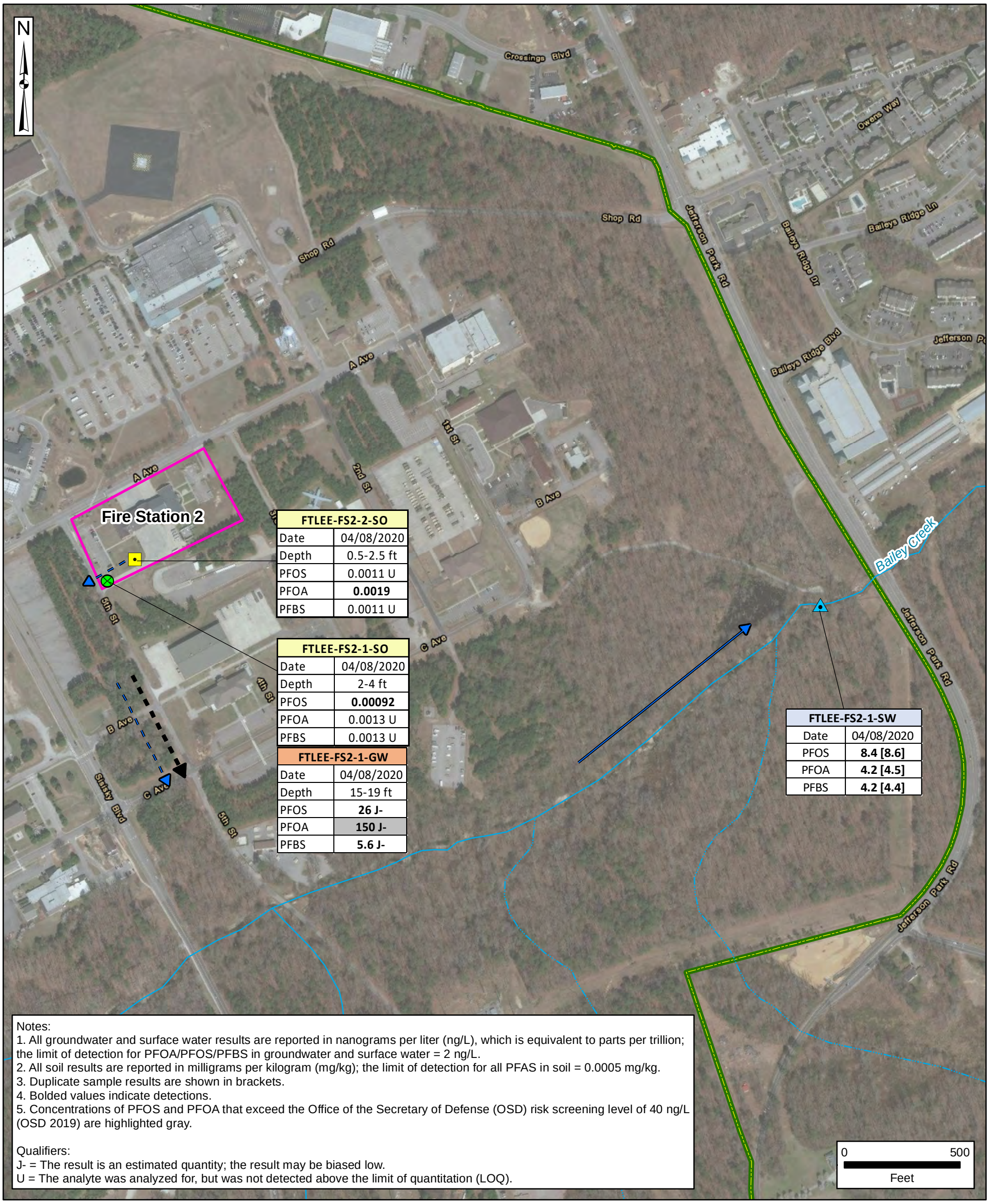
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-3
Fire Station 2
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. All groundwater and surface water results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater and surface water = 2 ng/L.
2. All soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L (OSD 2019) are highlighted gray.

Qualifiers:
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Area of Potential Interest (AOPI)
- Surface Water Flow Direction
- Surface Runoff Flow Direction
- Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
- Shallow Soil Sampling Location
- Soil and Groundwater Sampling Location
- Surface Water Sampling Location

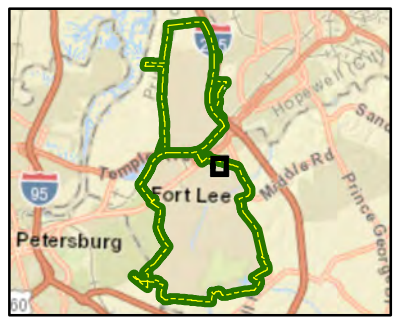
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil
SW = surface water

