



**Final  
Site Inspections Report  
of Fire Fighting Foam Usage at  
Joint Base Charleston-Air,  
Charleston County, and North Auxiliary Airfield,  
Orangeburg County, South Carolina**

**May 2018**

**Submitted to:**

**Air Force Civil Engineer Center  
3515 General McMullen Suite 155  
San Antonio, Texas 78226-2018**

**Submitted by:**

**U.S. Army Corps of Engineers  
Savannah District  
100 W. Oglethorpe Avenue  
Savannah, Georgia 31401-3640**



**Prepared by:**

**Aerostar SES LLC  
1006 Floyd Culler Court  
Oak Ridge, Tennessee 37830-8022  
under  
Contract No. W912HN-15-C-0022**

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## Acronyms and Abbreviations

µg/L	micrograms per liter
µg/kg	micrograms per kilogram
AFFF	aqueous film forming foam
AFCEC	Air Force Civil Engineer Center
amsl	above mean sea level
AR	Air Force Record
AS	air-sparge
ASL	Aerostar SES LLC
AST	aboveground storage tank
bgs	below ground surface
btoc	below top of casing
CAS	Chemical Abstracts Service
CE	Civil Engineering
CHN	Charleston County
CHRTN	Joint Base Charleston
CL	clay
CO-NUM	County-Number ID
CSM	conceptual site model
DoD	Department of Defense
DOM	domestic
DOR	Dorchester County
DOT	Department of Transportation
DPT	direct push technology
dup	duplicate
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
EZ	exclusion zone
FES	Fire Emergency Services
ft	foot/feet
FPTA	fire protection training area
FTA	fire training area
GW	groundwater
HA	health advisory
Halliburton	Halliburton NUS Corporation
HDPE	high-density polyethylene
HQ	hazard quotient
ID	identification
IRP	Installation Restoration Program
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
JBCA	Joint Base Charleston-Air
MDG	Medical Group
mg/kg	milligrams per kilogram
MW	monitoring well
N/A	not available
NAAF	North Auxiliary Airfield
ND	not detected at the Method Detection Limit
NL	not listed

NFRAP	No Further Response Action Planned
NM	not measured
No.	number
OH	open hole
ORG	Orange County
OSI	Office of Special Investigation
OWS	oil/water separator
PA	preliminary assessment
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
pH	potential of hydrogen
PS	public supply
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RFA	RCRA Facility Assessment
RI	remedial investigation
RSL	regional screening level
SAIC	Science Applications International Corporation
SC	clayey sands
SCDHEC	South Carolina Department of Health and Environmental Control
SD	sediment
SI	site inspection
SM	silty sands
SO	subsurface soil
SP	poorly graded or gravelly sands
SP-16	stainless steel screen point-16 sampler
SS	surface soil
SVE	soil vapor extraction
SW	surface water
SWMU	solid waste management unit
TOC	total organic carbon
TW	temporary well
U	The analyte was not detected above the reported sample quantification limit
USACE	U.S. Army Corps of Engineers
USAF	United States Air Force
USCS	Unified Soil Classification System

## 1.0 INTRODUCTION

Aerostar SES LLC (ASL) under contract to the U.S. Army Corps of Engineers (USACE) Savannah District (Contract No. W912HN-15-C-0022) conducted screening-level site inspections (SIs) at nine known or suspected aqueous film forming foam (AFFF) release areas at Joint Base Charleston-Air (JBCA) in Charleston County, South Carolina, and the North Auxiliary Airfield (NAAF) in Orangeburg County, South Carolina (Figure 1, Appendix A). This work was performed in accordance with the approved quality assurance project plan (QAPP) (ASL, January 2017). The purpose of the inspections was to determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), and perfluorobutane sulfonate (PFBS) in the environment at these areas. PFOA, PFOS, and PFBS are in a class of synthetic fluorinated chemicals used in industrial and consumer products, including defense-related applications. This class of compounds is also referred to as per- and polyfluorinated alkyl substances (PFAS).

In 1970, the United States Air Force (USAF) began using AFFF firefighting agents containing PFOS and PFOA to extinguish petroleum fires. Releases of AFFF to the environment routinely occur during fire training, equipment maintenance, storage, and use. Although manufacturers have reformulated AFFF to eliminate PFOS, the United States Environmental Protection Agency (EPA) continues to permit the use of PFOS-based AFFF, and USAF maintains a significant inventory of PFOS-based AFFF. As of this report, the USAF is actively removing PFOS-based AFFF from its inventory and replacing it with formulations based on shorter carbon chains, which may be less persistent and bioaccumulative in the environment.

Per Department of Defense (DoD) Instruction 4715.18, “Emerging Contaminants (ECs)” (DoD, June 2009); *Interim USAF Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and Base Realignment and Closure (BRAC) Installations* (USAF, August 2012); and the *USAF/IE Policy on Perfluorinated Compounds of Concern* (USAF, 2016), the USAF will

- identify locations where there is a reasonable expectation that PFOA/PFOS may have been released from USAF actions;
- determine if there is unacceptable risk to human health and the environment; and
- address releases that pose an unacceptable risk, including off-site migration.

The objectives of this study are to

- determine if PFOS and PFOA are present in groundwater or surface water at the inspection areas at concentrations exceeding the EPA lifetime health advisory (HA) for drinking water;
- determine if PFBS is present in soil, sediment, groundwater, or surface water at the inspection areas at concentrations exceeding generic Regional Screening Levels (RSLs);
- determine if PFOA and PFOS are present in soil or sediment at the inspection areas at concentrations exceeding calculated RSLs; and
- identify potential receptor pathways with immediate impacts to human health.

The objectives of the SIs were to identify any releases of AFFF that resulted in PFOS or PFOA contamination in the environment above the project screening levels and identify any possible human exposure to drinking water above the HA levels. This report does not include assessment of ecological exposure pathways, receptors, or risk from PFAS impacts to the environment. Confirmed releases may require further investigation to fully delineate the extent of contamination and perform a complete risk assessment that includes ecological receptors.

Screening levels for this SI were determined for PFOS, PFOA, and PFBS. The screening level for PFOS and PFOA in soil and sediment was calculated using EPA’s RSL calculator ([https://epaprgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epaprgs.ornl.gov/cgi-bin/chemicals/csl_search)) using a residential scenario based on a hazard quotient 0.1 (HQ = 0.1)

(Appendix F). The toxicity value input for the calculator is the Tier 3 value reference dose of 0.02 µg/kg per day derived by EPA in its Drinking Water Health Advisories for PFOS (EPA, May 2016b) and PFOA (EPA, May 2016a). Screening levels for PFOS and PFOA in groundwater and surface water are based on EPA lifetime drinking water HAs for PFOA (EPA, May 2016a) and PFOS (EPA, May 2016b). A PFAS release was considered confirmed when exceedances of the following concentrations were identified:

**PFOS:**

- 0.07 micrograms per liter (µg/L) in groundwater/surface water (combined with PFOA value).
- <sup>a</sup>126 micrograms per kilogram (µg/kg) in soil (calculated in the absence of RSL values).
- <sup>a</sup>126 µg/kg in sediment (calculated in the absence of RSL values).

**PFOA:**

- 0.07 µg/L in groundwater/surface water (combined with PFOS value).
- <sup>a</sup>126 µg/kg in soil (calculated in the absence of RSL values).
- <sup>a</sup>126 µg/kg in sediment (calculated in the absence of RSL values).

EPA has also derived RSL values for PFBS (EPA, November 2017). The USAF will also consider a release to be confirmed if the following concentrations are exceeded:

**PFBS:**

- 40 µg/L in groundwater/surface water.
- 130,000 µg/kg in soil/sediment.

**Note:**

<sup>a</sup>Screening levels were calculated using the EPA RSL calculator ([https://epaprgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epaprgs.ornl.gov/cgi-bin/chemicals/csl_search))(updated November 2017). Published generic regional and calculated screening levels presented in the QAPP and QAPP addendum were based on an HQ of 1.0. The screening levels have subsequently been revised to reflect an HQ of 0.1. This change affects PFBS screening levels for all media and calculated PFOS and PFOA screening levels for soil and sediment. Screening levels for PFOA and PFOS in groundwater and surface water remain at 0.07 µg/L and are based on the EPA lifetime HA for drinking water.

To streamline reporting and discussion of PFOS, PFOA, and PFBS sampling and analysis, these compounds will hereafter be referred to, collectively, as “PFAS.” Table 1 presents the screening values for comparing the analytical results for these three PFAS compounds.

**Table 1 Regulatory Screening Values**

Parameter	Chemical Abstracts Number	EPA Regional Screening Level Table (November 2017) <sup>a</sup>		Calculated RSL for Soil and Sediment <sup>b</sup> (µg/kg)	EPA Health Advisory for Drinking Water (Surface Water or Groundwater) (µg/L) <sup>c</sup>
		Residential Soil (µg/kg)	Tap Water (µg/L)		
Perfluorobutane sulfonate (PFBS)	29420-43-3	130,000	40	NL	NL
Perfluorooctanoic acid (PFOA)	335-67-1	NL	NL	126	0.07 <sup>d</sup>
Perfluorooctane sulfonate (PFOS)	1763-23-1	NL	NL	126	

<sup>a</sup> EPA Regional Screening Levels (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

<sup>c</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>d</sup> Combined concentrations of PFOA and PFOS should be compared with the 0.07 µg/L health advisory level. Only groundwater and surface water were sampled during the SI, but analytical results have been compared to the tap water screening levels.

µg/kg = micrograms per kilogram      µg/L = micrograms per liter      EPA = Environmental Protection Agency

NL = not listed      RSL = regional screening level



## 2.0 AFFF AREA DESCRIPTIONS

JBCA is approximately 16 miles northwest of Charleston, South Carolina (Figure 1, Appendix A). It encompasses 3,731 acres in central Charleston County (Figure 2, Appendix A). JBCA is adjacent to Charleston International Airport, and runways on JBCA are used by Charleston County Aviation Authority and the USAF under a joint use agreement. JBCA has been an Air Mobility Command base since 1992. It is bordered by residential and commercial development. Interstate 26 and Interstate 526 are approximately 1.5 miles to the east, the Ashley River is approximately ½ mile to the southwest, and the Cooper River is approximately 5 miles to the east. The topography of the Base is nearly flat. Surface elevations range from 15 feet above mean sea level (amsl) along the southern edge of the Base to 45 feet amsl at the northern edge of the Base.

NAAF is in Orangeburg County, approximately 85 miles northwest of JBCA, and 2 miles east of North, South Carolina (Figure 1, Appendix A). NAAF encompasses 2,400 acres, of which 1,150 acres are undeveloped (Figure 3, Appendix A). NAAF is operated by JBCA for airdrop training and as a contingency training site for other JBCA units and other USAF and Army units. The airfield has a main runway 12,000 feet long and an assault runway 3,000 feet long. The only permanently assigned personnel at NAAF are roughly one dozen firefighters and one civilian groundskeeper.

### *Hydrological Setting at Joint Base Charleston-Air*

Surface water drainage from the approximately 3,500-acre watershed is controlled by unlined and concrete-lined ditches and buried concrete pipes. Three major channels drain the Base:

- Golf Course Creek, which discharges into Popperdam Creek, a tributary of the Ashley River;
- Runway Creek, near Runway 03/21, a tributary of the Ashley River; and
- A tributary of Turkey Creek near Runway 15/33, which discharges into Goose Creek, a tributary of the Cooper River.

The drainage divide on the Base is approximately parallel to Runway 15/33. Surface water east of Runway 15/33 flows toward the Goose Creek Reservoir and the Cooper River, and surface water west of Runway 15/33 flows toward Popperdam Creek and the Ashley River. Most of the small, unlined drainage ditches are above the water table and are influent or losing streams. Conversely, the large streams (Golf Course Creek and Runway Creek) intersect the water table and are probably effluent or gaining streams (Halliburton NUS Corporation [Halliburton], June 1995).

Other surface water bodies in the vicinity of JBCA include Goose Creek Reservoir and wetland areas. Goose Creek Reservoir is about 2 miles northeast of the Base and supplies potable water to the area. There are 25 isolated and/or adjacent, jurisdictional, freshwater wetlands at JBCA that cover 282 acres (Halliburton, June 1995).

### *Hydrological Setting at North Auxiliary Airfield*

NAAF is between the North Fork Edisto River and Bull Swamp Creek. The North Fork Edisto River flows along the southern edge of NAAF, which is within the 100-year floodplain. The river is used as the water supply source for the city of Orangeburg, downstream from NAAF. Bull Swamp Creek is more than 2,000 feet east of NAAF (Science Applications International Corporation [SAIC], March 1989).

### *Surficial Geology at Joint Base Charleston-Air*

JBCA is in the Lower Coastal Plain Physiographic Province. The area is immediately underlain by sedimentary rocks and unconsolidated sediments of Tertiary and Quaternary Age. A thin veneer of Holocene/ Pleistocene beach deposits overlies the deeper Tertiary Age rocks that are underlain in turn by the Cretaceous Age basement rocks of the Coastal Plain. High-energy depositional environments – such as barrier island, beach, or tidal facies – are characterized by coarse-grained or sand-dominated deposits.

Relatively lower-energy depositional environments, such as marshes or mud flats, are usually associated with fine-grained, clay-dominated deposits or lithologies. Because of the fluctuations in sea level in response to glaciation and interglacial melting, these depositional environments were periodically changing, resulting in interbedded sands and clays. The shallowest Tertiary unit underlying the area is the Cooper Formation, which is approximately 40 feet below ground surface (bgs) at JBCA and regionally serves as a confining unit in the Charleston area (Halliburton, June 1995).

The shallow subsurface geology consists of sand with some silt, intermittent clay, and clay stringers of the Ladson Formation. The clay stringers often contain silt and are discontinuous across the area of interest. Clay content increases with depth, especially near the contact with the underlying Cooper Marl. The Cooper Marl is characterized by olive silt and clay with some disseminated phosphate grains and is encountered in monitoring well borings between 35 and 43 feet bgs. Shallow groundwater exists at depths of less than 10 feet bgs over most of JBCA (Halliburton, June 1995).

#### *Surficial Geology at North Auxiliary Airfield*

NAAF is in the Upper Coastal Plain Physiographic Province. The area is immediately underlain by sedimentary rocks and unconsolidated sediments of Tertiary Age. The Tertiary Age sediments are underlain by Cretaceous Age basement rocks of the Coastal Plain. The surficial geology at NAAF consists of 200 feet of poorly drained unconsolidated sands with interbedded clays. Soils in the area have a tendency to erode. The water table in the area is 30 to 100 feet below the land surface, but interbedded clay units limit the vertical movement of infiltrating water and may cause perched water tables and semi-confining conditions within the surficial aquifer. There is good interconnection between groundwater and surface water in the area. Deeper aquifers can mix with the surficial aquifer because the hydraulic gradient is upward in the vicinity of NAAF. Groundwater flows to the southwest and discharges to surface water in the southern portion of the field (Air Force Record [AR] #108, March 1900).

#### *Climate*

Eastern South Carolina has a humid subtropical climate characterized by warm, humid summers and mild winters. Historical data for a 30-year period in the JBCA area indicates that the mean annual precipitation was 51.4 inches. The calculated net annual precipitation (precipitation minus evapotranspiration) for the JBCA area is approximately 14.5 inches, and the one-year, 24-hour rainfall event for this area is estimated to be 4 inches (Tetra Tech, Inc., April 2010).

#### *Preliminary Assessment Findings*

The Preliminary Assessment (PA) conducted at JBCA during the week of October 27, 2015, identified five sites that warranted an SI to determine the presence or absence of PFASs (CH2M Hill, January 2016). The five sites at JBCA (now identified as AFFF Areas 1 through 5) are listed in Table 2. These areas are discussed in Sections 2.1 through 2.5, and the area locations are shown on Figure 2 (Appendix A).

A PA for PFASs was not conducted for NAAF. ASL conducted a brief assessment for NAAF (provided as Appendix B in the JBCA site-specific addendum to the QAPP [ASL, January 2017]) and identified four sites that warranted initiation of an SI to determine the presence or absence of PFASs. The four sites (now identified as AFFF Areas 6 through 9) from NAAF selected for an SI are also listed in Table 2. These areas are discussed in Sections 2.6 through 2.9, and the area locations are shown on Figure 3 (Appendix A).

#### *Previous Investigations*

Environmental investigations have been conducted at SWMU 55 (FPTA 3) and the current FTA (SWMU 52); however, none of the past investigations targeted PFASs (CH2M Hill, January 2016).

**Table 2 AFFF Areas and Selection Rationale for Site Inspections at Joint Base Charleston-Air**

<b>AFFF Area</b>	<b>Location</b>	<b>Associated Existing IRP ID</b>	<b>Rationale</b>
1	SWMU 55 (FT003, Fire Protection Training Area 3)	SWMU 55	<ul style="list-style-type: none"> <li>Operational from 1981 to 1989.</li> <li>AFFF was used during training exercises, but quantities discharged are unknown.</li> </ul>
2	SWMU 52 (AT551, Current Fire Training Area)	SWMU 52	<ul style="list-style-type: none"> <li>The old FTA system was operational from 1986 to 1992, and sprayed water was contained and discharged to an intermittent stream near the area.</li> <li>AFFF likely has been used at the location from 1986 to 1992.</li> <li>The old FTA system was removed in 1996 and replaced with a propane-fueled FTA system.</li> <li>Up to 5 feet of soil were excavated at the FTA in 1994.</li> <li>AFFF has not been used during fire training at the propane-fueled FTA.</li> <li>Annual AFFF system spray testing for the fire department vehicles is performed at the current FTA. Quantities are unknown.</li> <li>Liquids from the lined FTA flow into the adjacent lined pond. The pond periodically overflows into the adjacent low area.</li> </ul>
3	Building 570 (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>Currently has a high-expansion foam system.</li> <li>Formerly had an AFFF system.</li> <li>10 AFFF discharges are estimated to have occurred. Quantities of AFFF discharged are not known.</li> <li>Several discharges exited the hangar and possibly flowed to the storm drain in a grassy area south of the hangar.</li> <li>Storm drainage flows to Outfall 003.</li> </ul>
4	2005 Private Plane Crash Area (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>20 gallons of AFFF were used to extinguish an aircraft fire.</li> </ul>
5	Outfall 003 (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>Discharges from the Building 570 AFFF system flowed into the stormwater system and discharged at Outfall 003.</li> <li>Quantities of AFFF discharged are not known.</li> </ul>
6	NAAF Fire Station (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>269 five-gallon jugs (1,345 gallons) of AFFF are stored at the station.</li> <li>Spills inside the building have gone into drains that empty to an OWS, which is connected to the sanitary sewer system.</li> <li>Equipment is rinsed in the paved area north of the bays, and small amounts may have flowed into a low-lying area with two drainage ditches/pits north of the building.</li> </ul>
7	NAAF Pump House – Foam Truck Flush Area (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>A truck with a foam leak was flushed out at the pump house.</li> <li>Runoff flows into the drainage ditch east of the building and AST #7.</li> </ul>
8	NAAF Foam Test Area and Old C-141 (No RCRA Permit ID)	None (new area)	<ul style="list-style-type: none"> <li>The area consists of a newly constructed pond with a culvert that goes from the middle of the pond north under the runway to an infiltration point.</li> <li>The former pond was approximately 1,000 feet northwest of the new pond, just inside the current tree line.</li> <li>The C-141 was used for training.</li> </ul>

AFFF Area	Location	Associated Existing IRP ID	Rationale
9	FT010 (No RCRA Permit ID, NAAF Fire Training Area)	FT010	<ul style="list-style-type: none"> <li>• Intermittently used from 1979 to 1986 for fire protection training exercises four to six times per month.</li> <li>• Exact location uncertain; two areas were investigated in 1986 and 1987 (Site 10A and Site10B).</li> <li>• Firefighting agents used may have included protein foam, chlorobromomethane, Purple K powder, and carbon dioxide.</li> </ul>

Note: Table modified from CH2M Hill, January 2016

AFFF = aqueous film forming foam

FTA = fire training area

IRP = Installation Restoration Program

NAAF = North Auxiliary Air Field

PFAS = per- and polyfluorinated alkyl substances

SWMU = Solid Waste Management Unit

AST = aboveground storage tank

ID = identification

JBCA = Joint Base Charleston

OWS = oil/water separator

RCRA = Resource Conservation and Recovery Act

## 2.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1

SWMU 55 (AFFF Area 1) is in the east corner of the Base, near the intersection of South Aviation Avenue and Fighter Drive. SWMU 55 operated from 1971 until 1983 and consisted of a pit with a crushed limestone base and a surrounding earthen berm. An average of two training exercises occurred per month using up to 300 gallons of JP-4 per fire per exercise. Firefighting agents used at SWMU 55 included AFFF, dry chemicals, and Halon (CH2M Hill, January 2016).