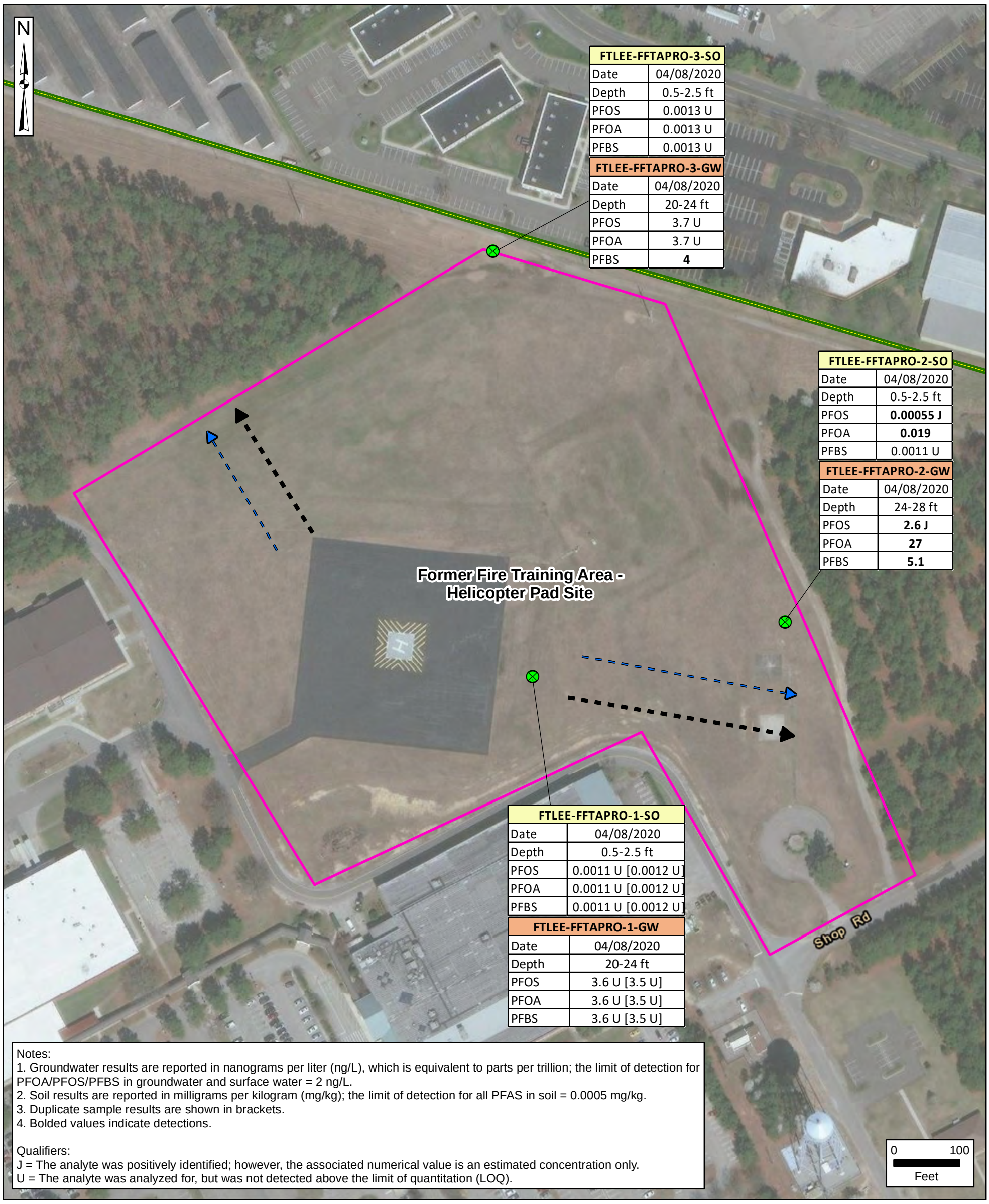
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-4
Former Fire Training Area - Helicopter Pad Site
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater and surface water = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Area of Potential Interest (AOPI)
- Surface Runoff Flow Direction
- Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
- Soil and Groundwater Sampling Location

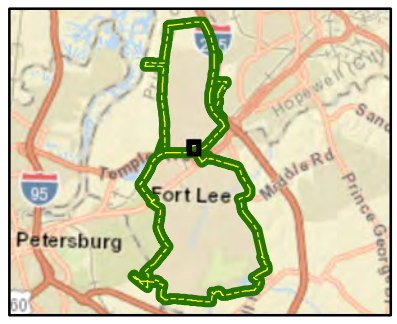
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
Fort Lee, GIS Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-5
Former Fire Training Area - South of Range Control
PFOS, PFOA, and PFBS Analytical Results



N

MW01

FTLEE-MW1612	
Date	04/07/2020
PFOS	**590**
PFOA	**34**
PFBS	**32**

MW1614

Former Fire Training Area - South of Range Control

MW1613

MW02

FTLEE-FFTARC-2-SO	
Date	04/07/2020
Depth	0.5-2.5 ft
PFOS	**0.011**
PFOA	0.0010 U
PFBS	0.0010 U

FTLEE-FFTARC-1-SO	
Date	04/07/2020
Depth	0.5-2.5 ft
PFOS	**0.0012 J**
PFOA	0.0014 U
PFBS	0.0014 U

FTLEE-FFTARC-1-GW	
Date	04/07/2020
Depth	0-5 ft
PFOS	**130 J-**
PFOA	**38 J-**
PFBS	**17 J-**

FTLEE-MW03	
Date	04/07/2020
PFOS	**450**
PFOA	**23**
PFBS	**21**

ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100
Feet

Installation Boundary
Area of Potential Interest (AOPI)
Stream (Intermittent)
Surface Runoff Flow Direction
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
Monitoring Well
Shallow Soil Sampling Location
Soil and Groundwater Sampling Location
Groundwater Sampling Location - Existing Well