Four environmental investigations have been conducted at SWMU 55. Soil, sediment, and groundwater samples were collected and analyzed during

- the Stage I Installation Restoration Program (IRP),
- the Stage 2 IRP investigation/feasibility study,
- the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI), and
- the Phase II RFI.

Media sampled at SWMU 55 were not analyzed for PFASs during any of these investigations. Currently, there is an inoperable air sparge (AS)/soil vapor extraction (SVE) system on site (CH2M Hill, January 2016).

## 2.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2

SWMU 52, the current FTA (AFFF Area 2), is on South Davis Avenue, west of its intersection with South Graves Avenue. Firefighting exercises were conducted from 1986 until 1992 using JP-4 as a fuel source. It consisted of a gravel area with a mock aircraft on an 85-foot diameter concrete pad that was surrounded by a concrete berm and a gravel area with no vegetation. Information regarding which extinguishing agents were used on the JP-4 fires is not available.

Eventually, the use of JP-4 to fuel fires ceased, and wooden pallets were used instead. SWMU 52 was used approximately once every six weeks. Water from the training exercises flowed from the pad to an oil/ water separator (OWS), which discharged to an intermittent stream south of SWMU 52. Because of its operational history, the site has undergone an array of RCRA environmental investigations and remediation efforts. None of the previous investigations targeted PFASs (CH2M Hill, January 2016).

A RCRA Facility Assessment (RFA) was conducted in 1990 followed by RFA Phase II sampling. In 1994, the original FTA was demolished, and soil was excavated to 5 feet across the entire containment area. An RFI recommending No Further Action for soil was completed in 1994 and included the FTA (SWMU 52), holding tanks (SWMU 102 and 103), and the OWS (SWMU 83). Additionally, the RFI included surface water and sediment sampling at the intermittent stream next to the FTA (SWMU 131) (CH2M Hill, January 2016).

Following the soil removal, the site was modified to include, among other features, a liquid propane burner. The new propane-fueled FTA has gravel over a liner with a mock aircraft and began operation in 1996. It is surrounded by asphalt-paved areas and forested land. During training exercises, propane-fueled fires are extinguished with high-pressure water, which collects in a high-density polyethylene-lined pond for reuse. Since the system modifications were completed in 1996, AFFF has not been used at the current FTA; however, annual testing of AFFF systems on the fire trucks is performed at the current FTA (CH2M Hill, January 2016).

At the time of the PA, 58 five-gallon buckets and 13 55-gallon drums of AFFF were stored in two sheds at SWMU 52. No AFFF spills at the storage sheds were identified (CH2M Hill, January 2016).

Because SWMU 52 is lined, PFASs are unlikely to exist in the environmental media surrounding the area; however, it is possible that PFASs migrated from the lined pond to an adjacent low area because of heavy rains. The pond was observed to be completely full during CH2M Hill's October 27, 2015, visit. Additional water entering the pond would overflow into adjacent lower areas (CH2M Hill, January 2016).

### **2.3 BUILDING 570 – AFFF AREA 3**

Building (Hangar) 570 (AFFF Area 3) is on North Graves Avenue, across from Building 610 (Base Supply). The hangar has a high-expansion foam system with a 55-gallon capacity bladder supply tank manufactured in 2011. This building previously had an AFFF system, but the supply tank size is unknown. The hangar has grate-covered trench drains that flow to an underground holding tank outside the south building wall. The holding tank is not connected to the sanitary sewer system and requires a pump to remove any liquid (CH2M Hill, January 2016).

An estimated 10 discharges from the AFFF system are known to have occurred at Building 570 since 1992. The quantities of AFFF released are unknown; however, several discharges flowed outside the hangar onto the apron, the adjacent grassy area, and likely into the single storm drain inlet south of the building. Once in the storm drain system, overflow liquids would have traveled through a series of underground pipes and concrete-lined ditches, eventually leaving the Base through Outfall 003. Outfall 003 flows into an unnamed tributary of Popperdam Creek, then into Popperdam Creek, and finally into the Ashley River (CH2M Hill, January 2016).

### **2.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

A small private plane crashed at the south end of the flightline in 2005 (AFFF Area 4). The Base fire department responded and extinguished the fire using approximately 20 gallons of AFFF. The area is grassed and maintained regularly because it is part of the airfield. A storm drain near the site conveys surface drainage to an open ditch, generally flowing south toward the commercial aircraft terminal (CH2M Hill, January 2016).

## **2.5   OUTFALL 003 – AFFF AREA 5**

Outfall 003 (AFFF Area 5) is in the southwest corner of the Wrenwoods Golf Course, near Rickenbacker Circle. Surface drainage flows through a ditch, portions of which are concrete-lined, into an unnamed tributary of Popperdam Creek, then into Popperdam Creek, which in turn flows into Ashley River (CH2M Hill, January 2016).

An estimated 10 AFFF releases are known to have occurred at Building 570 since 1992; however, the quantities of AFFF released are unknown. Any release likely would result in AFFF entering the stormwater system through the inlet at the south end of Building 570 and being conveyed to Outfall 003 (CH2M Hill, January 2016).

## **2.6   NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

NAAF Fire Station is in Building 20 (AFFF Area 6), which was constructed in the early 1990s. In 2016, 269 five-gallon jugs (1,345 gallons) of AFFF were stored in the fire station western bay. Five firefighting vehicles were at the station:

- One rapid intervention vehicle (Truck #10) with a 56-gallon AFFF capacity,
- Two P19Rs (Truck #7 and #30 [unmarked]) with 210-gallon AFFF capacities,
- One P23 (Truck #35) with a 500-gallon AFFF capacity, and
- One foam trailer with a 1,000-gallon AFFF capacity.

No spills, leaks, or accidental discharges of AFFF at the station have been reported. However, equipment is rinsed in the paved area north of the bays, and small amounts may have run off into a low-lying area with two drainage ditches/ pits north of the building. There have been no emergency responses involving the use of AFFF (ASL, January 2017).

## **2.7   NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

NAAF Pump House (AFFF Area 7) is in Building 10. Reportedly, a truck with a foam leak was flushed at the pump house on NAAF. Runoff would have flowed into the north-south drainage ditch east of the building and Aboveground Storage Tank (AST) #7. ASL inspected the area but could not find any evidence of the former activities and no additional information could be located for this area (ASL, January 2017).

## **2.8   NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

NAAF Foam Test Area and Old C-141 training area (AFFF Area 8) are in the southeast quadrant of the facility. The Foam Test Area and Old C-141 training area consist of a newly constructed pond at the woods' edge in the southern corner of NAAF. A culvert goes from the middle of the pond north under the runway to an infiltration point. Approximately 1,000 feet northwest of the new pond, ASL personnel observed a depression just inside the current line that appeared to be the old pond location (ASL, January 2017).

## **2.9   FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

Former FTA Site FT010 (AFFF Area 9) was approximately 2,000 feet east of the main 230/50 runway for NAAF in the northeastern corner of the field and approximately 1,200 feet south of the installation

boundary. Site FT010 was a shallow depression (pit) in the ground and was intermittently used from 1979 to 1986 for fire protection training exercises. Exercises were performed four to six times per month. The pit was usually sprayed and saturated with water prior to placing JP-4 jet fuel in the pit to minimize infiltration of fuel into the ground. Firefighting agents may have included protein foam, chlorobromomethane, Purple K powder, and carbon dioxide. These compounds naturally decay and were not considered a hazard. The exact location of FT010 is uncertain, and in 1986 and 1987 two areas were investigated (Site 10A and Site 10B). Neither area showed obvious signs of fire training activities. Site 10A showed significant amounts of oil and grease in the soil. No cleanup was performed at the site because of its remote location, because no receptors were close, and because the observed contaminants were biodegrading. The area remains an open field (AR File No. 108USAF, December 2003).

### 3.0 FIELD ACTIVITIES AND FINDINGS

ASL conducted field activities at JBCA between January 10, 2017, and February 10, 2017. Fieldwork was conducted in accordance with the QAPP (ASL, January 2016) and the JBCA site-specific addendum to the QAPP (ASL, January 2017).

#### 3.1 FIELD ACTIVITIES AND SAMPLING PROCEDURES

Field activities included collecting groundwater samples from direct push technology (DPT) borings using a stainless-steel screen point-16 sampler (SP-16), installing and sampling temporary wells, or sampling existing monitoring wells; collecting surface soil and subsurface soil samples from hand auger or DPT soil borings, and collecting surface water and sediment samples. ASL selected sampling locations most likely to have detectable concentrations of the target compounds as a result of a known or suspected AFFF release. Field duplicate samples were collected at a frequency of one for every 10 samples for each sample media. Matrix spike/ matrix spike duplicate samples were collected at a frequency of one per every 20 samples for each media.

Tables summarizing analytical data are presented in the Analytical Results subsection for each AFFF area discussion. Field forms – including readiness review forms, boring logs, groundwater sampling and groundwater grab sampling logs, soil and sediment sampling logs, surface water sampling logs, and field instrument calibration logs – are presented in Appendix B. The validation report, chains of custody, and laboratory data are presented in Appendix C. Physiochemical sample results are presented in Appendix D. Groundwater level data is presented in Appendix E.

Soil, sediment, surface water, and groundwater samples were submitted via overnight courier to Maxxam Analytics International Corporation of Mississauga, Ontario, Canada, under chain of custody procedures and analyzed for PFAS compounds using modified EPA Method 537. All samples were analyzed for the following parameters.

<u>Analyte</u>	<u>*CAS Number</u>
• Perfluorooctanesulfonic acid (PFOS)	1763-23-1
• Perfluorohexanesulfonic acid (PFHxS)	355-46-4
• Perfluorooctanoic acid (PFOA)	335-67-1
• Perfluoroheptanoic acid (PFHpA)	375-85-9
• Perfluorononanoic acid (PFNA)	375-95-1
• Perfluorobutanesulfonic acid (PFBS)	29420-43-3
• Perfluorobutanoic acid (PFBA)	375-22-4
• Perfluoropentanoic acid (PFPA)	2706-90-3

- Perfluorohexanoic acid (PFHxA) 307-24-4
- Perfluorooctanesulfonamide (PFOSA) 754-91-6
- Perfluorodecanoic acid (PFDA) 335-76-2
- Perfluorodecanesulfonic acid (PFDS) 335-77-3
- Perfluoroundecanoic acid (PFUnA) 2058-94-8
- Perfluorododecanoic acid (PFDoA) 307-55-1
- Perfluorotridecanoic acid (PFTriA) 72629-94-8
- Perfluorotetradecanoic acid (PFTeA) 376-06-7
- 6:2 Fluorotelomer sulfonate (6:2 FTS) 27619-97-2
- 8:2 Fluorotelomer sulfonate (8:2 FTS) 39108-34-4

\*CAS = Chemical Abstracts Service

DataChek conducted third-party data validation on 100% of the analytical data. Overall, the quality of the data was acceptable. The precision and accuracy results were acceptable for the project. Other data quality indicators (i.e. precision, accuracy, representativeness, comparability, and completeness) also met the project objectives. Data validation qualifiers were applied as needed to the data. All the results were evaluated as usable for the decisions being made. No determinations of an AFFF release are based upon quality control (QC)-qualified data. Complete laboratory data for modified EPA Method 537 results and the data validation report are presented in Appendix C. To provide basic soil parameter information, ASL also collected representative composite surface soil samples and composite subsurface soil samples from each area, which were analyzed for potential of hydrogen (pH), particle size distribution, percent solids, and total organic carbon (TOC). The physiochemical sample results are presented in Appendix D.

Soil borings at the sites were advanced with a track-mounted DPT drill rig. Surface soil samples were collected with stainless steel hand augers from 6 inches bgs. Subsurface soil samples were collected immediately above the water saturated/unsaturated soil interface using a DPT Macro-core<sup>®</sup> sampler with an acetate liner. Soil samples were placed in sampling containers using stainless steel spoons.

Groundwater samples were collected from existing monitoring wells, temporary monitoring wells installed at DPT soil borings, or from an SP-16 sampler installed at DPT soil borings. Temporary wells were constructed with ¾-inch diameter polyvinyl chloride prepacked well screens and risers. Grab samples were collected through a reusable GeoProbe<sup>®</sup> SP-16 drive point groundwater sampler consisting of a sheathed 0.78-inch inside diameter by 41-inch long stainless steel screen. The drive point was advanced to the desired depth and the sheath retracted to expose the screen. Polyvinyl tubing was then inserted through the drill rods into the screen. Groundwater samples from AFFF Areas 1, 2, 3, 4, 5, 6, and 9 were collected using a peristaltic pump, and groundwater samples from AFFF Areas 7 and 8 were collected manually using a check valve attached to the end of sample tubing. In both situations disposable polyvinyl tubing was inserted to the approximate midpoint of the saturated portion of the screened interval at each location. Sediment samples were collected using stainless steel spoons. Surface water samples were collected by attaching the sample container to an extendable rod designed for sampling and dipping the container into the water.

Sample points were located by Ashley Land Surveying, Inc. of Summerville, South Carolina, on February 8 and 9, 2017. Northing and easting coordinates were recorded in the South Carolina State Plane Coordinate System based on the North American Datum 83 (2011). Elevations were referenced to North American Vertical Datum 1988.

Sample locations, area-specific lithology, groundwater flow direction, analytical results, and conclusions for each AFFF area are presented in Sections 3.3 through 3.11.



## 3.2 PFAS CROSS-CONTAMINATION AVOIDANCE PROCEDURES

Field personnel complied with PFAS cross-contamination avoidance procedures and considerations, which are included in ASL Standard Operating Procedure 028 “Field Sampling Protocols to Avoid Cross-Contamination at Perfluorinated Compounds (PFCs) Sites.”

### 3.2.1 Field Equipment

- Teflon<sup>®</sup>-containing materials (Teflon<sup>®</sup> tubing, bailers, tape, plumbing paste, or other Teflon<sup>®</sup> materials) were not used because Teflon<sup>®</sup> contains fluorinated compounds.
- High-density polyethylene (HDPE) and silicon materials were acceptable.
- Peristaltic pumps were used to sample groundwater at depths of 25 feet or shallower. Pumps with Teflon<sup>®</sup> impellers, such as Grundfos RediFlo pumps, were not used. Field notes were recorded in a bound logbook that did not have waterproof paper. All personnel changed gloves between recording and sampling activities to prevent cross-contamination.
- Post-It Notes<sup>®</sup> were not allowed on site.
- Only Sharpie<sup>®</sup> brand markers were used. Pens were used to document field activities in the logbooks and on field forms, to label sample containers, and to prepare the chains of custody.
- Chemical (blue) ice packs were not used to store samples, food, or drinks.

### 3.2.2 Field Clothing and Personal Protective Equipment

- The sampling personnel wore field clothing made of synthetic and natural fibers (preferably cotton). The clothing had to have been laundered at least six times without using a fabric softener since it was purchased. New clothing was not allowed because it could contain PFAS-related treatments.
- Only rain gear made from polyurethane and wax-coated materials was allowed.
- Clothing or boots containing Gore-Tex<sup>™</sup> was not allowed because it consists of a PFAS membrane.
- Tyvek<sup>®</sup> clothing was not allowed on site because it contains fluorinated compounds.
- Disposable nitrile gloves were worn at all times when field activities were being conducted, and a new pair was donned prior to the following activities at each sample location:
  - Decontamination of reusable sampling equipment;
  - Contact with sample bottles or water containers;
  - Insertion of anything into the well (HDPE tubing, HydraSleeve<sup>®</sup> bailer, etc.);
  - Insertion of silicon tubing into the peristaltic pump;
  - Completion of monitor well purging;
  - Sample collection; and
  - Handling of any quality assurance/QC samples, including field blanks and equipment blanks.
- A new pair of nitrile gloves was worn after handling any nondedicated sampling equipment, after contact with surfaces that had not been decontaminated, or when field personnel thought it was necessary.

### 3.2.3 Sample Containers

- All samples were collected in polypropylene or HDPE bottles with screw caps made of the same materials. The liners of screw caps were not made of Teflon<sup>®</sup> and did not contain PFASs.
- Glass sample containers were not used.

- Container labels were completed using a Sharpie® pen after the caps had been placed on each bottle.

### **3.2.4 Wet Weather**

Field personnel who were sampling during wet weather (such as rainfall or snowfall) wore appropriate clothing that did not pose a risk of cross-contamination. Sampling personnel avoided synthetic gear treated with water-repellant finishes containing PFAS. Only rain gear made from polyurethane and wax-coated materials was allowed.

Field personnel wore gloves when erecting or moving a gazebo tent overtop used for protection from rain at sampling locations because the canopy material may have been treated with a PFAS-based coating. Gloves were changed immediately after handling the tent, and any further contact with the tent was avoided until all sampling activities were finished and the team was ready to move on to the next sample location.

### **3.2.5 Equipment Decontamination**

Field sampling equipment, including oil-water interface meters and water level indicators, were decontaminated using Alconox® or Liquinox® soap. Decon 90® was not used during decontamination activities. Laboratory-certified PFAS-free water was used for the final decontamination rinse of sampling equipment. Larger equipment, such as drill rigs, was decontaminated using potable water and a high-pressure washer and then rinsed with potable water.

### **3.2.6 Personnel Hygiene**

- Field personnel did not use cosmetics, moisturizers, hand cream, or other related products as part of their personal hygiene routine before a sampling event because these products may contain surfactants and be a potential source of PFAS.
- Because many manufactured sunblock and insect repellants contain PFAS, only sunblock and insect repellants that contain 100% natural ingredients were allowed.
- For restroom breaks, field personnel left the exclusion zone (EZ) before removing PPE. Before returning to the EZ, field personnel washed as normal, allowing extra time to rinse with water after using soap. Field personnel used a mechanical dryer to avoid using paper towels if possible.