Data Sources:
Fort Lee, GIS Data, 2019
Fluor Daniel, Confirmation Sampling Report, Well Locations, 1996
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

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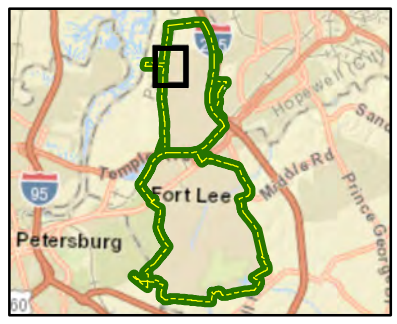
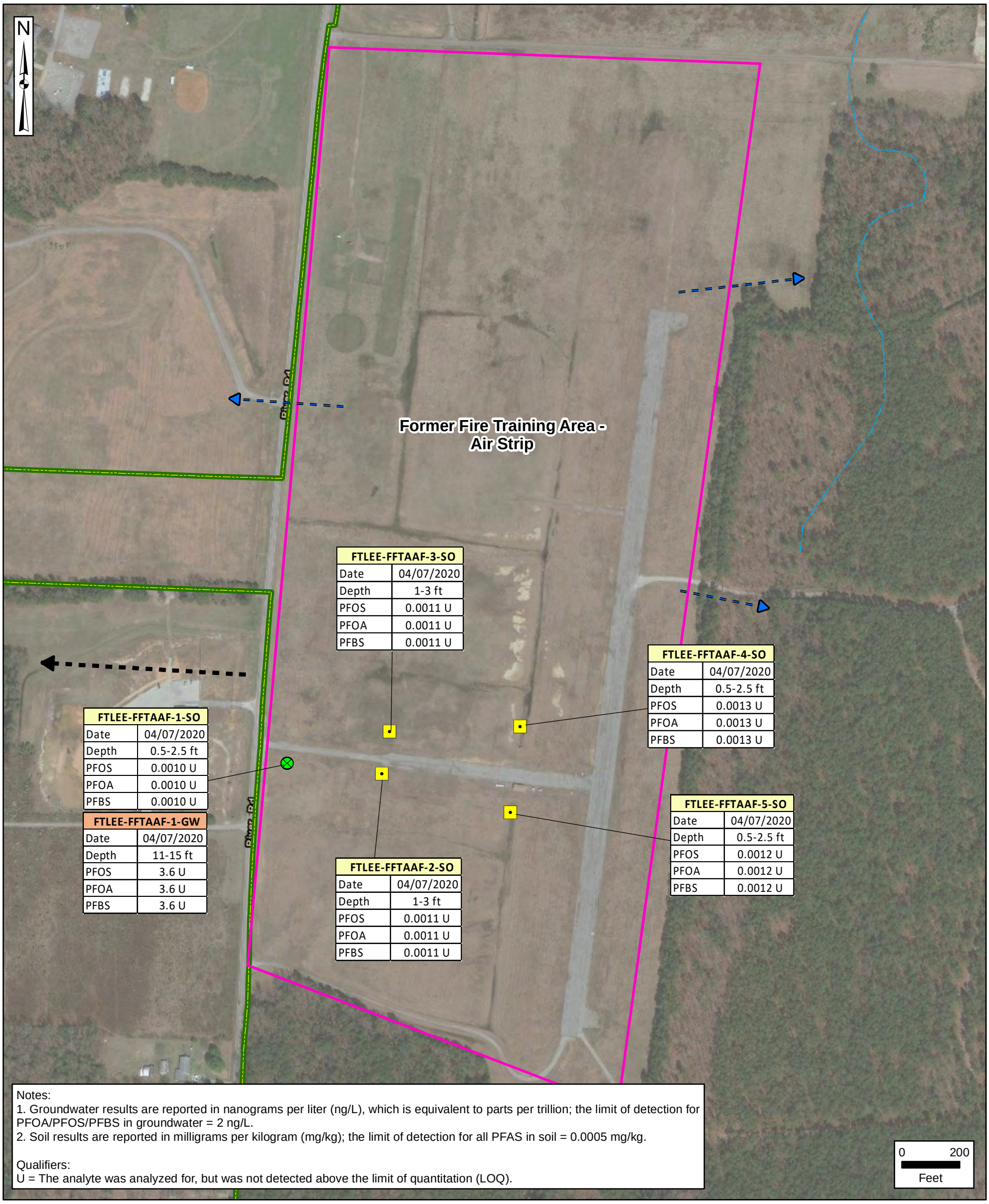
Fort Lee, VA

Figure 7-6
Former Fire Training Area - Air Strip
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Area of Potential Interest (AOPI)
- Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
- Surface Runoff Flow Direction
- Shallow Soil Sampling Location
- Soil and Groundwater Sampling Location

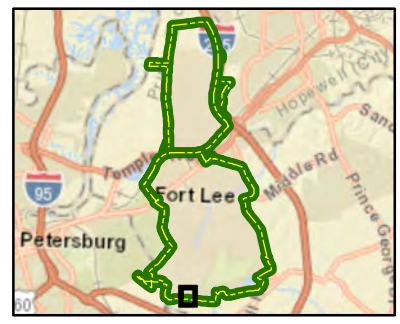
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

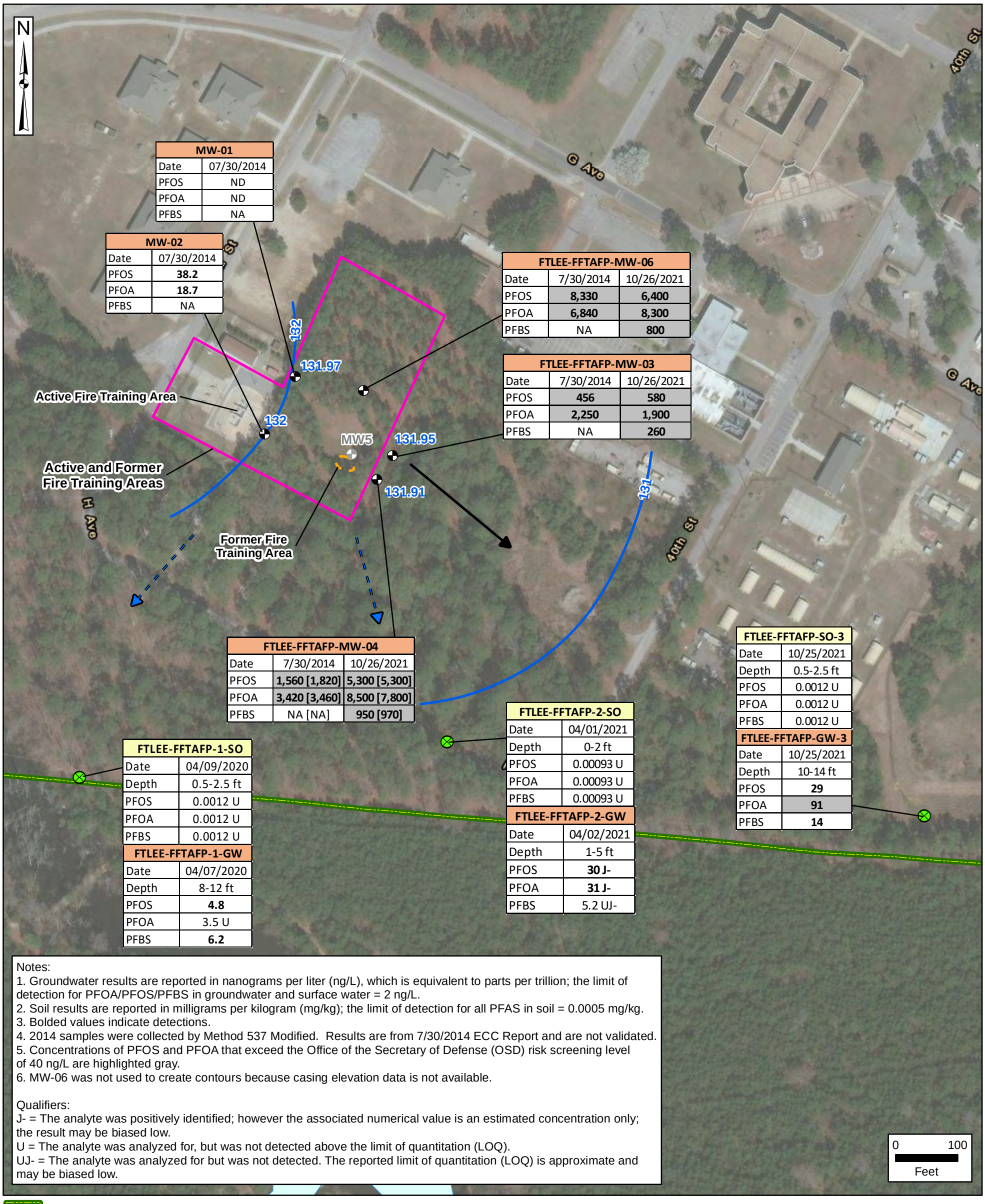
Data Sources:
Fort Lee, GIS Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-7
Active and Former Fire Training Areas (FTLE-7, FTLE 30, and FTLE-31) PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater and surface water = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Bolded values indicate detections.
4. 2014 samples were collected by Method 537 Modified. Results are from 7/30/2014 ECC Report and are not validated.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L are highlighted gray.
6. MW-06 was not used to create contours because casing elevation data is not available.

Qualifiers:
J- = The analyte was positively identified; however the associated numerical value is an estimated concentration only; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).
UJ- = The analyte was analyzed for but was not detected. The reported limit of quantitation (LOQ) is approximate and may be biased low.

- Installation Boundary
- Area of Potential Interest (AOPI)
- Former Fire Training Area Location
- Surface Runoff Flow Direction
- Groundwater Flow Direction
- Groundwater Elevation Contour
- 132 Groundwater Elevation
- Monitoring Well
- Monitoring Well Destroyed
- Soil and Groundwater Sampling Location

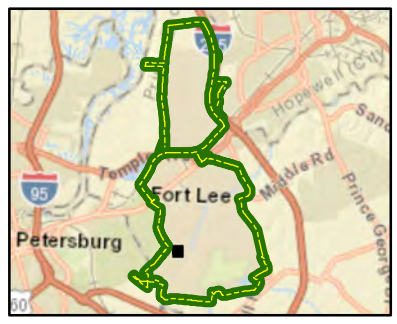
ft = feet
GW = groundwater
NA = not analyzed
ND = not detected
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