### **3.2.7 Food Considerations**

Field personnel did not eat or drink inside the EZ.

### **3.2.8 Visitors**

Site visitors remained outside the EZ during all sampling activities.

### **3.3 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

#### **3.3.1 Sample Locations**

To assess possible releases of PFAS at AFFF Area 1, three borings were installed in the vicinity of the former AS/SVE system on February 2, 2017. Soil boring CHRTN01-001-001 was installed in the vicinity of the telephone pole (closest to the former system), and soil borings CHRTN01-001-002 and CHRTN01-001-003 were placed to form a triangle, so the groundwater flow direction could also be determined. Two surface and subsurface soil samples were collected from the borings closest to the former AS/SVE system, and groundwater samples were collected from all three locations from temporary wells. Reportedly, monitoring wells were just outside the area of investigation; however, ASL personnel could not locate the wells during the field event to collect groundwater elevation measurements. Three temporary wells were installed at the boring locations. The temporary wells were screened near the top of the uppermost saturated zone with total depths of 15.0 feet bgs and constructed with 10-foot long, prepacked screens. Sampling locations are shown on Figure 4 (Appendix A).

#### **3.3.2 Lithology**

The lithology at AFFF Area 1 (from ground surface) generally consists of clayey sand (Unified Soil Classification System [USCS] – SC), silty sand (USCS – SM), or silty clay (USCS – CL). The surficial water table was observed in the soil between approximately 5 and 6.5 feet bgs. All borings were terminated within the Quaternary Terrace Deposit of the surficial aquifer. Detailed boring logs are included in Appendix B.

#### **3.3.3 Groundwater Flow**

Based on water levels from the temporary wells gauged on February 3, 2017, the uppermost water-bearing zone in AFFF Area 1 was detected at elevations ranging from 27.29 feet to 29.16 feet amsl as summarized in Appendix E. Shallow groundwater flowed west/southwest as shown on Figure 4 (Appendix A).

#### **3.3.4 Analytical Results**

##### *Surface Soil*

Two primary surface soil samples (CHRTN01-001-SS-001 and CHRTN01-002-SS-001) and one field duplicate (CHRTN01-001-SS-901) were collected at AFFF Area 1 at 6 inches bgs. PFBS was detected in one sample and the duplicate at estimated concentrations of 0.55 µg/kg and 4.4 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all samples at concentrations ranging from an estimated 2.9 µg/kg to 70 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all samples at concentrations ranging from 71 µg/kg to 810 µg/kg, with the concentration in CHRTN01-002-SS-001 (810 µg/kg) above the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 3 and on Figure 5 (Appendix A).

##### *Subsurface Soil*

Two primary subsurface soil samples (CHRTN01-001-SO-004 and CHRTN01-002-SO-005) and one field duplicate (CHRTN01-001-SO-904) were collected at AFFF Area 1 at 3 and 5 feet bgs. PFBS was detected in all samples at estimated concentrations ranging from 0.90 µg/kg to 9.0 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all samples at concentrations ranging from 18 µg/kg to 46 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all samples at concentrations

ranging from 46 µg/kg to 130 µg/kg, with the concentration in CHRTN01-002-SO-005 (130 µg/kg) above the calculated RSL of 126 µg/kg. Subsurface soil analytical results are shown in Table 4 and on Figure 5 (Appendix A).

**Table 3 Solid Waste Management Unit 55 (FT003, Fire Protection Training Area 3)  
AFFF Area 1 Surface Soil Analytical Results**

	Sample ID	CHRTN01-001-SS-001	CHRTN01-001-SS-901 (dup)	CHRTN01-002-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/2/17	2/2/17	2/2/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.44 U	<b>0.55 J</b>	<b>4.4 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>2.9 J</b>	<b>4.1 J</b>	<b>70</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>71</b>	<b>80</b>	<b>810</b>

Bold values indicate analyte was detected at the concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA Regional Screening Level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

SS = surface soil

U = The analyte was not detected above the reported sample quantification limit

**Table 4 Solid Waste Management Unit 55 (FT003, Fire Protection Training Area 3)  
AFFF Area 1 Subsurface Soil Analytical Results**

	Sample ID	CHRTN01-001-SO-004	CHRTN01-001-SO-904 (dup)	CHRTN01-002-SO-005
	Depth (feet)	3 - 4	3 - 4	4 - 5
	Sample Date	2/2/17	2/2/17	2/2/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>6.0 J</b>	<b>9.0 J</b>	<b>0.90 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>35 J</b>	<b>46</b>	<b>18</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>51 J</b>	<b>46</b>	<b>130</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA Regional Screening Level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN01-004-SS-001) and subsurface (CHRTN01-004-SO-006) soil samples were collected at AFFF Area 1. The samples were submitted for

analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

### Groundwater

Three primary groundwater samples (CHRTN01-001-GW-010, CHRTN01-002-GW-010, and CHRTN01-003-GW-010) and one field duplicate (CHRTN01-001-GW-910) were collected at AFFF Area 1. PFBS was detected in all samples at concentrations ranging from 2.8 µg/L to 34 µg/L, all below the RSL of 40 µg/L. PFOA was detected in all samples at concentrations ranging from 37 µg/L to 790 µg/L, all above the EPA HA of 0.07 µg/L. PFOS was detected in all samples at concentrations ranging from 54 µg/L to 360 µg/L, all above the EPA HA of 0.07 µg/L. Combined concentrations of PFOA plus PFOS ranged from 91 µg/L to 1,150 µg/L, above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 5 and on Figure 6 (Appendix A).

**Table 5 Solid Waste Management Unit 55 (FT003, Fire Protection Training Area 3)  
AFFF Area 1 Groundwater Analytical Results**

	Sample ID	CHRTN01-001-GW-010	CHRTN01-001-GW-910 (dup)	CHRTN01-002-GW-010	CHRTN01-003-GW-010
	Depth (feet)	10	10	10	10
	Sample Date	2/3/17	2/3/17	2/3/17	2/3/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	34	28	2.8	34
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	280	290	37	790
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	160	150	54	360
PFOA + PFOS	0.07 <sup>c</sup>	440	440	91	1,150

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

GW = groundwater

ID = identification

### 3.3.5 Conclusions

Two primary surface soil samples, two primary subsurface soil samples, three primary groundwater samples, and one duplicate sample of these media were collected from AFFF Area 1. PFBS, PFOA, and PFOS were detected in the surface and subsurface soil samples; one surface soil sample and one subsurface soil sample showed a PFOS concentration above the calculated RSL. PFBS, PFOA, PFOS, and combined PFOA and PFOS were detected in the analyzed groundwater samples; the concentrations of PFOA, PFOS, and combined PFOA and PFOS in all three samples were above the EPA HA. Therefore, concentrations of PFAS above screening levels in the surface soil, subsurface soil, and groundwater have been confirmed at AFFF Area 1.

### **3.4 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

#### **3.4.1 Sample Locations**

To assess possible releases of PFAS at AFFF Area 2, three borings were installed in the grassy area west of the training pad and north and east of the lined drainage pond on February 8, 2017. Surface soil and subsurface soil samples were collected. Temporary wells were installed at two boring locations, and groundwater samples were collected. The temporary wells were screened near the top of the uppermost saturated zone with total depths of 15.0 feet bgs and constructed with 10-foot long, prepacked screens. Two existing monitor wells (17.5 feet bgs) south of the training pad were sampled, and a sediment sample and surface water sample were collected from the surface water runoff area south of the pond and southwest of the training area. The surface water runoff area is at lower elevation than the training pad. The sample locations are shown on Figure 7 (Appendix A).

#### **3.4.2 Lithology**

The lithology at AFFF Area 2 (from ground surface) generally consists of silt-silty clay (USCS – OL), clayey sand (USCS – SC), clay (USCS – CL), or silty sand (USCS – SM). The surficial water table was observed in the soil between approximately 6 and 8 feet bgs. All borings were terminated within the Quaternary Terrace Deposit of the surficial aquifer. Detailed boring logs are included in Appendix B.

#### **3.4.3 Groundwater Flow**

Water levels were gauged from the temporary wells on February 2, 2017, and monitoring wells on February 8, 2017. The uppermost water-bearing zone in AFFF Area 2 was at elevations ranging from 20.54 feet to 24.27 feet amsl as summarized in Appendix E. Historical groundwater flow direction has been determined to be to the south/southwest, as shown on Figure 7 (Appendix A).

#### **3.4.4 Analytical Results**

##### *Surface Soil*

Three surface soil samples (CHRTN02-001-SS-001, CHRTN02-002-SS-001, and CHRTN02-003-SS-001) were collected at AFFF Area 2 at 6 inches bgs. PFBS was detected in one sample at a concentration of 2.0 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all three samples at concentrations ranging from 1.6 µg/kg to 10 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at concentrations ranging from 77 µg/kg to 91 µg/kg, below the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 6 and on Figure 8 (Appendix A).

##### *Subsurface Soil*

Three subsurface soil samples (CHRTN02-001-SO-005, CHRTN02-002-SO-006, and CHRTN02-003-SO-006) were collected at AFFF Area 2 from 4 to 6 feet bgs. PFBS was detected in one sample at a concentration of 2.2 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all three samples at concentrations from an estimated 0.35 µg/kg to a 3.4 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at estimated concentrations ranging from 1.2 µg/kg to 33 µg/kg, below the calculated RSLs of 126 µg/kg. Subsurface soil analytical results are shown in Table 7 and on Figure 8 (Appendix A).

**Table 6 Solid Waste Management Unit 52 (AT551, Current Fire Training Area)  
AFFF Area 2 Surface Soil Analytical Results**

	Sample ID	CHRTN02-001-SS-001	CHRTN02-002-SS-001	CHRTN02-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/8/17	2/8/17	2/8/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>2.0</b>	0.40 U	0.37 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>10</b>	<b>1.6</b>	<b>2.1</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>85</b>	<b>77</b>	<b>91</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA Regional Screening Level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SS = surface soil

U = The analyte was not detected above the reported sample quantification limit

**Table 7 Solid Waste Management Unit 52 (AT551, Current Fire Training Area)  
AFFF Area 2 Subsurface Soil Analytical Results**

	Sample ID	CHRTN02-001-SO-005	CHRTN02-002-SO-006	CHRTN02-003-SO-006
	Depth (feet)	4 - 5	5 - 6	5 - 6
	Sample Date	2/8/17	2/8/17	2/8/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.48 U	<b>2.2</b>	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.35 J</b>	<b>3.4</b>	<b>0.63 J</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>1.2 J</b>	<b>33 J</b>	<b>14</b>

Bold values indicate was analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN02-005-SS-001) and subsurface (CHRTN02-005-SO-007) soil samples were collected at AFFF Area 2. The samples were submitted for analysis of pH, TOC, percent solids, and grain size. The physiochemical laboratory data sheets and summary table are included in Appendix D.

### Groundwater

Four groundwater samples were collected at AFFF Area 2: two from temporary wells (CHRTN02-001-GW-010 and CHRTN02-002-GW-011) and two from existing monitoring wells (CHRTN02-52MW-02-

017.5 and CHRTN02-52MW-03-017.5). PFBS was detected in all four samples at concentrations ranging from 0.057 µg/L to 0.93 µg/L, all below the RSL of 40 µg/L. PFOA was detected in all four samples at concentrations ranging from 0.17 µg/L to 0.89 µg/L, above the EPA HA of 0.07 µg/L. PFOS was detected in all four samples at concentrations ranging from 0.18 µg/L to 24 µg/L, above the EPA HA of 0.07 µg/L. PFOA and PFOS were detected at combined concentrations ranging from 0.35 µg/L to 24.89 µg/L, above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 8 and on Figure 9 (Appendix A).

**Table 8 Solid Waste Management Unit 52 (AT551, Current Fire Training Area)  
AFFF Area 2 Groundwater Analytical Data**

	Sample ID	CHRTN02-001-GW-010	CHRTN02-002-GW-011	CHRTN02-52MW-02-017.5	CHRTN02-52MW-03-017.5
	Depth (feet)	10	11	17.5	17.5
	Sample Date	2/2/17	2/2/17	2/8/17	2/8/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.057</b>	<b>0.58</b>	<b>0.40</b>	<b>0.93</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.17</b>	<b>0.56</b>	<b>0.38</b>	<b>0.89</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.18</b>	<b>4.3</b>	<b>2.1</b>	<b>24</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.35</b>	<b>4.86</b>	<b>2.48</b>	<b>24.89</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

### *Sediment*

One primary sediment sample (CHRTN02-004-SD-001) and one duplicate sample (CHRTN02-004-SD-901) were collected at AFFF Area 2. PFBS was detected in the primary and the duplicate sample at an estimated concentration of 0.49 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in the primary sample but not the duplicate, at an estimated concentration of 0.47 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in the primary and the duplicate samples at estimated concentrations of 2.9 µg/kg and 6.9 µg/kg, below the calculated RSL of 126 µg/kg. Sediment analytical results are shown in Table 9 and on Figure 8 (Appendix A).

### *Surface Water*

One primary surface water sample (CHRTN02-004-SW-001) and one duplicate sample (CHRTN02-004-SW-901) were collected at AFFF Area 2. PFBS was detected in both samples at concentrations of 0.044 µg/L and 0.050 µg/L, below the RSL of 40 µg/L. PFOA was detected in both samples at estimated concentrations of 0.031 µg/L and 0.057 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected in both samples at an estimated concentration of 0.34 µg/L and a concentration of 0.35 µg/L, above the EPA HA of 0.07 µg/L. The estimated combined PFOA and PFOS concentrations were 0.371 µg/L and 0.407



µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 10 and on Figure 9 (Appendix A).

**Table 9 Solid Waste Management Unit 52 (AT551, Current Fire Training Area)  
AFFF Area 2 Sediment Analytical Results**

	Sample ID	CHRTN02-004-SD-001	CHRTN02-004-SD-901 (dup)
	Depth (feet)	0 - 0.5	0 - 0.5
	Sample Date	2/3/17	2/3/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>0.49 J</b>	<b>0.49 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.47 J</b>	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>6.9 J</b>	<b>2.9 J</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilogram

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

**Table 10 Solid Waste Management Unit 52 (AT551, Current Fire Training Area)  
AFFF Area 2 Surface Water Analytical Results**

	Sample ID	CHRTN02-004-SW-001	CHRTN02-004-SW-901 (dup)
	Sample Date	2/3/17	2/3/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.050</b>	<b>0.044</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.031 J</b>	<b>0.057 J</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.34 J</b>	<b>0.35</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.371 J</b>	<b>0.407 J</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>)

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/kg = micrograms per kilogram

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

### **3.4.5 New AFFF Release**

Air Force Civil Engineer Center provided the following information regarding a new AFFF spill at AFFF Area 2 on JBCA. On June 2, 2017, the JBCA deputy fire chief reported that when staff arrived on site to set up a training exercise, they became aware vandalism had occurred at the FTA. Staff noted damage to the retention pond and fire prevention trailer, and AFFF agent was released from recycled totes. General materials and training devices were strewn around the training grounds. Security Forces Squadron (SFS) investigators and Office of Special Investigations (OSI) representatives responded to investigate and take statements from firefighters. Civil Engineering (CE) Environmental responded to look at the spills and ground/soil contamination. A photographer took multiple photos of the area. Medical Group (MDG)/Bioenvironmental also responded to support as needed. Fire Emergency Services (FES) conducted an assessment and determined that approximately 1,100 gallons of AFFF were released to a grassy area and flowed across the asphalt toward a propane tank, but did not reach the fence line or surface water ditch. The release area was dry upon discovery, and grass appeared dead. No soil was excavated. Figure 10 shows the approximate area of the June 2017 release of AFFF.

### **3.4.6 Conclusions**

Three surface soil samples, three subsurface soil samples, four groundwater samples, one primary and one duplicate sediment sample, and one primary and one duplicate surface water sample were collected from AFFF Area 2. PFBS, PFOA, and PFOS were detected in the surface soil, subsurface soil, and sediment samples; however, all concentrations were below RSLs. PFBS, PFOA, and PFOS were detected in the groundwater and surface water samples. PFOA, PFOS, and the combined PFOA and PFOS concentrations exceeded the EPA HA in the four groundwater samples. PFOS and the combined PFOA and PFOS concentrations exceeded the EPA HA in both surface water samples. Therefore, concentrations of PFAS above screening levels in the soil and sediment have not been confirmed at AFFF Area 2; however, concentrations of PFAS above screening levels in the groundwater and surface water have been confirmed at AFFF Area 2. The release that occurred in June 2017, after ASL's SI field events were completed, will likely increase PFAS impacts at AFFF Area 2.

## **3.5 BUILDING 570 – AFFF AREA 3**

### **3.5.1 Sample Locations**

To assess possible releases of PFAS at AFFF Area 3, three borings with temporary wells were installed south of Building 570 on February 7, 2017. Surface soil, subsurface soil, and groundwater samples were collected. A sediment and surface water sample were collected for AFFF Area 3 at the end of the concrete-lined drainage ditch leading from Building 570 to Outfall #3. The temporary wells were screened near the top of the uppermost saturated zone with total depths ranging from 15 to 20 feet bgs, and they were constructed with 10-foot long, prepacked screens. One surface water sample and one sediment sample were collected at the end of the concrete-lined drainage ditch leading from Building 570 to Outfall #3. The soil and groundwater sample locations are shown on Figure 11, and the surface water and sediment sample location are shown on Figure 12 (Appendix A).

### **3.5.2 Lithology**

The lithology at AFFF Area 3 (from ground surface) generally consists of silt-silty clay (USCS – OL), silty sand (USCS – SM), and clayey sand (USCS – SC). The surficial water table was observed in the soil between approximately 6.5 and 7.5 feet bgs. All borings were terminated within the Quaternary Terrace Deposit of the surficial aquifer. Detailed boring logs are included in Appendix B.

### 3.5.3 Groundwater Flow

Based on water levels from the temporary wells gauged on February 7, 2017, the uppermost water-bearing zone in AFFF Area 3 was at elevations ranging from 30.44 feet to 31.30 feet amsl as summarized in Appendix E. Shallow groundwater flowed west/southwest as shown on Figure 11 (Appendix A).

### 3.5.4 Analytical Results

#### Surface Soil

Three surface soil samples (CHRTN03-001-SS-001, CHRTN03-002-SS-001, and CHRTN03-003-SS-001) were collected at AFFF Area 3 at 6 inches bgs. PFBS and PFOA were not detected in any of the samples. PFOS was detected in all three samples at concentrations ranging from 3.5 µg/kg to 32 µg/kg, below the calculated RSL of 126 µg/kg. PFBS, PFOA, and PFOS surface soil analytical results are shown in Table 11 and on Figure 13 (Appendix A).

**Table 11 Building 570 AFFF Area 3 Surface Soil Analytical Results**

	Sample ID	CHRTN03-001-SS-001	CHRTN03-002-SS-001	CHRTN03-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/7/17	2/7/17	2/7/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.44 U	0.37 U	0.39 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.22 U	0.19 U	0.19 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>23</b>	<b>32</b>	<b>3.5</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

CHRTN = Joint Base Charleston

ID = identification

SS = surface soil

U = The analyte was not detected above the reported sample quantification limit

#### Subsurface Soil

Three subsurface soil samples (CHRTN03-001-SO-006, CHRTN03-002-SO-005, and CHRTN03-003-SO-006) were collected at AFFF Area 3 at 4 to 6 feet bgs. PFBS was not detected in any of the samples. PFOA was detected in one sample at an estimated concentration of 0.25 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at concentrations ranging from an estimated 0.48 µg/kg to 12 µg/kg, below the calculated RSL of 126 µg/kg. Subsurface soil analytical results are shown in Table 12 and on Figure 13 (Appendix A).

#### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN03-004-SS-001) and subsurface (CHRTN03-004-SO-007) soil samples were collected at AFFF Area 3. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

**Table 12 Building 570 AFFF Area 3 Subsurface Soil Analytical Results**

	Sample ID	CHRTN03-001-SO-006	CHRTN03-002-SO-005	CHRTN03-003-SO-006
	Depth (feet)	5 – 6	4 - 5	5 - 6
	Sample Date	2/7/17	2/7/17	2/7/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.44 U	0.44 U	0.40 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.22 U	<b>0.25 J</b>	0.20 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>0.48 J</b>	<b>12</b>	<b>0.60 J</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

### Groundwater

Three groundwater samples (CHRTN03-001-GW-010, CHRTN03-002-GW-015, and CHRTN03-003-GW-015) were collected from DPT borings at AFFF Area 3. Groundwater samples CHRTN03-002-GW-015 and CHRTN03-003-GW-015 were inadvertently labeled with a sample depth of 15 feet. However, the temporary wells were installed to a depth of 15 feet with a screen of 5 to 15 feet bgs, and depth to water was approximately 9 feet bgs. Therefore, these samples should have been labeled with a sample depth of 12 feet bgs. To avoid confusion, no changes have been made to the sample identifications or the groundwater logs.

PFBS was detected in all three samples at concentrations ranging from 0.020 µg/L to 0.22 µg/L, below the RSL of 40 µg/L. PFOA was detected in all samples at concentrations ranging from 0.020 µg/L to 0.24 µg/L; two of the three concentrations were above the EPA HA of 0.07 µg/L. PFOS was detected in all three samples at concentrations ranging from 0.49 µg/L to 6.7 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from 0.51 µg/L to 6.94 µg/L, above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 13 and on Figure 14 (Appendix A).

### Sediment

One sediment sample (CHRTN03-004-SD-001) was collected for AFFF Area 3 at the end of the concrete-lined drainage ditch leading from Building 570 to Outfall #3. PFBS and PFOA were not detected. PFOS was detected at an estimated concentration of 0.52 µg/kg, below the calculated RSL of 126 µg/kg. Sediment analytical results are shown in Table 14 and on Figure 15 (Appendix A).

### Surface Water

One surface water sample (CHRTN03-004-SW-001) was co-located with the sediment sample. PFBS was detected in the surface water sample at 0.12 µg/L, below the RSL of 40 µg/L. PFOA was detected at 0.081 µg/L, above the EPA HA of 0.07 µg/L. PFOS was detected at 1.9 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 1.981 µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 15 and on Figure 16 (Appendix A).

**Table 13 Building 570 AFFF Area 3 Groundwater Analytical Results**

	Sample ID	CHRTN03-001-GW-010	CHRTN03-002-GW-015	CHRTN03-003-GW-015
	Depth (feet)	10	12	12
	Sample Date	2/7/17	2/7/17	2/7/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.020</b>	<b>0.22</b>	<b>0.043</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.020</b>	<b>0.24</b>	<b>0.091</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.49</b>	<b>6.7</b>	<b>2.0</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.51</b>	<b>6.94</b>	<b>2.091</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

**Table 14 Building 570 AFFF Area 3 Sediment Analytical Results**

	Sample ID	CHRTN03-004-SD-001
	Depth (feet)	0.5
	Sample Date	2/7/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>0.52 J</b>

Note: Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilogram

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

**Table 15 Building 570 AFFF Area 3 Surface Water Analytical Results**

	Sample ID	CHRTN03-004-SW-001
	Sample Date	2/7/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.12</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.081</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>1.9</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>1.981</b>

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SW = surface water

### 3.5.5 Conclusions

Three surface soil samples, three subsurface soil samples, three groundwater samples, one sediment sample, and one surface water sample were collected from AFFF Area 3. PFOS was detected in the surface soil, subsurface soil, and sediment samples; however, all concentrations were below RSLs. PFBS, PFOA, and PFOS were detected in the groundwater and surface water samples. The concentrations of PFOA, PFOS, and combined PFOA and PFOS were above the EPA HA in groundwater and surface water samples. Therefore, concentrations of PFAS above screening levels in the soil and sediment have not been confirmed at AFFF Area 3; however, concentrations of PFAS above screening levels in the groundwater and surface water have been confirmed at AFFF Area 3.

## 3.6 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4

### 3.6.1 Sample Locations

To assess possible releases of PFAS at AFFF Area 4, three borings were installed in a triangle across the 2005 private plane crash area on February 9, 2017. Grab groundwater samples were collected from a SP-16 sampler screen set at the uppermost saturated zone of 11 to 15 feet bgs. Surface soil, subsurface soil, and groundwater samples were collected from each SP-16 location. One sediment sample and one surface water sample were collected from the drainage ditch east of the site. The sample locations are shown on Figure 17 (Appendix A).

### 3.6.2 Lithology

The lithology at AFFF Area 4 (from ground surface) generally consists of silt-silty clay (USCS – OL), silty sand (USCS – SM), and sandy clay (USCS – CL). The surficial water table was observed in the soil between 7 and 7.5 feet bgs approximately. All borings were terminated within the Quaternary Terrace Deposit of the surficial aquifer. Detailed boring logs are included in Appendix B.

### 3.6.3 Groundwater Flow

Airfield personnel requested that no temporary wells be installed near the runway. On February 9, 2017, groundwater samples were collected using an SP-16 sampler, so groundwater levels could not be obtained. Therefore, groundwater flow direction has not been determined for AFFF Area 4 although groundwater flow direction has historically been estimated to the southwest (Halliburton, June 1995). Groundwater was observed in the soil during drilling at approximately 7.5 feet bgs.

### 3.6.4 Analytical Results

#### Surface Soil

Three primary surface soil samples (CHRTN04-001-SS-001, CHRTN04-002-SS-001, and CHRTN04-003-SS-001) and one duplicate (CHRTN04-002-SS-901) were collected at AFFF Area 4 at 6 inches bgs. PFBS was not detected in any samples. PFOA was detected in one primary sample at an estimated concentration of 0.29 µg/kg and in the duplicate at an estimated concentration of 0.38 µg/kg. PFOS was detected in all samples at concentrations of an estimated 0.43 µg/kg to 1.3 µg/kg; all concentrations were below the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 16 and on Figure 18 (Appendix A).

**Table 16 2005 Private Plane Crash Area AFFF Area 4 Surface Soil Analytical Results**

	Sample ID	CHRTN04-001-SS-001	CHRTN04-002-SS-001	CHRTN04-002-SS-901 (dup)	CHRTN04-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5	0.5
	Sample Date	2/9/17	2/9/17	2/9/17	2/9/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.44 U	0.44 U	0.40 U	0.44 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.29 J</b>	0.22 U	<b>0.38 J</b>	0.22 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>1.3</b>	<b>0.69 J</b>	<b>0.75 J</b>	<b>0.43 J</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SS = surface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

#### Subsurface Soil

Three primary subsurface soil samples (CHRTN04-001-SO-006, CHRTN04-002-SO-006, and CHRTN04-003-SO-006) and one duplicate (CHRTN04-002-SO-906) were collected at AFFF Area 4 at 5 to 6 feet bgs. PFBS, PFOA, and PFOS were not detected in any of the samples. Subsurface soil analytical results are shown in Table 17 and on Figure 18 (Appendix A).

**Table 17 2005 Private Plane Crash Area AFFF Area 4 Subsurface Soil Analytical Results**

	Sample ID	CHRTN04-001-SO-006	CHRTN04-002-SO-006	CHRTN04-002-SO-906 (dup)	CHRTN04-003-SO-006
	Depth (feet)	5 - 6	5 - 6	5 - 6	5 - 6
	Sample Date	2/9/17	2/9/17	2/9/17	2/9/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.48 U	0.44 U	0.40 U	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.24 U	0.22 U	0.20 U	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	0.48 U	0.44 U	0.40 U	0.48 U

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.onrl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.onrl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

#### *Soil Physiochemical Analyses*

To provide basic soil parameter information, composite surface (CHRTN04-005-SS-001) and subsurface (CHRTN04-005-SO-007) soil samples were collected at AFFF Area 4. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

#### *Groundwater*

Three primary groundwater samples (CHRTN04-001-GW-013, CHRTN04-002-GW-013, and CHRTN04-003-GW-013) and one duplicate sample (CHRTN04-002-GW-913) were collected at AFFF Area 4. PFBS was detected in two primary samples and the duplicate at concentrations ranging from an estimated 0.013 µg/L to 0.032 µg/L, below the EPA RSL of 40 µg/L. PFOA was detected in two primary samples and the duplicate at concentrations ranging from an estimated 0.017 µg/L to 0.025 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected in two primary samples and the duplicate at concentrations ranging from 0.044 µg/L to 0.21 µg/L, with one primary sample and the duplicate at concentrations above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from an estimated 0.061 to 0.235, with one primary sample and the duplicate at concentrations above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 18 and on Figure 19 (Appendix A).

#### *Sediment*

One sediment sample (CHRTN04-004-SD-001) was collected from AFFF Area 4. PFBS and PFOA were not detected. PFOS was detected at 7.0 µg/kg, below the calculated RSL of 126 µg/kg. The sediment analytical results are shown in Table 19 and on Figure 18 (Appendix A).



**Table 18 2005 Private Plane Crash Area AFFF Area 4 Groundwater Analytical Results**

	Sample ID	CHRTN04-001-GW-013	CHRTN04-002-GW-013	CHRTN04-002-GW-913 (dup)	CHRTN04-003-GW-013
	Depth (feet)	13	13	13	13
	Sample Date	2/9/17	2/9/17	2/9/17	2/9/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.013 J</b>	<b>0.032</b>	<b>0.029</b>	0.0070 U
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.017 J</b>	<b>0.025</b>	<b>0.024</b>	0.014 U
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.044</b>	<b>0.21</b>	<b>0.18</b>	0.010 U
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.061 J</b>	<b>0.235</b>	<b>0.204</b>	ND

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>)

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

GW = groundwater

ND = not detected

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

**Table 19 2005 Private Plane Crash Area AFFF Area 4 Sediment Analytical Results**

	Sample ID	CHRTN04-004-SD-001
	Depth (feet)	<b>0 - 0.5</b>
	Sample Date	2/9/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.92 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.46 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>7.0</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

### Surface Water

A surface water sample (CHRTN04-004-SW-001) was co-located with the sediment sample. PFBS was detected at an estimated concentration of 0.015 µg/L, below the RSL of 40 µg/L. PFOA was detected at a

concentration of 0.040 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected at a concentration of 0.30 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration detected was 0.34 µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 20 and on Figure 19 (Appendix A).

**Table 20 2005 Private Plane Crash Area AFFF Area 4 Surface Water Analytical Results**

	Sample ID	CHRTN04-004-SW-001
	Sample Date	2/9/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.015 J</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.040</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.30</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.34</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SW = surface water

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

### 3.6.5 Conclusions

Three primary and one duplicate surface soil samples, three primary and one duplicate subsurface soil samples, three primary and one duplicate groundwater samples, one sediment sample, and one surface water sample were collected from AFFF Area 4. PFOA and PFOS were detected in the surface soil, and PFOS was detected in the sediment sample; however, all concentrations were below RSLs. PFBS, PFOA, and PFOS were detected in two primary and one duplicate groundwater samples and in the surface water sample. PFOS and the combined concentrations of PFOA and PFOS exceeded the EPA HA in one primary and the duplicate groundwater sample and in the surface water sample. Therefore, concentrations of PFAS above screening levels in the soil and sediment have not been confirmed at AFFF Area 4; however, concentrations of PFAS above screening levels in the groundwater and surface water have been confirmed at AFFF Area 4.

## 3.7 OUTFALL 003 – AFFF AREA 5

### 3.7.1 Sample Locations

To assess possible releases of PFAS at AFFF Area 5, one boring was installed south of the canal on February 7, 2017. A grab groundwater sample was collected from a SP-16 sampler screen set at the uppermost saturated zone of 6 to 10 feet bgs. A sediment sample and surface water sample were collected from Outfall 003. The sample locations are shown on Figure 12 (Appendix A).

### 3.7.2 Lithology

The lithology at the AFFF Area 5 (from ground surface) generally consists of silt-silty clay (USCS – OL), silty sand (USCS – SM), and sandy clay (USCS – CL). The surficial water table was observed in the soil

at approximately 3.5 feet bgs. The boring was terminated within the Quaternary Terrace deposit of the surficial aquifer. A detailed boring log is included in Appendix B.

### 3.7.3 Groundwater Flow

On February 7, 2017, one groundwater sample was collected using an SP-16 sampler; therefore, groundwater flow direction was not determined for AFFF Area 5. Historical groundwater flow direction was estimated to the southeast (Halliburton, June 1995). Groundwater was observed in the soil during drilling at approximately 3.5 feet bgs.

### 3.7.4 Analytical Results

#### Groundwater

One groundwater sample (CHRTN05-002-GW-008) was collected from AFFF Area 5. PFBS was estimated at 0.0052 µg/L, below the RSL of 40 µg/L. PFOA was detected at an estimated 0.0072 µg/L, and PFOS was detected at an estimated 0.014 µg/L. The estimated combined PFOA and PFOS concentration was 0.0212 µg/L. PFOA, PFOS, and combined PFOA and PFOS were below the EPA of HA 0.07 µg/L. Groundwater analytical results are shown in Table 21 and on Figure 16 (Appendix A).

**Table 21 Outfall 003 Area 5 Groundwater Analytical Results**

	<b>Sample ID</b>	<b>CHRTN05-002-GW-008</b>
	<b>Depth (feet)</b>	<b>8</b>
	<b>Sample Date</b>	<b>2/7/17</b>
<b>Analyte</b>	<b>Screening Level (µg/L)</b>	<b>Result (µg/L)</b>
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.0052 J</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.0072 J</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.014 J</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.0212 J</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

#### Sediment

One sediment sample (CHRTN05-001-SD-001) was collected from AFFF Area 5. PFBS and PFOA were not detected. PFOS was detected at an estimated 0.84 µg/kg, below the calculated RSL of 126 µg/kg. Sediment analytical results are shown in Table 22 and on Figure 15 (Appendix A).

#### Surface Water

One surface water sample (CHRTN05-001-SW-001) was co-located with the sediment sample. PFBS was detected at 0.065 µg/L, below the RSL of the 40 µg/L. PFOA was detected at 0.041 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected at 0.82 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.861 µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 23 and on Figure 16 (Appendix A).

**Table 22 Outfall 003 AFFF Area 5 Sediment Analytical Results**

	Sample ID	CHRTN05-001-SD-001
	Depth (feet)	0 - 0.5
	Sample Date	2/7/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>0.84 J</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit.

**Table 23 Outfall 003 AFFF Area 5 Surface Water Analytical Results**

	Sample ID	CHRTN05-001-SW-001
	Sample Date	2/7/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.065</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.041</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.82</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.861</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Charleston

ID = identification

SW = surface water

### 3.7.5 Conclusions

One groundwater sample, one sediment sample, and one surface water sample were collected from AFFF Area 6. PFOS was detected below the calculated RSL in the sediment sample. PFBS, PFOA, and PFOS were detected in the groundwater sample and surface water sample. PFOS and the combined concentration of PFOA and PFOS were above the EPA HA of 0.07 µg/L in the surface water sample. Therefore, concentrations of PFAS above screening levels in the groundwater and sediment have not been confirmed at AFFF Area 5; however, concentrations of PFAS above screening levels in the surface water have been confirmed at AFFF Area 5.

## 3.8 NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6

### 3.8.1 Sample Locations

To assess possible releases of PFAS at AFFF Area 6, two borings with temporary wells were installed in the low-lying area with stormwater swales northwest of the fire station; staining in the area showed that water pools during storms. A third boring and temporary well were installed in the grass southwest of the fire station apron, between the vehicle bays and the wash rack. The temporary wells were screened near the top of the uppermost saturated zone with total depths ranging from 30 to 35 feet bgs, and they were constructed with 10-foot long, prepacked screens. Surface soil, subsurface soil, and groundwater samples were collected from each location. One sediment and one surface water sample were collected from the drainage ditch northwest of the building. The sample locations are shown on Figure 20.

### 3.8.2 Lithology

The lithology at AFFF Area 6 (from ground surface) generally consists of silt-silty clay (USCS – OL), silty sand (USCS – SM), sandy clay (USCS – CL), and sand (USCS – SW). The surficial water table was observed in the soil between approximately 25.5 and 30.5 feet bgs. All borings were terminated within the Cretaceous age-Orangeburg Group aquifer. Detailed boring logs are included in Appendix B.

### 3.8.3 Groundwater Flow

Based on water levels from the temporary wells gauged on February 4, 2017, the uppermost water-bearing zone in AFFF Area 6 ranged from 272.39 feet to 272.73 feet amsl as summarized in Appendix E. Shallow groundwater flowed southeast as shown on Figure 20 (Appendix A).

### 3.8.4 Analytical Results

#### *Surface Soil*

Three surface soil samples (CHRTN06-001-SS-001, CHRTN06-002-SS-001, and CHRTN06-003-SS-001) were collected at AFFF Area 6 at 6 inches bgs. PFBS was detected in one sample at an estimated concentration of 0.44 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all three samples at concentrations ranging from an estimated 0.58 µg/kg to 1.8 µg/kg below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at concentrations ranging from 13 µg/kg to 200 µg/kg with the concentration in CHRTN06-003-SS-001 (200 µg/kg) above the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 24 and on Figure 21 (Appendix A).

#### *Subsurface Soil*

Three subsurface soil samples (CHRTN06-001-SO-025, CHRTN06-002-SO-024, and CHRTN06-003-SO-029) were collected at AFFF Area 6 from 24 feet to 29 feet bgs. PFBS was detected in two samples at concentrations of an estimated 0.42 µg/kg and 2.0 µg/kg, below the EPA RSL of 130,000 µg/kg. PFOA was detected in one sample at an estimated concentration of 0.64 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at concentrations ranging from 6.0 µg/kg to 17 µg/kg, below the calculated RSL of 126 µg/kg. Subsurface soil analytical results are shown in Table 25 and on Figure 21 (Appendix A).

**Table 24 North Auxiliary Airfield Fire Station AFFF Area 6 Surface Soil Analytical Results**

	Sample ID	CHRTN06-001-SS-001	CHRTN06-002-SS-001	CHRTN06-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/3/17	2/3/17	2/3/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>0.44 J</b>	0.38 U	0.40 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.58 J</b>	<b>0.71 J</b>	<b>1.8</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>19</b>	<b>13</b>	<b>200</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SS = surface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

**Table 25 North Auxiliary Airfield Fire Station AFFF Area 6 Subsurface Soil Analytical Results**

	Sample ID	CHRTN06-001-SO-025	CHRTN06-002-SO-024	CHRTN06-003-SO-029
	Depth (feet)	24 - 25	23 - 24	28 - 29
	Sample Date	2/3/17	2/3/17	2/3/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>2.0</b>	<b>0.42 J</b>	0.40 UJ
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.64 J</b>	0.20 U	0.20 UJ
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>17</b>	<b>6.0</b>	<b>6.4</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup> EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

UJ = The analyte was not detected at the reported value. The reported value is approximate.

### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN06-005-SS-001) and subsurface (CHRTN06-005-SO-027) soil samples were collected at AFFF Area 6. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

### Groundwater

Three groundwater samples (CHRTN06-001-GW-025, CHRTN06-002-GW-025, and CHRTN06-003-GW-030) were collected from AFFF Area 6. PFBS was detected in all three samples at concentrations ranging from 0.13 µg/L to 13 µg/L, below the RSL of 40 µg/L. PFOA was detected in all three samples at concentrations ranging from 0.10 µg/L to 2.6 µg/L, above the EPA HA of 0.07 µg/L. PFOS was detected in all three samples at concentrations ranging from 1.7 µg/L to 85 µg/L, above the EPA HA of 0.07 µg/L.

The combined PFOA and PFOS concentration ranged from 1.84 µg/L to 87.6 µg/L, all above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 26 and on Figure 22 (Appendix A).

**Table 26 North Auxiliary Airfield Fire Station AFFF Area 6 Groundwater Analytical Results**

	Sample ID	CHRTN06-001-GW-025	CHRTN06-002-GW-025	CHRTN06-003-GW-030
	Depth (feet)	25	25	30
	Sample Date	2/4/17	2/4/17	2/4/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>13</b>	<b>0.60</b>	<b>0.13</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>2.6</b>	<b>0.14</b>	<b>0.10</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>85</b>	<b>1.7</b>	<b>3.5</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>87.6</b>	<b>1.84</b>	<b>3.6</b>

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup>EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

### *Sediment*

One sediment sample (CHRTN06-004-SD-001) was collected from AFFF Area 6. PFBS was detected at an estimated concentration of 0.46 µg/kg, below the RSL of 130,000 µg/kg. PFOA was not detected. PFOS was detected at a concentration of 7.4 µg/kg, below the calculated RSL of 126 µg/kg. Sediment analytical results are shown in Table 27 and on Figure 21 (Appendix A).

**Table 27 North Auxiliary Airfield Fire Station AFFF Area 6 Sediment Analytical Results**

	Sample ID	CHRTN06-004-SD-001
	Depth (feet)	0 - 0.5
	Sample Date	2/3/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	<b>0.46 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.22 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>7.4</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-November-2017>).

<sup>b</sup>Screening levels were calculated using the EPA Regional Screening Level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

### Surface Water

One surface water sample (CHRTN06-004-SW-001) was co-located with the sediment sample. PFBS was detected at 0.021 µg/L, below the RSL of 40 µg/L. PFOA was detected at 0.023 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected at 0.43 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.453 µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 28 and on Figure 22 (Appendix A).

**Table 28 North Auxiliary Airfield Fire Station AFFF Area 6 Surface Water Analytical Results**

	Sample ID	CHRTN06-004-SW-001
	Sample Date	2/3/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.021</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.023</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.43</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.453</b>

Bold values indicate analyte was detected at concentration indicated.

Shaded cells indicate analyte was detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SW = surface water

### 3.8.5 Conclusions

Three surface soil samples, three subsurface soil samples, three groundwater samples, one sediment sample, and one surface water sample were collected from AFFF Area 6. PFBS, PFOA, and PFOS were detected in the surface soil and subsurface soil samples; the concentration of PFOS in one surface soil sample was above the calculated RSL. PFBS and PFOS were detected in the sediment sample at concentrations below the RSLs. PFBS, PFOA, and PFOS were detected in the groundwater and surface water samples. PFOA, PFOS, and the combined PFOA and PFOS concentrations were above the EPA HA in all groundwater samples. PFOS and the combined PFOA and PFOS concentrations were above the EPA HA in the surface water sample. Therefore, concentrations of PFAS above screening levels in the subsurface soil and sediment have not been confirmed at AFFF Area 6; however, concentrations of PFAS above screening levels in the surface soil, groundwater, and surface water have been confirmed at AFFF Area 6.

## 3.9 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7

### 3.9.1 Sample Locations

To assess possible releases of PFAS at AFFF Area 7, two borings with temporary wells were installed north and south of the service road in the stormwater swale northeast of the pump house and AST #7 on February 3 and 4, 2017. A third boring and temporary well were installed south of the pump house on the north side of the service road. The temporary wells were screened near the top of the uppermost saturated zone with total depths of 55 feet bgs and constructed with 10-foot long, prepacked screens. Surface soil,



subsurface soil, and groundwater samples were collected from all three locations. No surface water bodies were in the immediate vicinity of the area. The sample locations are shown on Figure 23.

### 3.9.2 Lithology

The lithology at the AFFF Area 7 (from ground surface) generally consists of silty sand (USCS – SM), sandy clay (USCS – CL), and sand (USCS – SP and SW). The surficial water table was observed in the soil between approximately 38 and 39.5 feet bgs. All borings were terminated within the Cretaceous age-Orangeburg Group aquifer. Detailed boring logs are included in Appendix B.

### 3.9.3 Groundwater Flow

Based on water levels from the temporary wells gauged on February 4, 2017, the uppermost water-bearing zone in AFFF Area 7 ranged from 275.45 feet to 275.88 feet amsl as summarized in Appendix E. Shallow groundwater flowed southeast as shown on Figure 23 (Appendix A).

### 3.9.4 Analytical Results

#### Surface Soil

Three surface soil samples (CHRTN07-001-SS-001, CHRTN07-002-SS-001, and CHRTN07-003-SS-001) were collected at AFFF Area 7 at 6 inches bgs. PFBS was detected in one sample at an estimated concentration of 0.77 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all three samples at concentrations ranging from an estimated 0.75 µg/kg to 1.3 µg/kg. PFOS was detected in all three samples at concentrations ranging from 10 µg/kg to 100 µg/kg, below the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 29 and on Figure 25 (Appendix A).

**Table 29 North Auxiliary Airfield Pump House – Foam Truck Flush Area AFFF Area 7  
Surface Soil Analytical Results**

	Sample ID	CHRTN07-001-SS-001	CHRTN07-002-SS-001	CHRTN07-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/3/17	2/4/17	2/4/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.44 U	0.44 U	<b>0.77 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>1.1</b>	<b>0.75 J</b>	<b>1.3 J</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>10</b>	<b>40</b>	<b>100</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SS = surface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

### Subsurface Soil

Three subsurface soil samples (CHRTN07-001-SO-038, CHRTN07-002-SO-038, and CHRTN07-003-SO-037) were collected at AFFF Area 7 from 36 to 38 feet bgs. PFBS was detected in one sample at 1.7 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in all three samples at estimated concentrations ranging from 0.11 µg/kg to 0.85 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all samples at concentrations ranging from 1.6 µg/kg to 26 µg/kg, below the calculated RSL of 126 µg/kg. Subsurface soil analytical results are shown in Table 30 and on Figure 24 (Appendix A).

**Table 30 North Auxiliary Airfield Pump House – Foam Truck Flush Area AFFF Area 7  
Subsurface Soil Analytical Results**

	Sample ID	CHRTN07-001-SO-038	CHRTN07-002-SO-038	CHRTN07-003-SO-037
	Depth (feet)	37 – 38	37 - 38	36 – 37
	Sample Date	2/3/17	2/4/17	2/4/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.40 U	0.38 U	1.7
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	<b>0.28 J</b>	<b>0.11 J</b>	<b>0.85 J</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>26</b>	<b>1.6</b>	<b>25</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA Regional Screening Level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN07-004-SS-001) and subsurface (CHRTN07-004-SO-039) soil samples were collected at AFFF Area 7. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

### Groundwater

Three groundwater samples (CHRTN07-001-GW-040, CHRTN07-002-GW-040, and CHRTN07-003-GW-040) were collected from temporary wells at AFFF Area 7. PFBS was detected in all three samples at concentrations ranging from an estimated 0.014 µg/L to 1.2 µg/L, all below the RSL of 40 µg/L. PFOA was detected in all three samples at concentrations ranging from an estimated 0.012 µg/L to 0.50 µg/L; one sample was above the EPA HA of 0.07 µg/L. PFOS was detected in all three samples at concentrations ranging from 0.062 µg/L to 3.4 µg/L; two samples were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from 0.074 µg/L to 3.9 µg/L, all above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 31 and on Figure 25 (Appendix A).

## 3.9.5 Conclusions

Three surface soil samples, three subsurface soil samples, and three groundwater samples were collected from AFFF Area 7. PFBS, PFOA, and PFOS were in the surface soil and subsurface soil samples; however, all concentrations were below RSLs. PFBS, PFOA, and PFOS were in the groundwater

samples. PFOA was above the EPA HA in one sample, and PFOS was above the EPA HA in two samples. The combined PFOA and PFOS concentrations exceeded the EPA HA in all three samples. Therefore, concentrations of PFAS above screening levels in the soil have not been confirmed at AFFF Area 7; however, concentrations of PFAS above screening levels in the groundwater have been confirmed at AFFF Area 7.

**Table 31 North Auxiliary Airfield Pump House – Foam Truck Flush Area AFFF Area 7  
Groundwater Analytical Results**

	Sample ID	CHRTN07-001-GW-040	CHRTN07-002-GW-040	CHRTN07-003-GW-040
	Depth (feet)	40	40	40
	Sample Date	2/4/17	2/5/17	2/4/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	0.11	0.014 J	1.2
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	0.012 J	0.027	0.50
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	0.062	0.13	3.4
PFOA + PFOS	0.07 <sup>c</sup>	0.074 J	0.157	3.9

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

### 3.10 NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8

#### 3.10.1 Sample Locations

To assess possible releases of PFAS at AFFF Area 8, three borings were installed on February 4 and 5, 2017. One was installed inside the tree line to the north in the location of the former pond, one was installed next to the stormwater pond to the south of the former runways, and the third was installed to the west of the former north/south runway, east of the first two borings. Surface soil, subsurface soil, and groundwater samples were collected from all three locations. A surface water sample and sediment sample were collected from the stormwater pond. Sample locations are shown on Figure 26 (Appendix A).

#### 3.10.2 Lithology

The lithology at AFFF Area 8 (from ground surface) generally consists of silty sand (USCS – SM), silty clay (USCS – CL), and sand (USCS – SP). The surficial water table was observed in the soil between approximately 51 and 56.5 feet bgs. All borings were terminated within the Cretaceous age-Orangeburg Group aquifer. Detailed boring logs are included in Appendix B.

### 3.10.3 Groundwater Flow

Based on water levels from the temporary wells gauged on February 5, 2017, the uppermost water-bearing zone in AFFF Area 8 ranged from 211.23 feet to 211.92 feet amsl as summarized in Appendix E. Shallow groundwater flowed southwest as shown on Figure 26 (Appendix A).

### 3.10.4 Analytical Results

#### Surface Soil

Three primary surface soil samples (CHRTN08-001-SS-001, CHRTN08-002-SS-001, and CHRTN08-003-SS-001) and one duplicate surface soil sample (CHRTN08-003-SS-901) were collected at AFFF Area 8 at 6 inches bgs. PFBS was not detected in any of the samples. PFOA was detected in one sample at 0.94 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three primary samples and the duplicate at concentrations ranging from 2.6 µg/kg to 480 µg/kg, with the concentrations in CHRTN08-003-SS-001 (470 µg/kg) and the duplicate (480 µg/kg) above the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 32 and on Figure 27 (Appendix A).

**Table 32 North Auxiliary Airfield Foam Test Area and Old C-141 (Training) AFFF Area 8 Surface Soil Analytical Results**

	Sample ID	CHRTN08-001-SS-001	CHRTN08-002-SS-001	CHRTN08-003-SS-001	CHRTN08-003-SS-901 (dup)
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/4/17	2/5/17	2/5/17	2/5/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.40 U	0.36 U	4.0 U	4.0 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.20 U	<b>0.94</b>	2.0 U	2.0 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>2.6</b>	<b>36</b>	<b>470</b>	<b>480</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SS = surface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit.

#### Subsurface Soil

Three primary subsurface soil samples (CHRTN08-001-OS-053, CHRTN08-002-SO-050, and CHRTN08-003-OS-055) and one duplicate subsurface soil sample (CHRTN08-003-SO-955) were collected at AFFF Area 8 from 50 to 55 feet bgs. PFBS was detected in two primary samples and the duplicate at estimated concentrations from 0.37 µg/kg to 3.6 µg/kg, below the RSL of 130,000 µg/kg. PFOA was detected in one primary sample and the duplicate at estimated concentrations of 0.29 µg/kg and 0.58 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in two primary samples and the duplicate at concentrations ranging from an estimated 1.7 µg/kg to 22 µg/kg, below the calculated

RSL of 126 µg/kg. Subsurface soil analytical results are shown in Table 33 and on Figure 27 (Appendix A).

**Table 33 North Auxiliary Airfield Foam Test Area and Old C-141 (Training) AFFF Area 8 Subsurface Soil Analytical Results**

	Sample ID	CHRTN08-001-SO-053	CHRTN08-002-SO-050	CHRTN08-003-SO-055	CHRTN08-003-SO-955 (dup)
	Depth (feet)	52 - 53	49 - 50	54 - 55	54 - 55
	Sample Date	2/4/17	2/5/17	2/5/17	2/5/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.39 U	<b>0.37 J</b>	<b>3.6 J</b>	<b>2.0 J</b>
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.19 U	0.19 U	<b>0.58 J</b>	<b>0.29 J</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	0.39 U	<b>22</b>	<b>4.5 J</b>	<b>1.7 J</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

ID = identification

SO = subsurface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit.

#### Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface (CHRTN08-005-SS-001) and subsurface (CHRTN08-005-SO-053) soil samples were collected at AFFF Area 8. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.

#### Groundwater

Three primary groundwater samples (CHRTN08-001-GW-055, CHRTN08-002-GW-050, and CHRTN08-003-GW-055) and one duplicate sample (CHRTN08-002-GW-950) were collected at AFFF Area 8. PFBS was detected in all three primary samples and the duplicate at concentrations from 0.033 µg/L to 4.2 µg/L, all below the RSL of 40 µg/L. PFOA was detected in two primary samples and the duplicate at concentrations ranging from 0.21 µg/L to 0.96 µg/L, all above the EPA HA of 0.07 µg/L. PFOS was detected in all three primary samples and the duplicate at concentrations from an estimated 0.0064 µg/L to 6.8 µg/L; two primary samples and the duplicate were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from 0.0064 µg/L to 7.02 µg/L; two primary samples and the duplicate were above the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 34 and on Figure 28 (Appendix A).

#### Sediment

One sediment sample (CHRTN08-004-SD-001) was collected from AFFF Area 8. PFBS and PFOA were not detected. PFOS was detected at 5.7 µg/kg, below the calculated RSL of 126 µg/kg. Sediment analytical results are summarized in Table 35 and shown on Figure 27 (Appendix A).

**Table 34 North Auxiliary Airfield Foam Test Area and Old C-141 (Training) AFFF Area 8  
Groundwater Analytical Results**

	Sample ID	CHRTN08-001-GW-055	CHRTN08-002-GW-050	CHRTN08-002-GW-950 (dup)	CHRTN08-003-GW-055
	Depth (ft)	55	50	50	55
	Sample Date	2/5/17	2/5/17	2/5/17	2/5/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.033</b>	<b>0.75</b>	<b>0.68</b>	<b>4.2</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	0.014 U	<b>0.22</b>	<b>0.21</b>	<b>0.96</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.0064 J</b>	<b>6.8</b>	<b>5.1</b>	<b>4.0</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.0064 J</b>	<b>7.02</b>	<b>5.31</b>	<b>4.96</b>

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

dup = duplicate

GW = groundwater

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

**Table 35 North Auxiliary Airfield Foam Test Area and Old C-141 (Training)  
AFFF Area 8 Sediment Analytical Results**

	Sample ID	CHRTN08-004-SD-001
	Depth (feet)	0 - 0.5
	Sample Date	2/3/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>5.7</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SD = sediment

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U = The analyte was not detected above the reported sample quantification limit.

### Surface Water

One surface water sample (CHRTN08-004-SW-001) was co-located with the sediment sample. PFBS was detected at an estimated 0.013 µg/L, below the RSL of 40 µg/L. PFOA was detected at 0.025 µg/L, below the EPA HA of 0.07 µg/L. PFOS was detected at 0.38 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.405 µg/L, above the EPA HA of 0.07 µg/L. Surface water analytical results are shown in Table 36 and on Figure 28 (Appendix A).

**Table 36 North Auxiliary Airfield Foam Test Area and Old C-141 (Training)  
AFFF Area 8 Surface Water Analytical Results**

	Sample ID	CHRTN08-004-SW-001
	Sample Date	2/3/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.013 J</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	<b>0.025</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.38</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.405</b>

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>).

<sup>b</sup>EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SW = surface water

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit.

### 3.10.5 Conclusions

Three primary and one duplicate surface soil samples, three primary and one duplicate subsurface soil samples, three primary and one duplicate groundwater samples, one sediment sample, and one surface water sample were collected from AFFF Area 8. PFBS was detected in the subsurface soil samples and PFOA was detected in surface and subsurface soil samples at concentrations below the RSLs. PFOS was detected in surface soil, subsurface soil, and sediment samples, with the concentrations in one surface soil sample and the duplicate above the calculated RSL of 126 µg/kg. PFBS, PFOA, and PFOS were detected in the groundwater and surface water samples. PFOA was above the EPA HA of 0.07 µg/L in two primary groundwater samples and the duplicate. PFOS was above the EPA HA of 0.07 µg/L in two primary groundwater samples, the duplicate sample, and the surface water sample. The combined PFOA and PFOS concentration was above the EPA HA of 0.07 µg/L in two primary groundwater samples, the duplicate, and the surface water sample. Therefore, concentrations of PFAS above screening levels in the subsurface soil and sediment have not been confirmed at AFFF Area 8; however, concentrations of PFAS above screening levels in the surface soil, groundwater, and surface water have been confirmed at AFFF Area 8.

### **3.11 FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

#### **3.11.1 Sample Locations**

To assess possible releases of PFAS at Area 9, three borings were installed in a triangle within the footprint of the former FTA on February 5 and 6, 2017. Surface soil, subsurface soil, and groundwater samples were collected from all three locations. No surface water bodies were in the immediate vicinity of the site. The sample locations are shown on Figure 29 (Appendix A).

#### **3.11.2 Lithology**

The lithology at AFFF Area 9 (from ground surface) generally consists of silt (USCS – OL), silty sand (USCS – SM), sand (USCS – SP), sandy clay (USCS – CL), and clayey sand (USCS – SC). The surficial water table was observed in the soil between approximately 19.5 and 26 feet bgs. All borings were terminated within the Cretaceous age-Orangeburg Group aquifer. Detailed boring logs are included in Appendix B.

#### **3.11.3 Groundwater Flow**

Based on water levels from the temporary wells gauged on February 6, 2017, the uppermost water-bearing zone in AFFF Area 9 was detected at elevations ranging from 275.64 feet to 269.39 feet amsl as summarized in Appendix E. Shallow groundwater flowed northeast as shown on Figure 29 (Appendix A).