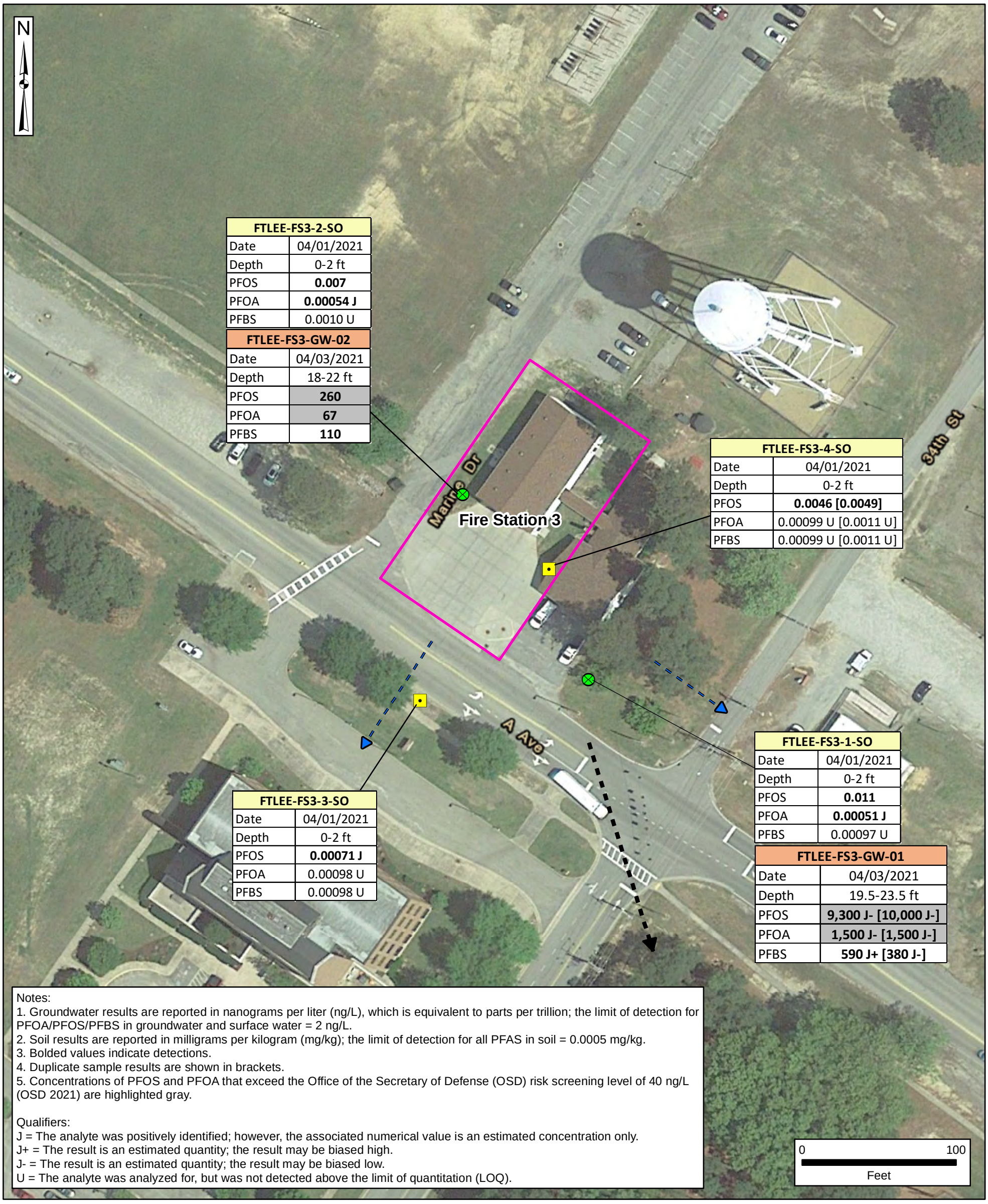
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-8
Fire Station 3
PFOS, PFOA, and PFBS Analytical Results





FTLEE-FS3-2-SO	
Date	04/01/2021
Depth	0-2 ft
PFOS	**0.007**
PFOA	**0.00054 J**
PFBS	0.0010 U

FTLEE-FS3-GW-02	
Date	04/03/2021
Depth	18-22 ft
PFOS	**260**
PFOA	**67**
PFBS	**110**

FTLEE-FS3-4-SO	
Date	04/01/2021
Depth	0-2 ft
PFOS	**0.0046 [0.0049]**
PFOA	0.00099 U [0.0011 U]
PFBS	0.00099 U [0.0011 U]

FTLEE-FS3-3-SO	
Date	04/01/2021
Depth	0-2 ft
PFOS	**0.00071 J**
PFOA	0.00098 U
PFBS	0.00098 U

FTLEE-FS3-1-SO	
Date	04/01/2021
Depth	0-2 ft
PFOS	**0.011**
PFOA	**0.00051 J**
PFBS	0.00097 U

FTLEE-FS3-GW-01	
Date	04/03/2021
Depth	19.5-23.5 ft
PFOS	**9,300 J- [10,000 J-]**
PFOA	**1,500 J- [1,500 J-]**
PFBS	**590 J+ [380 J-]**

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater and surface water = 2 ng/L.
2. Soil results are reported in milligrams per kilogram (mg/kg); the limit of detection for all PFAS in soil = 0.0005 mg/kg.
3. Bolded values indicate detections.
4. Duplicate sample results are shown in brackets.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

0 100
Feet

Installation Boundary
Area of Potential Interest (AOPI)
Surface Runoff Flow Direction
Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
Shallow Soil Sampling Location
Soil and Groundwater Sampling Location

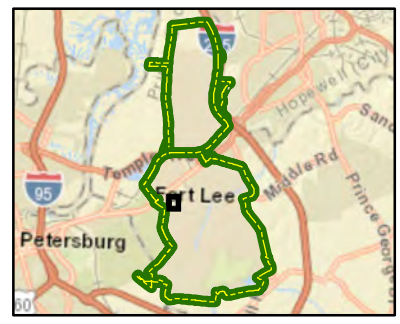
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

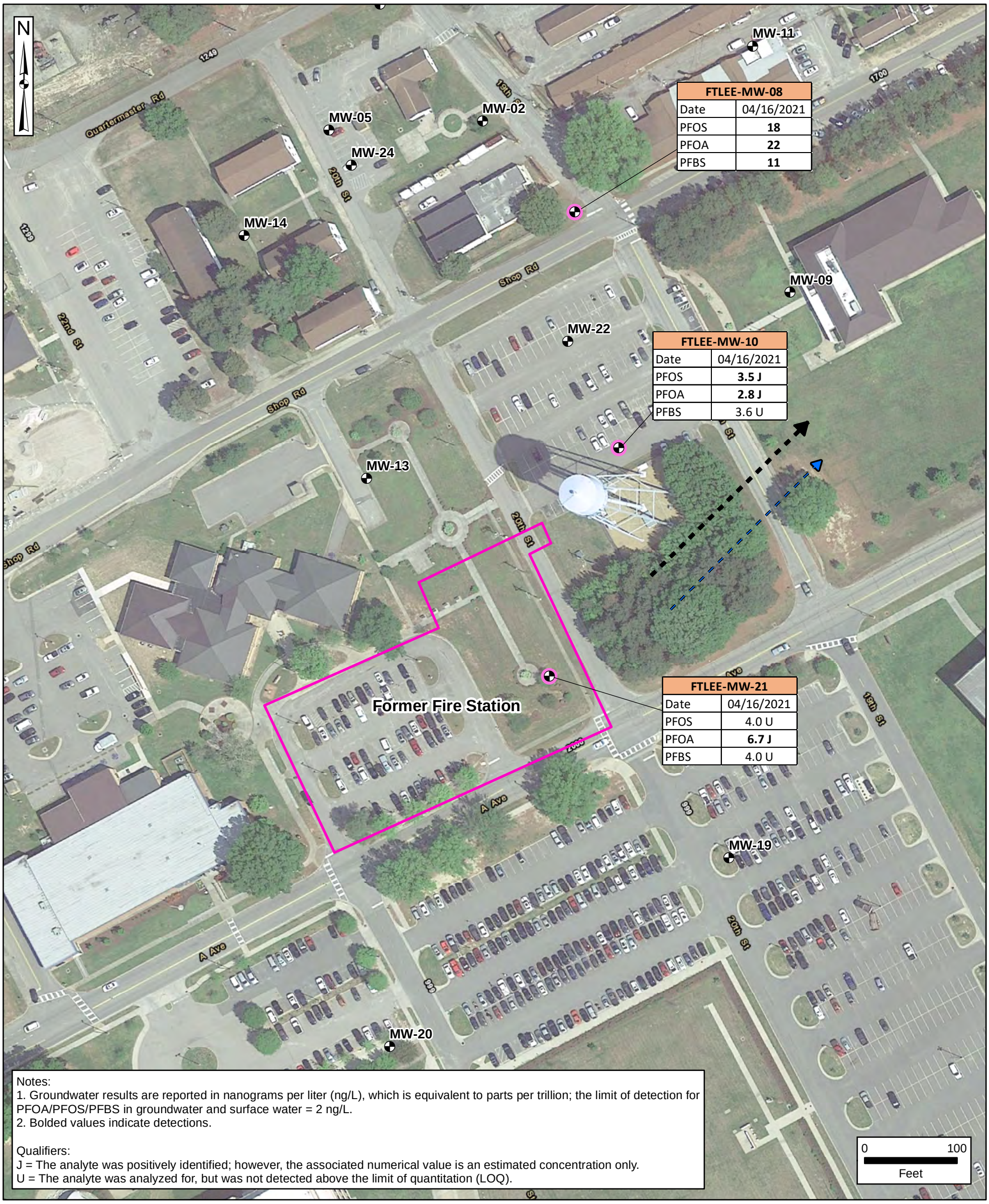
Data Sources:
Fort Lee, GIS Data, 2019
USGS, NHD, Water Bodies, 2019
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, VA

Figure 7-9
Fire Station 3
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms per liter (ng/L), which is equivalent to parts per trillion; the limit of detection for PFOA/PFOS/PFBS in groundwater and surface water = 2 ng/L.
2. Bolded values indicate detections.