#### **3.11.4 Analytical Results**

##### *Surface Soil*

Three surface soil samples (CHRTN09-001-SS-001, CHRTN09-002-SS-001, and CHRTN09-003-SS-001) were collected from AFFF Area 9 at 6 inches bgs. PFBS was not detected in any samples. PFOA was detected in one sample at an estimated concentration of 0.18 µg/kg, below the calculated RSL of 126 µg/kg. PFOS was detected in all three samples at concentrations ranging from an estimated 0.32 µg/kg to 1.8 µg/kg, below the calculated RSL of 126 µg/kg. Surface soil analytical results are shown in Table 37 and on Figure 30 (Appendix A).

##### *Subsurface Soil*

Three subsurface soil samples (CHRTN09-001-SO-025, CHRTN09-002-SO-020, and CHRTN09-003-SO-018) were collected from AFFF Area 9 from 17 to 25 feet bgs. PFBS, PFOA, and PFOS were not detected. Subsurface soil analytical results are shown in Table 38 and on Figure 30 (Appendix A).

##### *Soil Physiochemical Analyses*

To provide basic soil parameter information, composite surface (CHRTN09-004-SS-001) and subsurface (CHRTN09-004-SO-023) soil samples were collected at AFFF Area 9. The samples were submitted for analysis of pH, TOC, percent solids, and grainsize. The physiochemical laboratory data sheets and summary table are included in Appendix D.



**Table 37 FT010 (North Auxiliary Airfield Fire Training Area) AFFF Area 9  
Surface Soil Analytical Results**

	Sample ID	CHRTN09-001-SS-001	CHRTN09-002-SS-001	CHRTN09-003-SS-001
	Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	2/5/17	2/6/17	2/6/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.37 U	0.35 U	0.35 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.19 U	0.17 U	<b>0.18 J</b>
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	<b>1.8</b>	<b>0.32 J</b>	<b>1.0</b>

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SS = surface soil

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

**Table 38 FT010 (North Auxiliary Airfield Fire Training Area) AFFF Area 9  
Subsurface Soil Analytical Results**

	Sample ID	CHRTN09-001-SO-025	CHRTN09-002-SO-020	CHRTN09-003-SO-018
	Depth (feet)	24 - 25	19 - 20	17 - 18
	Sample Date	2/6/17	2/6/17	2/6/17
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	130,000 <sup>a</sup>	0.40 U	0.44 U	0.48 U
Perfluorooctanoic acid (PFOA)	126 <sup>b</sup>	0.20 U	0.22 U	0.24 U
Perfluorooctane sulfonate (PFOS)	126 <sup>b</sup>	0.40 U	0.44 U	0.48 U

Bold values indicate analyte was detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Levels for Residential Soil (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> Screening levels were calculated using the EPA regional screening level Calculator ([https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search)). The RSL calculations are presented in Appendix F.

µg/kg = micrograms per kilograms

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

ID = identification

SO = subsurface soil

U = The analyte was not detected above the reported sample quantification limit.

### Groundwater

Three groundwater samples (CHRTN09-001-GW-025, CHRTN09-002-GW-023, and CHRTN09-003-GW-025) were collected from AFFF Area 9. PFBS was in two samples at estimated concentrations of 0.0071 µg/L and 0.0073 µg/L, both below the RSL of 40 µg/L. PFOA was in one sample at an estimated concentration of 0.013 µg/L, below the EPA HA of 0.07 µg/L. PFOS was in all samples at concentrations ranging from an estimated 0.0052 µg/L to 0.043 µg/L, all below the EPA HA of 0.07 µg/L. The combined estimated PFOA and PFOS concentration ranged from an 0.0052 µg/L to 0.056 µg/L, all below the EPA HA of 0.07 µg/L. Groundwater analytical results are shown in Table 39 and on Figure 31 (Appendix A).

**Table 39 FT010 (North Auxiliary Airfield Fire Training Area) AFFF Area 9  
Groundwater Analytical Results**

	Sample ID	CHRTN09-001-GW-025	CHRTN09-002-GW-023	CHRTN09-003-GW-025
	Depth (feet)	25	23	25
	Sample Date	2/6/17	2/6/17	2/6/17
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	40 <sup>a</sup>	<b>0.0073 J</b>	0.0070 U	<b>0.0071 J</b>
Perfluorooctanoic acid (PFOA)	0.07 <sup>b</sup>	0.014 U	0.014 U	<b>0.013 J</b>
Perfluorooctane sulfonate (PFOS)	0.07 <sup>b</sup>	<b>0.0052 J</b>	<b>0.0099 J</b>	<b>0.043</b>
PFOA + PFOS	0.07 <sup>c</sup>	<b>0.0052 J</b>	<b>0.0099 J</b>	<b>0.056 J</b>

Bold values indicate analyte detected at concentration indicated.

<sup>a</sup>EPA Regional Screening Level for tap water (November 2017) (<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017>)

<sup>b</sup> EPA, May 2016a. “Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)” and EPA, May 2016b. “Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).”

<sup>c</sup>EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter

AFFF = aqueous film forming foam

CHRTN = Joint Base Charleston

GW = groundwater

ID = identification

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

U = The analyte was not detected above the reported sample quantification limit

### 3.11.5 Conclusions

Three surface soil samples, three subsurface soil samples, and three groundwater samples were collected from AFFF Area 9. PFBS was not in any of the soil samples. PFOA and PFOS were in the surface soil samples at concentrations below RSLs. Subsurface soil did not show any concentrations above laboratory detection limits. PFBS, PFOA, PFOS, and combined PFOA and PFOS were in the groundwater samples at concentrations below screening levels. Therefore, concentrations of PFAS above screening levels in the soil and groundwater have not been confirmed at AFFF Area 9.

### 3.12 INVESTIGATION-DERIVED WASTE

The USAF has awarded a separate contract to others for the removal and proper disposal of soil and water investigation-derived waste generated during this SI. Waste soil and water were placed in Department of Transportation-approved steel drums (three drums of soil and two drums of water). The drums at JBCA are staged near Buildings B692 and B697, and drums at NAAF are staged near the Fire Station. A representative sample was collected from each media, submitted to CT Laboratories, and analyzed for PFAS, total petroleum hydrocarbons, toxicity (using the Toxicity Characteristic Leaching Procedure [TCLP] for the full TCLP list of analytes), flashpoint, pH, cyanide, and sulfide. These analytical results have been submitted to the USAF electronically.

Construction waste – such as paper, plastic, trash, and personal protective equipment – was placed in plastic garbage bags and placed in an on-site dumpster for disposal

#### 4.0 GROUNDWATER PATHWAY

JBCA is approximately 16 miles northwest of Charleston Harbor and the Atlantic Ocean in the Lower Atlantic Coastal Plain physiographic province. NAAF is approximately 85 miles northwest of JBCA in the Upper Atlantic Coastal Plain physiographic province. The Coastal Plain physiographic province of South Carolina consists of a wedge of sediments that thicken from the Fall Line (a geomorphic region commonly found along the eastern coast of the United States, where an abrupt change in stream gradient results in waterfalls and/or rapids), near the middle of the state, to the coast. Near Charleston, the sediment is more than 3,000 feet thick. The topography of the Base is nearly flat. Surface elevations range from 15 feet amsl along the southern edge of the Base to 45 feet amsl at the northern edge of the Base (Halliburton, June 1995).

The underlying sedimentary rocks and unconsolidated sediments are of Tertiary and Quaternary Age. A thin veneer of Holocene/ Pleistocene beach deposits overlies the deeper Tertiary Age rocks that are underlain in turn by the Cretaceous Age basement rocks of the Coastal Plain. High-energy depositional environments – such as barrier island, beach, or tidal facies – are characterized by coarse-grained or sand-dominated deposits. Relatively lower-energy depositional environments, such as marshes or mud flats, are usually associated with fine-grained, clay-dominated deposits or lithologies. Because of the fluctuations in sea level in response to glaciation and interglacial melting, these depositional environments were periodically changing, resulting in interbedded sands and clays. The shallowest Tertiary unit underlying the area is the Cooper Formation, which is approximately 40 feet bgs at JBCA and regionally serves as a confining unit in the Charleston area (Halliburton, June 1995). Figure 32 (Appendix A) presents a generalized hydrogeologic column of the JBCA area.

The shallow subsurface geology consists of sand with some silt, intermittent clay, and clay stringers of the Ladson Formation. The clay stringers often contain silt and are discontinuous across the area of interest. Clay content increases with depth, especially near the contact with the underlying Cooper Marl. The Cooper Marl is characterized by olive silt and clay with some disseminated phosphate grains and is encountered in monitoring well borings between 35 and 43 feet bgs. Shallow groundwater exists at depths of less than 10 feet bgs over most of JBCA (Halliburton, June 1995).

Joint Base Charleston has no drinking water wells. JBCA and most of Charleston County obtain their public water supply from the Charleston Commission of Public Works. The water supply system contains three upstream water intakes that are on the Edisto River (approximately 25 miles northwest of JBCA), on Goose Creek Reservoir (approximately 2 miles northeast of JBCA), and on Foster Creek (approximately 8 miles north of JBCA).

During the SI, groundwater flow at JBCA was to the west/southwest and groundwater flow at NAAF was to the southeast. As part of the SI, available well records were reviewed to determine if drinking water wells (domestic or public supply) were within 4 miles of JBCA and to determine if any of the wells are downgradient from each AFFF area. Resources used were

- the Environmental Data Resources, Inc. (EDR) report dated November 5, 2015 (included in the PA only for JBCA, not NAAF),
- the South Carolina Watershed Atlas (<https://gis.dhec.sc.gov/watersheds>),
- the South Carolina Department of Health and Environmental Control (SCDHEC) Well Inventory (<http://dnr.sc.gov/water/hydro/WellRecords/locatewells/index.html>),
- the city of Orangeburg, South Carolina, Department of Public Utilities, and
- the town of North, South Carolina, Department of Public Utilities.

SCDHEC issued the wells an identification code (County-Number ID [CO-NUM]), which has been used to identify the wells in the following discussion. The wells are in Charleston County (CHN), Dorchester County (DOR), and Orange County (ORG).

- The PA previously reported that 13 water wells were identified in the EDR report to the west/southwest (downgradient) of JBCA within 4 miles. Upon further evaluation, only six wells are used for drinking water purposes within 4 miles of JBCA. They are CHN-213, CHN-298, CHN-912, and CHN-96 to the north/northwest; DOR-366 to the west; and CHN-503 to the southwest. These permitted water wells range from 300 to 610 feet bgs, below the Cooper Formation (approximately 40 feet bgs), the confining unit in the area (CH2M Hill, January 2016).
- The city of Orangeburg, South Carolina, confirmed its main water supply is obtained from the Edisto River from intakes approximately 1.5 miles north of the water treatment plant. Orangeburg also confirmed there are two public supply wells that are used infrequently. One public water supply well is near the intersection of Neese Highway and Rivers Turn Road, and one is southeast of the intersection of Calvary Church Road and Willard Road; both are more than 7 miles southeast or southwest of NAAF.
- The town of North, South Carolina, confirmed its drinking water is obtained from public supply wells (groundwater sources) approximately 2 miles northeast (ORG-373 [Bull Swamp Rural Water Well 1]) and 2 miles northwest (ORG-252 [Town of North Well 1], ORG-359 [Town of North Well 2], and ORG-374 [Bull Swamp Rural Water Well 2]) from NAAF ranging in depth from 255 to 267 feet bgs and set within a confined aquifer. Additional wells within 4 miles of NAAF are ORG-24 to the southwest; ORG-37 and ORG-78 to the west; ORG-488 to the north; and ORG-36, ORG-39, ORG-46, ORG-86, and ORG-523 to the east. These wells range in depth from 121 to 206 feet bgs. They are also below a confining unit approximately 50 to 70 feet bgs in the area and within a confined aquifer (Gordon Aquifer).

A table summarizing the well information and maps showing the well locations is included in Appendix G. Specific groundwater pathways for each AFFF area are discussed in Sections 4.1 through 4.9. PFBS was not detected above screening levels in any groundwater samples and will not be discussed. PFOA, PFOS, and combined PFOA and PFOS were detected in the groundwater above screening levels and are discussed in Sections 4.1 through 4.9.

#### **4.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

Shallow groundwater has been impacted by use of AFFF during training exercises at AFFF Area 1. PFOA was in all three primary samples and the duplicate sample at concentrations ranging from 37 µg/L to 790 µg/L, above the EPA HA of 0.07 µg/L. PFOS was in all three primary samples and the duplicate at concentrations ranging from 54 µg/L to 360 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations in the primary samples and the duplicate ranged from 91 µg/L to 1,150 µg/L, above the EPA HA of 0.07 µg/L.

Based on water levels gauged on February 3, 2017, shallow groundwater elevations ranged from 27.29 feet to 29.16 feet amsl, and groundwater flowed to the west/southwest. However, historical groundwater flow at this AFFF area has been to the south/southwest toward the residential area.

There is no immediate threat to public water supply wells or private drinking water sources from PFOA-, PFOS-, or combined PFOA and PFOS-impacted groundwater at AFFF Area 1. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 2.5 miles north (upgradient) of AFFF Area 1. The area is a mostly wooded lot in the eastern corner of JBCA. A residential area is approximately 0.1 mile to the south and downgradient to

crossgradient from the investigation area. One drinking water supply well (CHN-503 for domestic use at 380 feet bgs) is approximately 2.75 miles southwest (down gradient) and set below a confining unit.

Although groundwater results showed concentrations of PFOS and PFOA above the EPA HAs at AFFF Area 1, the groundwater pathway is incomplete. There is one potable well within 4 miles downgradient; however, the well is set below a confining unit

#### **4.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

Shallow groundwater has been impacted by use of AFFF during training exercises at AFFF Area 2. PFOA was in all four samples at concentrations ranging from 0.17 µg/L to 0.89 µg/L, above the EPA HA of 0.07 µg/L. PFOS was in all four samples at concentrations ranging from 0.18 µg/L to 24 µg/L, which were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations exceeded the EPA HA of 0.07 µg/L and ranged from 0.35 µg/L to 24.89 µg/L.

Temporary wells were gauged on February 2, 2017, and monitoring wells were gauged on February 8, 2017. Shallow groundwater elevations ranged from 20.54 feet to 24.27 feet amsl. Shallow groundwater flow direction was not determined; however, historical flow direction has been to the south/southwest.

There is no immediate threat to public water supply wells or private drinking water sources from PFOA-, PFOS-, or combined PFOA- and PFOS-impacted groundwater at AFFF Area 2. The area is surrounded by woods to the west, east, and south and bordered by South Davis Road to the north. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 3.3 miles northeast (upgradient) of AFFF Area 2. One drinking water well (CHN-503 for domestic use at 380 feet bgs) is approximately 1.5 miles southwest (downgradient) and set below a confining unit. The closest residential area is upgradient to crossgradient from AFFF Area 2. A JBCA housing area is approximately 0.3 mile to the west (CH2M Hill, January 2016).

Although groundwater results showed concentrations of PFOS and PFOA above the EPA HAs at AFFF Area 2, the groundwater pathway is incomplete. There is one potable well within 4 miles downgradient; however, the well is set below a confining unit

#### **4.3 BUILDING 570 – AFFF AREA 3**

Shallow groundwater has been impacted by use of AFFF at AFFF Area 3. PFOA was in all three samples at concentrations from 0.020 µg/L to 0.24 µg/L, and two of the three samples were above the EPA HA of 0.07 µg/L. PFOS was in all three samples at concentrations from 0.49 µg/L to 6.7 µg/L, all above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from 0.51 µg/L to 6.94 µg/L, all above the EPA HA of 0.07 µg/L.

Based on water levels gauged on February 7, 2017, shallow groundwater elevations ranged from 30.44 feet to 31.30 feet amsl, and groundwater flowed west/southwest.

There is no immediate threat to public water supply wells from PFOA- or PFOS- impacted groundwater at AFFF Area 3. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 2.6 miles northeast (upgradient) of AFFF Area 3. The closest drinking water well to AFFF Area 3 (CHN-213 for domestic use at 300 feet bgs) is approximately 1.1 miles to the northeast. The closest downgradient drinking water well (CHN-503 for domestic use at 380 feet bgs) is approximately 2.45 miles southwest and set below a confining unit. A

second drinking water well (DOR-366 for domestic use and screened at 139 to 360 feet bgs) is approximately 4.1 miles west (downgradient) and set below a confining unit. The closest residential area is upgradient to crossgradient from AFFF Area 3, approximately 0.8 mile to the east (CH2M Hill, January 2016).

Although groundwater results showed concentrations of PFOS and PFOA above the EPA HAs at AFFF Area 3, the groundwater pathway is incomplete. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit.

#### **4.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

Shallow groundwater has been impacted by use of AFFF at the 2005 plane crash location at AFFF Area 4. PFOA was in two primary samples and the duplicate at concentrations ranging from an estimated 0.017 µg/L to 0.025 µg/L, below the EPA HA of 0.07 µg/L. PFOS was in two primary samples and the duplicate at concentrations ranging from 0.044 µg/L to 0.21 µg/L; one primary sample and the duplicate were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration in two primary samples and the duplicate ranged from an estimated 0.061 µg/L to 0.235 µg/L; one primary sample and the duplicate were above the EPA HA of 0.07 µg/L.

Groundwater samples were collected using an SP-16 sampler, so groundwater levels could not be obtained. Therefore, current groundwater flow direction has not been determined for AFFF Area 4 although historical groundwater flow direction has been estimated to the southwest. Groundwater was observed in the soil during drilling at approximately 7.5 feet bgs.

There is no immediate threat to public water supply wells from PFOS- or PFOA-impacted groundwater at AFFF Area 4. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 3 miles northeast (upgradient) of AFFF Area 4. One downgradient drinking water well (CHN-503 for domestic use at 380 feet bgs) is approximately 2 miles southwest and set below a confining unit. The closest residential area is upgradient from AFFF Area 4, approximately 0.9 mile east (CH2M Hill, January 2016).

Although groundwater results showed concentrations of PFOS and PFOA above the EPA HAs at AFFF Area 4, the groundwater pathway is incomplete. There is one potable well within 4 miles downgradient; however, the well is set below a confining unit.

#### **4.5 OUTFALL 003 – AFFF AREA 5**

Shallow groundwater has not been impacted by AFFF entering Outfall 003 at AFFF Area 5. Estimated concentrations of PFOA, PFOS, and combined PFOA and PFOS were below the EPA HA of 0.07 µg/L.

Groundwater samples were collected using an SP-16 sampler, so groundwater levels could not be obtained. Therefore, groundwater flow direction was not determined for AFFF Area 5 although the historical groundwater flow direction has been estimated to the southeast. Groundwater was observed in the soil during drilling at approximately 3.5 feet bgs. There are no downgradient drinking water wells.

Based on shallow groundwater results for AFFF Area 5, the groundwater pathway is incomplete.

#### **4.6 NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

Shallow groundwater has been impacted by use of AFFF at AFFF Area 6. PFOA was in all three samples at concentrations ranging from 0.10 µg/L to 2.6 µg/L, all above the EPA HA of 0.07 µg/L. PFOS was in all three samples at concentrations ranging from 1.7 µg/L to 85 µg/L, all above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration in the three samples ranged from 1.84 µg/L to 87.6 µg/L, all above the EPA HA of 0.07 µg/L.