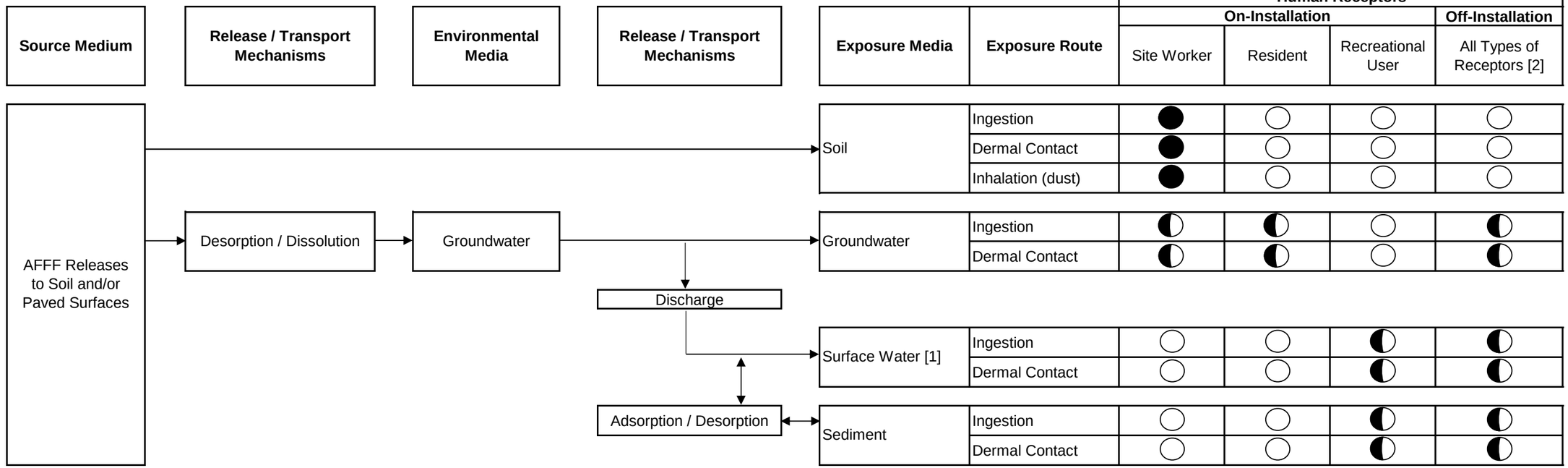
Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Area of Potential Interest (AOPI)
- Surface Runoff Flow Direction
- Inferred Unconfined Groundwater Flow Direction Based on Surface Topography
- Monitoring Well
- Groundwater Sampling Location (Existing Well)

PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Fort Lee, GIS Data, 2019
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 18 North



Legend:

= Potentially Complete Exposure Pathway

= Incomplete Exposure Pathway

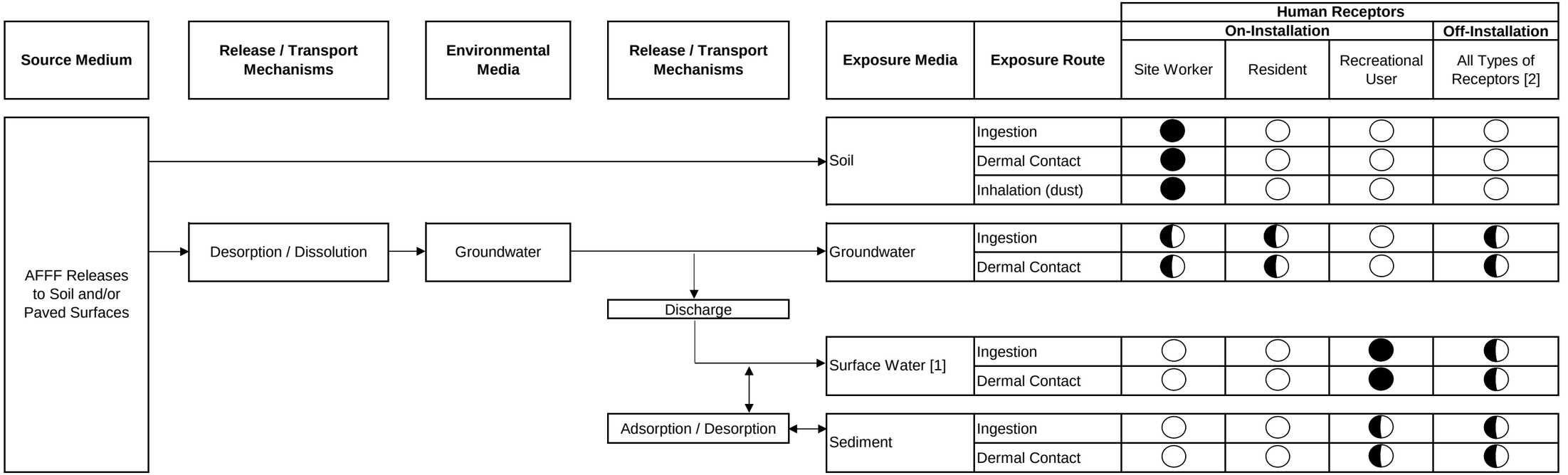
= Complete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film-forming foam

ARCADIS

Conceptual Site Model - Fire Station 1, FFTA – Helicopter Pad, FFTA – South of Range Control, and Fire Station 3
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, Virginia
INTERNAL DELIBERATIVE - DO NOT RELEASE

Figure 7-10



Legend:

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

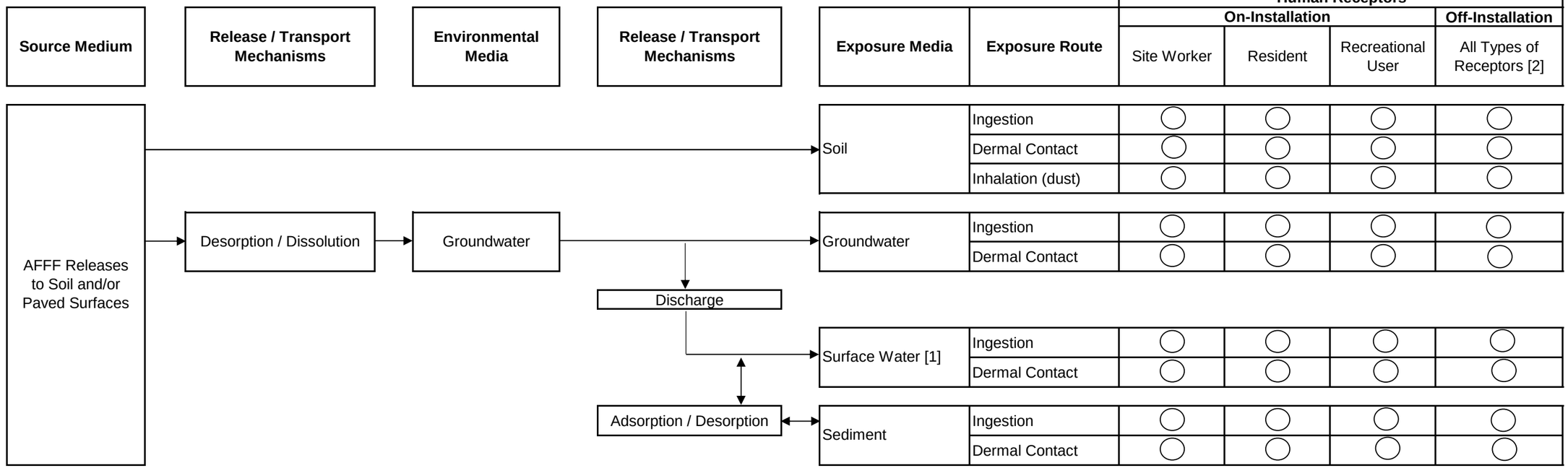
● = Complete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film-forming foam

ARCADIS

Conceptual Site Model - Fire Station 2
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, Virginia
INTERNAL DELIBERATIVE - DO NOT RELEASE

Figure 7-11



Legend:

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

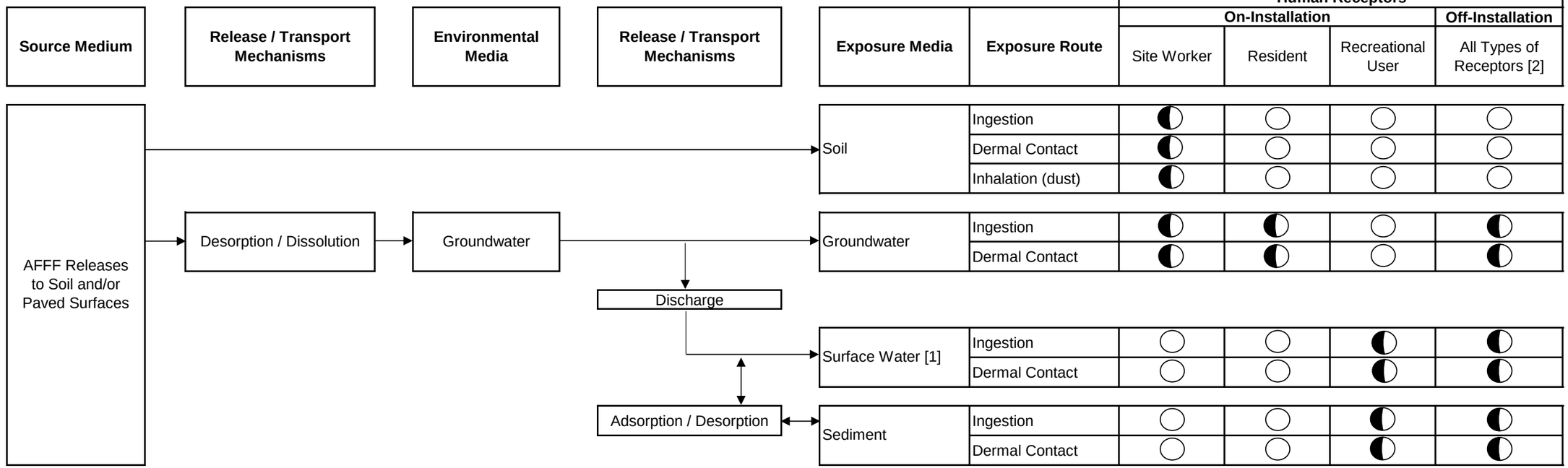
● = Complete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film-forming foam

ARCADIS

Conceptual Site Model - FFTA – Airstrip
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, Virginia
INTERNAL DELIBERATIVE - DO NOT RELEASE

Figure 7-12



Legend:

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

● = Complete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film-forming foam

ARCADIS

Conceptual Site Model - Active and Former Fire Training Areas (FTLE-7, FTLE 30, and FTLE-31) and Former Fire Station
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Lee, Virginia
INTERNAL DELIBERATIVE - DO NOT RELEASE

Figure 7-13