Based on water levels from the temporary wells gauged on February 4, 2017, shallow groundwater elevations ranged from 272.39 feet to 272.73 feet amsl, and groundwater flowed southeast toward the North Fork Edisto River.

The potential threat to public water supply wells from PFOA- or PFOS-impacted groundwater at AFFF Area 6 is low. The closest drinking water well to AFFF Area 6 (public supply well ORG-36 at 174 feet bgs) is approximately 1 mile to the northeast (sidegradient) and set within a confined aquifer. There are two public supply wells (ORG-39 at 130 feet bgs and ORG-46 at 206 feet bgs) approximately 1.2 miles southeast (downgradient) of AFFF Area 6 and set within a confined aquifer. The town of North, South Carolina, is to the northwest (upgradient) and obtains drinking water from public supply wells (groundwater sources) approximately 2.5 miles northeast (upgradient) and 2 to 3 miles northwest (upgradient) of AFFF Area 6. According to SCDHEC and the South Carolina Watershed Atlas database, these wells range in depth from 255 to 267 feet bgs and are within a confined aquifer. JBCA Bioenvironmental office has sampled the drinking water at NAAF Fire Station for AFFF compounds, and results have not shown any concentrations above the EPA HA.

The North Fork Edisto River, approximately 1.3 miles south of AFFF Area 6 (crossgradient to downgradient) forms the southern border of NAAF. Bull Swamp Creek is approximately 1.5 miles east (crossgradient) of AFFF Area 6 (associated wetlands begin approximately 1.4 miles east of the area). Both of these water bodies are part of the North Edisto River System, the potable water supply for the town of Orangeburg, South Carolina, approximately 15 miles southeast. The water intake for Orangeburg from the river is approximately 19 river miles downstream to the southeast of AFFF Area 6.

Based on shallow groundwater results, PFOS and PFOA are above EPA HAs in the groundwater around the fire station. The North Fork Edisto River is approximately 1.3 miles south (downgradient) of AFFF Area 6, is a drinking water source for Orangeburg, South Carolina, and the water intake from the river is approximately 19 river miles downstream. Although groundwater could release to the river, it is unlikely that human receptors could be impacted by groundwater from AFFF Area 6 because the distance to the water intake is more than 15 river miles downstream. Therefore, the groundwater pathway is incomplete.

#### **4.7 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

Shallow groundwater has been impacted by use of AFFF during flushing exercises at AFFF Area 7. PFOA was in all three samples at concentrations ranging from an estimated 0.012 µg/L to 0.50 µg/L; one sample was above the EPA HA of 0.07 µg/L. PFOS was in all three samples at concentrations ranging from 0.062 µg/L to 3.4 µg/L; two samples were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration ranged from an estimated 0.074 µg/L to 3.9 µg/L; all three were above the EPA HA of 0.07 µg/L.

Based on water levels from the temporary wells gauged on February 4, 2017, shallow groundwater elevations ranged from 275.45 feet to 275.88 feet amsl, and groundwater flowed southeast toward the North Fork Edisto River.

The potential threat to public water supply wells from PFOA-, PFOS-, or combined PFOA and PFOS-impacted groundwater at AFFF Area 7 is low. The closest drinking water well to AFFF Area 7 (public supply well ORG-36 at 174 feet bgs) is approximately 0.7 mile northeast (sidegradient) and set within a confined aquifer. There are two public supply wells (ORG-39 at 130 feet bgs and ORG-46 at 206 feet bgs) owned by the USAF approximately 1.1 miles southeast (downgradient) of AFFF Area 7 and set within a confined aquifer. The town of North, South Carolina, is northwest (upgradient) and obtains drinking water from public supply wells (groundwater sources) ranging in depth from 172 to 481 feet bgs within a confined aquifer. These wells are approximately 2 miles northeast (crossgradient) and 2 miles northwest (upgradient) of AFFF Area 7.

The North Fork Edisto River, approximately 1.6 miles south (crossgradient to downgradient) of AFFF Area 7 (associated wetlands begin approximately 1.3 miles south of the area), forms the southern border of NAAF. Bull Swamp Creek is approximately 1.25 miles east (crossgradient) of AFFF Area 7 (associated wetlands begin approximately 1.15 miles east of the area). Both of these water bodies are part of the North Edisto River System, the potable water supply for the town of Orangeburg, South Carolina, approximately 14.5 miles southeast (downgradient) of AFFF Area 7. The water intake for Orangeburg from the river is approximately 19.5 miles downstream to the southeast of AFFF Area 7.

Based on shallow groundwater results, AFFF constituents are in the groundwater around the pump house. The North Fork Edisto River, approximately 1.6 miles to the south (crossgradient to downgradient) of AFFF Area 7, is a drinking water source for Orangeburg, South Carolina, and the water intake from the river is approximately 19.5 river miles downstream. Although impacted groundwater could release to the river, it is unlikely that human receptors could be impacted by groundwater from AFFF Area 7 because the distance to the water intake is more than 15 river miles downstream. Therefore, the groundwater pathway is incomplete.

#### **4.8 NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

Shallow groundwater has been impacted by use of AFFF during testing exercises at AFFF Area 8. PFOA was in two primary samples and the duplicate at concentrations ranging from 0.21 µg/L to 0.96 µg/L, all above the EPA HA of 0.07 µg/L. PFOS was in all three primary samples and the duplicate at concentrations ranging from an estimated 0.0064 µg/L to 6.8 µg/L; two primary samples and the duplicate were above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations ranged from an estimated 0.0064 µg/L to 7.02 µg/L; two primary samples and the duplicate were above the EPA HA of 0.07 µg/L.

Based on water levels from the temporary wells gauged on February 5, 2017, shallow groundwater elevations ranged from 211.23 feet to 211.92 feet amsl, and groundwater flowed southwest toward the North Fork Edisto River.

The potential threat to public water supply wells from PFOA- or PFOS-impacted groundwater at AFFF Area 8 is low. The closest drinking water wells to AFFF Area 8 (public supply well ORG-39 at 130 feet bgs and public supply well ORG-46 at 206 feet bgs) are approximately 1.0 miles northeast (sidegradient) of AFFF Area 8 and set within a confined aquifer. There are no downgradient drinking water wells. The town of North, South Carolina, is northwest (crossgradient) and obtains drinking water from public supply wells (groundwater sources) ranging from 172 to 481 feet bgs within a confined aquifer. The aquifer is approximately 2.8 miles northeast (upgradient) and 2.7 miles northwest (crossgradient to upgradient) of AFFF Area 8.



The North Fork Edisto River, approximately 0.7 miles south (crossgradient to downgradient) of AFFF Area 8 (associated wetlands begin approximately 0.4 miles south of the area), forms the southern border of NAAF. Bull Swamp Creek is approximately 1.6 miles east (upgradient) of AFFF Area 8 (associated wetlands begin approximately 1.5 miles east of the area). Both of these water bodies are part of the North Edisto River System, the potable water supply for the town of Orangeburg, South Carolina, approximately 14 miles southeast from AFFF Area 8. The water intake for Orangeburg from the river is approximately 18.5 river miles downstream to the southeast of AFFF Area 8.

Based on shallow groundwater results, PFOS and PFOA are present at concentrations above EPA HAs in the groundwater around the old foam test area. The North Fork Edisto River, approximately 0.7 miles south (crossgradient to downgradient) of AFFF Area 8, is a drinking water source for Orangeburg, South Carolina, and the water intake from the river is approximately 18.5 river miles downstream. Although groundwater could release to the river, it is unlikely that human receptors could be impacted by groundwater from AFFF Area 8 because the distance to the water intake is more than 15 river miles downstream. Therefore, the groundwater pathway is incomplete.

#### **4.9 FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

Shallow groundwater has not been impacted by use of AFFF during training exercises at AFFF Area 9. The analytical results showed concentrations of PFOA, PFOS, and combined concentrations of PFOA and PFOS were below the EPA HA of 0.07 µg/L.

Based on water levels from the temporary wells gauged on February 6, 2017, shallow groundwater elevations ranged from 275.64 feet to 269.39 feet amsl, and groundwater flowed northeast toward Bull Swamp Creek, approximately 1 mile east of AFFF Area 9.

The closest drinking water well to AFFF Area 9 (public supply well ORG-36 at 174 feet bgs) is approximately 0.5 mile to the east (sidegradient/downgradient) and set within a confined aquifer. Two public supply wells (ORG-86 at 168 feet bgs and ORG-373 at 255 feet bgs) are downgradient approximately 1.6 and 1.9 miles northeast, respectively, of AFFF Area 9 and set within a confined aquifer.

Based on shallow groundwater results, no AFFF constituents in the groundwater around the FTA are above screening levels at AFFF Area 9. Therefore, the groundwater pathway for human receptors is incomplete.

### **5.0 SURFACE WATER PATHWAY**

#### *JBCA*

Surface water drainage at JBCA from the approximately 3,500-acre watershed is controlled by unlined and concrete-lined ditches and buried concrete pipes. Three major channels drain the Base:

- Golf Course Creek, which discharges into Popperdam Creek, a tributary of the Ashley River;
- Runway Creek, near Runway 03/21, a tributary of the Ashley River; and
- A tributary of Turkey Creek near Runway 15/33, which discharges into Goose Creek, a tributary of the Cooper River.

The drainage divide on the Base is approximately parallel to Runway 15/33. Surface water east of Runway 15/33 flows toward the Goose Creek Reservoir and the Cooper River, and surface water west of Runway 15/33 flows toward Popperdam Creek and the Ashley River. Most of the small, unlined drainage ditches are above the water table and are influent or losing streams. Conversely, the large streams (Golf

Course Creek and Runway Creek) intersect the water table and are probably effluent or gaining streams (Halliburton, June 1995).

Other surface water bodies in the vicinity of JBCA include Goose Creek Reservoir and wetland areas. Goose Creek Reservoir is about 2 miles northeast of the Base and supplies potable water to the area. There are 25 isolated and/or adjacent, jurisdictional, freshwater wetlands at JBCA that cover 282 acres (Halliburton, June 1995).

Specific surface water pathways for each AFFF area are discussed in Section 5.1 through Section 5.9. PFBS was detected at AFFF Area 2, AFFF Area 3, AFFF Area 4, AFFF Area 5, AFFF Area 6, and AFFF Area 8. However, it did not exceed the RSL at any of these areas and will not be discussed. PFOA, PFOS, or combined PFOA and PFOS were in the surface water above screening levels and are discussed in Section 5.1 through Section 5.9.

#### *NAAF*

NAAF is between the North Fork Edisto River and Bull Swamp Creek. The North Fork Edisto River flows southeast along the southern edge of NAAF, which is within the 100-year floodplain. Bull Swamp Creek is more than 2,000 feet east of NAAF and flows south. The North Fork Edisto River and Bull Swamp Creek converge southeast of NAAF to form the North Edisto River, which is used as the water supply source for the city of Orangeburg, approximately 15 miles southeast of NAAF (SAIC, March 1989). According to the director of the Drinking Water Division of Orangeburg, the water intake from the river is approximately 1 mile north of the water treatment plant in Orangeburg, which is approximately 18 river miles southeast of NAAF (Odom, Eric, personal communication, October 2017).

### **5.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

SWMU 55 is at the east corner of the Base near South Aviation Avenue. Residential areas exist approximately 0.1 mile to the south. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water is not typically present at SWMU 55, and no surface water samples were collected during the SI. No on-Base storm drains or ditches are within the vicinity of SWMU 55. However, a surface water drainage ditch is on private property approximately 400 feet due south of SWMU 55 adjacent to the Base boundary, and previous investigations have indicated that on-Base groundwater discharges to the ditch. Goose Creek Reservoir is approximately 2.5 miles north (upgradient) of AFFF Area 1. No surface water intakes are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and local waterways can be used for recreational fishing by residents of nearby communities (CH2M Hill, January 2016).

### **5.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

SWMU 52 is west of the runway and south of South Davis Drive. Residential areas exist approximately 0.3 miles west. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water at SWMU 52 is directed to the lined pond adjacent to the area, and overflow goes to the lower-lying area to the south. Surface water at SWMU 52 flows to the south/southwest, toward Outfall 001, a stormwater feature that flows off-Base to the south. No storm drains or ditches are within the vicinity of SWMU 52, and surface water drains to the surrounding subsurface or evaporates. The nearest water body is Ashley River, 1.2 miles southwest (downgradient). Goose Creek Reservoir is approximately 3.3 miles northeast (upgradient). No surface water intakes are adjacent to the surface water migration path within 15 miles

downstream of the location; however, several wetlands may be present, and residents of nearby communities can fish in local waterways (CH2M Hill, January 2016).

One primary surface water sample and one duplicate sample were collected from the lower-lying area at CHRTN02-004. PFOA was detected in both samples at estimated concentrations below the EPA HA of 0.07 µg/L. PFOS was detected in both samples at an estimated 0.34 µg/L and 0.35 µg/L, above the EPA HA of 0.07 µg/L. The estimated combined PFOA and PFOS concentrations were 0.371 µg/L and 0.407 µg/L, above the EPA HA of 0.07 µg/L.

Although PFOS and combined PFOS and PFOA are present at concentrations above EPA HAs in the surface water at AFFF Area 2, the human exposure pathway is incomplete. No surface water intakes were identified within 15 miles downstream.

### **5.3 BUILDING 570 – AFFF AREA 3**

Building 570 is a hangar in the north part of the Base east of Building 610 (Base Supply). This portion of the Base is developed with buildings, parking lots, and open grassy areas. Residential areas exist approximately 0.8 mile east. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water flows into a storm drain inlet south of Building 570. The drain discharges into underground piping that connects to a concrete-lined ditch. Water from the ditch discharges at Outfall 003 (AFFF Area 5) into an unnamed tributary of Popperdam Creek, then into Popperdam Creek, which flows into Ashley River. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and residents of nearby communities can fish in local waterways (CH2M Hill, January 2016).

One surface water sample was taken. PFOA was detected in the sample at 0.081 µg/L, slightly above the EPA HA of 0.07 µg/L. PFOS was detected in the sample at 1.9 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 1.981 µg/L, above the EPA HA of 0.07 µg/L. In addition, the combined PFOA and PFOS concentration in the surface water sample collected at Outfall 003 (AFFF Area 5) exceeded the EPA HA at a concentration of 0.861 µg/L (as discussed in Section 5.5).

Although PFOS and PFOA are present at concentrations above EPA HAs in the surface water at AFFF Area 3, the human exposure pathway is incomplete. No surface water intakes were identified within 15 miles downstream.

### **5.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

A small private plane crashed at the south end of the flightline in 2005. The area is covered in maintained grass and is near a stormwater drain. Residential areas exist approximately 0.9 mile east. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water at the 2005 plane crash area flows primarily to the east/southeast. The storm ditches sampled are to the east and southeast of the crash area. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and residents of nearby communities use local waterways for recreational fishing (CH2M Hill, January 2016).

PFOA was below the EPA HA of 0.07 µg/L. PFOS was detected at a concentration of 0.30 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.340 µg/L, above the EPA HA of 0.07 µg/L.

Although PFOS and combined PFOS and PFOA are present at concentrations above EPA HAs in the surface water at AFFF Area 4, the human exposure pathway is incomplete. No surface water intakes were identified within 15 miles downstream.

### **5.5   OUTFALL 003 – AFFF AREA 5**

Outfall 003 is at the western portion of the Base. Residential areas exist approximately 0.1 mile east. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water flows into a storm drain south of Building 570 (AFFF Area 3). The drain discharges into underground piping that connects to a concrete-lined ditch. Water from the ditch discharges at Outfall 003 into an unnamed tributary of Popperdam Creek, then into Popperdam Creek, which in turn flows into Ashley River. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and nearby residents can use local waterways for recreational fishing (CH2M Hill, January 2016).

PFOA was below the EPA HA of 0.07 µg/L. The PFOS concentration was 0.82 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.861 µg/L, above the EPA HA of 0.07 µg/L.

Although PFOS and combined PFOS and PFOA are present at concentrations above EPA HAs in the surface water at AFFF Area 5, the human exposure pathway is incomplete. No surface water intakes were identified within 15 miles downstream.

### **5.6   NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

Surface water at the NAAF Fire Station flows primarily to the northwest into a low-lying area with two drainage ditches/pits northwest of the building. The drainage ditches do not appear to tie directly into any other surface water bodies. Workers and wetlands are within 1 mile of the location. NAAF is between the North Fork Edisto River and Bull Swamp Creek. The North Fork Edisto River is approximately 1.3 miles south of AFFF Area 6 (crossgradient to downgradient) and forms the southern edge of NAAF, which is within the 100-year floodplain. Bull Swamp Creek is approximately 1.5 miles east (crossgradient) of AFFF Area 6. Both of these water bodies are part of the North Edisto River System, the potable water supply for the town of Orangeburg, South Carolina, approximately 15 miles southeast (downgradient) from AFFF Area 6. The water intake from the river for Orangeburg is approximately 19 river miles downstream to the southeast (ASL, January 2017).

PFOA was below the EPA HA of 0.07 µg/L. The PFOS concentration was 0.43 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.453 µg/L, above the EPA HA of 0.07 µg/L.

The potential for human exposure to PFOS or combined PFOA and PFOS from impacted surface water from the NAAF Fire Station is low. The water intake from the North Edisto River System for Orangeburg, South Carolina, is more than 15 river miles downstream. Therefore, the surface water pathway is incomplete.

## **5.7 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

Surface water at the NAAF pump house flows into the drainage ditch east of the building and AST #7. Surface water is not typically present at NAAF Pump House, and no surface water samples were collected during the SI.

## **5.8 NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

Surface water at the NAAF foam test area flows toward the stormwater pond. A culvert goes from the middle of the pond north under the runway to an infiltration point. Workers and wetlands are within 1 mile of the location. NAAF is between the North Fork Edisto River and Bull Swamp Creek. Bull Swamp Creek is approximately 1.6 miles east (upgradient) of AFFF Area 8 (associated wetlands begin approximately 1.5 miles east of the area). The North Fork Edisto River is approximately 0.7 miles south (crossgradient to downgradient) of Area 8 and forms the southern edge of NAAF, which is within the 100-year floodplain. Both of these water bodies are part of the North Edisto River System, the potable water supply for the town of Orangeburg, South Carolina, approximately 14 miles southeast (downgradient) from AFFF Area 8. The water intake for Orangeburg from the river is approximately 18.5 river miles downstream to the southeast (ASL, January 2017).

PFOA was below the EPA HA of 0.07 µg/L. The PFOS concentration was 0.38 µg/L, above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was 0.405 µg/L, above the EPA HA of 0.07 µg/L.

The potential for human exposure to PFOS or combined PFOA and PFOS from impacted surface water from the NAAF foam test area is low. The water intake from the North Edisto River System for Orangeburg is more than 15 river miles downstream. Therefore, the surface water pathway is incomplete.

## **5.9 FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

Surface water is not typically present at FT010, and no surface water samples were collected during the SI.

## **6.0 SOIL AND SEDIMENT EXPOSURE AND AIR PATHWAYS**

### **6.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

Sediment was not identified as a media of concern at SWMU 55 and was not sampled. PFBS and PFOA concentrations in surface and subsurface soil samples collected at AFFF Area 1 during this SI were below screening levels. PFOS concentrations in one surface soil sample and one subsurface soil sample were above the calculated RSL. The soil could act as continuing source of PFAS impacts to groundwater. However, exposure to impacted soil is unlikely because the area is heavily wooded and fenced with a locked gate. Therefore, the soil and air pathways are incomplete at AFFF Area 1.

## **6.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 2 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 2.

## **6.3 BUILDING 570 – AFFF AREA 3**

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 3 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 3.

## **6.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 4 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 4.

## **6.5 OUTFALL 003 – AFFF AREA 5**

Soil was not identified as a media of concern at Outfall 003 and was not sampled. PFBS, PFOA, and PFOS in sediment samples collected at AFFF Area 5 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 5.

## **6.6 NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

PFBS and PFOA concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 6 during this SI were below screening levels. The PFOS concentration in one surface soil sample was above the calculated RSL. Exposure to impacted soil would be low because the area is covered in mature vegetation. Therefore, the soil and air pathways are incomplete at AFFF Area 6.

## **6.7 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

Sediment was not identified as a media of concern at the Pump House and was not sampled. PFBS, PFOA, and PFOS concentrations in surface soil and subsurface soil samples collected at AFFF Area 7 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 7.

## **6.8 NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

PFBS and PFOA concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 8 during this SI were below screening levels. The PFOS concentration in one surface soil sample was above the calculated RSL. Exposure to impacted soil would be low because the area is covered in mature vegetation and is in a remote area on NAAF. Therefore, the soil and air pathways are incomplete at AFFF Area 8.

## **6.9 FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

Sediment was not identified as a media of concern at FT010 and was not sampled. PFBS, PFOA, and PFOS in surface soil and subsurface soil samples collected at AFFF Area 9 during this SI were below screening levels. Lacking concentrations of PFBS, PFOA, or PFOS above screening levels, the soil and air pathways are incomplete at AFFF Area 9.

## **7.0 UPDATES TO CONCEPTUAL SITE MODELS**

### **7.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

The conceptual site model (CSM) for SWMU 55 presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, and groundwater as media impacted by release of AFFF at the site.

Based on the findings discussed in Sections 3.3 and 4.1, groundwater at SWMU 55 had concentrations of PFOA, PFOS, or combined PFOA and PFOS above screening levels. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit, and there are no surface water intakes downstream within 15 miles. Therefore, the groundwater pathway is incomplete.

There was no surface water on Base at FT003 as indicated in Section 5.1. However, a surface water drainage ditch is on private property approximately 400 feet due south of SWMU 55 and adjacent to the Base boundary. Previous investigations have indicated on-Base groundwater discharges to the ditch.

Based on the findings discussed in Sections 3.3 and 6.1, surface soil and subsurface soil at SWMU 55 showed PFAS compounds above screening levels. However, exposure to impacted soil would be low because the area is heavily wooded and surrounded by a locked gate.

### **7.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

The CSM for SWMU 52 presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, surface water, sediment, and groundwater as media impacted by previous releases of AFFF at Area 2.

Based on the findings discussed in Sections 3.4 and 4.2, groundwater at the FTA showed concentrations of PFOA, PFOS, or combined PFOA and PFOS above screening levels. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit, and there are no surface water intakes downstream within 15 miles. Therefore, the groundwater pathway is incomplete.

Based on the findings discussed in Sections 3.4 and 5.2, surface water at the FTA showed PFOS or combined PFOA and PFOS at concentrations above screening levels. There are no surface water intakes downstream within 15 miles. Therefore, the surface water pathway is incomplete.

Based on the findings discussed in Sections 3.4 and 6.2, surface soil, subsurface soil, and sediment at the FTA did not show PFAS compounds above screening levels.

### **7.3 BUILDING 570 – AFFF AREA 3**

The CSM for Building 570 presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, surface water, sediment, and groundwater as media impacted by previous releases of AFFF at Area 3.

Based on the findings discussed in Sections 3.5 and 4.3, groundwater at Building 570 had PFOA, PFOS, or combined PFOA and PFOS at concentrations above screening levels. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit, and there are no water uptakes within 15 miles. Therefore, the groundwater pathway is incomplete.

Based on the findings discussed in Sections 3.5 and 5.3, surface water at Building 570 showed PFOA, PFOS, or combined PFOA and PFOS at concentrations above screening levels. There are no surface water intakes downstream within 15 miles. Therefore, the surface water pathway is incomplete.

Based on the findings discussed in Sections 3.5 and 6.3, surface soil, subsurface soil, and sediment did not show PFAS compounds above screening levels.

### **7.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

The CSM for the 2005 Private Plane Crash Area presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, surface water, sediment, and groundwater as media impacted by previous releases of AFFF at Area 4.

Based on the findings discussed in Sections 3.6 and 4.4, groundwater at the plane crash area had PFOS or combined PFOA and PFOS at concentrations above screening levels. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit, and there are no water uptakes within 15 miles. Therefore, the groundwater pathway is incomplete.

Based on the findings discussed in Sections 3.6 and 5.4, surface water at the plane crash area had PFOS or combined PFOA and PFOS at concentrations above screening levels. There are no surface water intakes downstream within 15 miles. Therefore, the surface water pathway is incomplete.

Based on the findings discussed in Sections 3.6 and 6.4, surface soil, subsurface soil, and sediment at the plane crash area did not show PFAS compounds above screening levels.

### **7.5 OUTFALL 003 – AFFF AREA 5**

The CSM for Outfall 003 presented in the QAPP addendum (ASL, January 2017) identified surface water, sediment, and groundwater as media impacted by previous releases of AFFF at Area 5.

Based on the findings discussed in Sections 3.7 and 4.5, groundwater at Outfall 003 did not show PFAS compounds at concentrations above screening levels. Based on shallow groundwater results for AFFF Area 5, the groundwater pathway is incomplete.

Based on the findings discussed in Sections 3.7 and 5.5, surface water at Outfall 003 showed PFOS or combined PFOA and PFOS at concentrations above screening levels. There are no surface water intakes downstream within 15 miles. Therefore, the surface water pathway is incomplete.



Based on the findings discussed in Sections 3.7 and 6.5, sediment at Outfall 003 did not show PFAS compounds above screening levels.

#### **7.6 NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

The CSM for the NAAF Fire Station presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, surface water, sediment, and groundwater as media impacted by previous releases of AFFF at Area 6.

Based on the findings discussed in Sections 3.8, 4.6, and 5.6, groundwater and surface water at the NAAF Fire Station have been impacted by PFOA and PFOS at concentrations above screening levels. Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water intake is more than 15 river miles downstream. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit. Therefore, the groundwater and surface water pathways are incomplete.

Based on the findings discussed in Sections 3.8 and 6.6, surface soil at the NAAF Fire Station showed PFAS compounds above screening levels. Subsurface soil and sediment did not show PFAS compounds above screening levels. Exposure to impacted soil would be low because the area is covered in mature vegetation.

#### **7.7 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

The CSM for the NAAF Pump House presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at Area 7.

Based on the findings discussed in Sections 3.9 and 4.7, groundwater at the NAAF Pump House had PFOA, PFOS, or combined PFOA and PFOS at concentrations above screening levels. Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water intake is more than 15 river miles downstream. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit. Therefore, the groundwater pathway is incomplete.

There is no surface water on Base at the NAAF Pump House as indicated in Section 5.7.

Based on the findings discussed in Sections 3.9 and 6.7, surface soil and subsurface soil at the NAAF Pump House did not show PFAS compounds above screening levels.

#### **7.8 NAAF FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

The CSM for the NAAF Foam Test Area and Old C-141 presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, groundwater, surface water, and sediment as media potentially impacted by previous releases of AFFF at Area 8.

Based on the findings discussed in Sections 3.10, 4.8, and 5.8, groundwater and surface water at the NAAF foam test area had PFOA and PFOS at concentrations above screening levels. Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water

intake is more than 15 river miles downstream. Potable water sources upgradient are below a confining unit. Therefore, the groundwater and surface water pathways are incomplete.

Based on the findings discussed in Sections 3.10 and 6.8, surface soil at the NAAF Foam Test Area and old C-141 showed PFAS compounds above screening levels. Subsurface soil and sediment did not show PFAS compounds above screening levels. Exposure to impacted soil would be low because the area is covered in mature vegetation and is in a remote area on NAAF.

## **7.9 FT010 (NO RCRA PERMIT ID, NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

The CSM for FT010 presented in the QAPP addendum (ASL, January 2017) identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at Area 9.

Based on the findings discussed in Sections 3.11 and 4.9, groundwater at the FTA did not show PFAS compounds at concentrations above screening levels. There are potable wells within 4 miles downgradient; however, the wells are set below a confining unit. Therefore, the groundwater pathway for AFFF Area 9 is incomplete.

Based on the findings discussed in Sections 3.9 and 6.9, surface soil and subsurface soil at the FTA did not show PFAS compounds above screening levels.

## **8.0 SUMMARY AND CONCLUSIONS**

ASL completed SIs at five known or suspected areas of AFFF releases at JBCA documented in the PA (CH2M Hill, January 2016) and at four known or suspected areas of AFFF releases at NAAF documented in the site-specific QAPP addendum (ASL, January 2017). Sampling was conducted during this SI at AFFF Areas 1 through 9:

- SWMU 55 (FT003, Fire Protection Training Area 3) (AFFF Area 1);
- SWMU 52 (AT551, Current Fire Training Area) (AFFF Area 2);
- Building 570 (AFFF Area 3);
- 2005 Private Plane Crash Area (AFFF Area 4);
- Outfall 003 (AFFF Area 5);
- NAAF Fire Station (AFFF Area 6);
- NAAF Pump House – Foam Truck Flush Area (AFFF Area 7);
- NAAF Foam Test Area and Old C-141 (AFFF Area 8);
- FT010 (NAAF Fire Training Area) (AFFF Area 9);

The objectives of this study were to

- determine if PFOS and PFOA are present in groundwater or surface water at the inspection areas at concentrations exceeding the EPA lifetime HA for drinking water,
- determine if PFBS is present in soil, sediment, groundwater, or surface water at the inspection areas at concentrations exceeding generic RSLs;
- determine if PFOA and PFOS are present in soil or sediment at the inspection areas at concentrations exceeding calculated RSLs; and
- identify potential receptor pathways with immediate impacts to human health.

Selected sample media were different for the nine areas but included surface soil, subsurface soil, groundwater, sediment, and surface water. Sampling was primarily limited to the immediate release areas and biased toward locations most likely to have been impacted by releases of AFFF.

All samples were analyzed for PFBS, PFOA, and PFOS using modified EPA Method 537. Soil and sediment PFBS analytical results were compared to published EPA RSLs. PFOA and PFOS soil and sediment analytical results were compared to calculated RSLs (126 µg/kg for both PFOA and PFOS). Groundwater and surface water PFBS analytical results were compared to the published EPA RSL; PFOA and PFOS analytical results were compared to the EPA HA of 0.07 µg/L for the individual and combined concentrations of PFOA and PFOS.

PFBS was not detected in any sampled media above screening levels at the nine AFFF areas. Where sampled, PFOS concentrations in surface soil in three areas and subsurface soil samples in one area exceeded the calculated RSL. PFOA in surface soil and subsurface soil and PFOA and PFOS in sediment were below calculated RSLs in samples collected at the nine areas during this SI.

The QAPP addendum identified groundwater as a known or potentially impacted media of concern at each of nine AFFF areas. Groundwater was sampled at all nine AFFF areas during the SI. Combined PFOA and PFOS concentrations in groundwater at each AFFF area exceeded the EPA HA except at AFFF Area 5 (Outfall 003) and AFFF Area 9 (FT010 NAAF FTA).

The QAPP addendum also identified surface water as a known or potentially impacted media of concern at AFFF Areas 2, 3, 4, 5, 6, and 8. Combined PFOA and PFOS concentrations in surface water at each of these AFFF areas exceeded the EPA HA.

Table 40 summarizes detected concentrations of PFBS, PFOA, and PFOS for each media sampled at each area. A brief summary of key findings and conclusions for each area (focusing on PFOA and PFOS exceedances) is included after the table.

### **8.1 SOLID WASTE MANAGEMENT UNIT 55 (FT003, FIRE PROTECTION TRAINING AREA 3) – AFFF AREA 1**

PFAS compounds were in groundwater above screening levels at SWMU 55 (AFFF Area 1). PFOA was in all three primary samples and the duplicate at concentrations above the EPA HA of 0.07 µg/L. PFOS was in all three primary samples and the duplicate at concentrations above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was above the EPA HA of 0.07 µg/L in all three primary samples and the duplicate. On February 3, 2017, groundwater elevations ranged from 27.29 feet to 29.16 feet amsl, and groundwater flowed to the west/southwest. Historical groundwater flow has been to the south/southwest.

There was no surface water at SWMU 55, as indicated in Section 5.1. No on-Base storm drains or ditches are within the vicinity of SWMU 55. However, a surface water drainage ditch is on private property approximately 400 feet due south of SWMU 55 and adjacent to the Base boundary. Previous investigations have indicated that on-Base groundwater discharges to the ditch. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and local waterways can be used for recreational fishing by residents of nearby communities. Goose Creek Reservoir is approximately 2.5 miles north (upgradient) of AFFF Area 1.

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 1 SWMU 55 (FT003, Fire Protection Training Area 3)</b>	<b>SWMU 55</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>Advance area to RI</b>
		PFBS	4.4 J	130,000	2/0	No		
		PFOA	70	126	2/0	No		
		PFOS	<b>810</b>	126	<b>2/1</b>	<b>Yes</b>		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	9.0 J	130,000	2/0	No		
		PFOA	46	126	2/0	No		
		PFOS	<b>130</b>	126	<b>2/1</b>	<b>Yes</b>		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	34	40	3/0	No		
		PFOA	<b>790</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		PFOS	<b>360</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		PFOA + PFOS	<b>1,150</b>	0.07	<b>3/3</b>	<b>Yes</b>		

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 2 SWMU 52 (AT551, Current Fire Training Area)</b>	<b>SWMU 52</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>Advance area to RI</b>
		PFBS	2.0	130,000	3/0	No		
		PFOA	10	126	3/0	No		
		PFOS	91	126	3/0	No		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	2.2	130,000	3/0	No		
		PFOA	3.4	126	3/0	No		
		PFOS	33 J	126	3/0	No		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	0.93	40	4/0	No		
		PFOA	<b>0.89</b>	0.07	<b>4/4</b>	<b>Yes</b>		
		PFOS	<b>24</b>	0.07	<b>4/4</b>	<b>Yes</b>		
		PFOA + PFOS	<b>24.89</b>	0.07	<b>4/4</b>	<b>Yes</b>		
		<b>Surface Water</b>	<b>(µg/L)</b>	<b>(µg/kg)</b>				
		PFBS	0.050	40	1/0	No		
		PFOA	0.057 J	0.07	1/0	No		
		PFOS	<b>0.35</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.407 J</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	0.49 J	130,000	1/0	No		
PFOA	0.47 J	126	1/0	No				
PFOS	6.9 J	126	1/0	No				

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 3 Building 570 (No RCRA Permit ID)</b>	<b>None (new area)</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>Advance area to RI</b>
		PFBS	ND	130,000	3/0	No		
		PFOA	ND	126	3/0	No		
		PFOS	32	126	3/0	No		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	ND	130,000	3/0	No		
		PFOA	0.25 J	126	3/0	No		
		PFOS	12	126	3/0	No		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	0.22	40	3/0	No		
		PFOA	<b>0.24</b>	0.07	<b>3/2</b>	<b>Yes</b>		
		PFOS	<b>6.7</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		PFOA + PFOS	<b>6.94</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		<b>Surface Water</b>	<b>(µg/L)</b>	<b>(µg/kg)</b>				
		PFBS	0.12	40	1/0	No		
		PFOA	<b>0.081</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOS	<b>1.9</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>1.981</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	ND	130,000	1/0	No		
PFOA	ND	126	1/0	No				
PFOS	0.52 J	126	1/0	No				

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

AFFF Area	IRP ID	Parameter	Maximum Detected Concentration	Screening Value	Number of Samples / Number of Exceedances*	Exceeds Screening Value	Potentially Complete DW Exposure Pathway	Recommendation
AFFF Area 4 2005 Private Plane Crash Area (No RCRA Permit ID)	None (new area)	<b>Surface Soil</b>	(µg/kg)	(µg/kg)			No	Advance area to RI
		PFBS	ND	130,000	3/0	No		
		PFOA	0.38 J	126	3/0	No		
		PFOS	1.3	126	3/0	No		
		<b>Subsurface Soil</b>	(µg/kg)	(µg/kg)				
		PFBS	ND	130,000	3/0	No		
		PFOA	ND	126	3/0	No		
		PFOS	ND	126	3/0	No		
		<b>Groundwater</b>	(µg/L)	(µg/L)				
		PFBS	0.032	40	3/0	No		
		PFOA	0.025	0.07	3/0	No		
		PFOS	<b>0.21</b>	0.07	<b>3/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.235</b>	0.07	<b>3/1</b>	<b>Yes</b>		
		<b>Surface Water</b>	(µg/L)	(µg/kg)				
		PFBS	0.015 J	40	1/0	No		
		PFOA	0.040	0.07	1/0	No		
		PFOS	<b>0.30</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.340</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>	(µg/kg)	(µg/kg)				
		PFBS	ND	130,000	1/0	No		
PFOA	ND	126	1/0	No				
PFOS	7.0	126	1/0	No				

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 5 Outfall 003 (No RCRA Permit ID)</b>	<b>None (new area)</b>	<b>Groundwater</b>					<b>No</b>	<b>Advance area to RI</b>
		PFBS	0.0052 J	40	1/0	No		
		PFOA	0.0072 J	0.07	1/0	No		
		PFOS	0.014 J	0.07	1/0	No		
		PFOA + PFOS	0.0212 J	0.07	1/0	No		
		<b>Surface Water</b>						
		PFBS	0.065	40	1/0	No		
		PFOA	0.041	0.07	1/0	No		
		PFOS	<b>0.82</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.861</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>						
		PFBS	ND	130,000	1/0	No		
		PFOA	ND	126	1/0	No		
		PFOS	0.84 J	126	1/0	No		



**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 6 NAAF Fire Station (No RCRA Permit ID)</b>	<b>None (New Area)</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>Advance area to RI</b>
		PFBS	0.44 J	130,000	3/0	No		
		PFOA	1.8	126	3/0	No		
		PFOS	<b>200</b>	126	<b>3/1</b>	<b>Yes</b>		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	2.0	130,000	3/0	No		
		PFOA	0.64 J	126	3/0	No		
		PFOS	17	126	3/0	No		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	13	40	3/0	No		
		PFOA	<b>2.6</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		PFOS	<b>85</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		PFOA + PFOS	<b>87.6</b>	0.07	<b>3/3</b>	<b>Yes</b>		
		<b>Surface Water</b>	<b>(µg/L)</b>	<b>(µg/kg)</b>				
		PFBS	0.021	40	1/0	No		
		PFOA	0.023	0.07	1/0	No		
		PFOS	<b>0.43</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.453</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	0.46 J	130,000	1/0	No		
PFOA	ND	126	1/0	No				
PFOS	7.4	126	1/0	No				

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 7 NAAF Pump House – Foam Truck Flush Area (No RCRA Permit ID)</b>	<b>None (New Area)</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>Advance area to RI</b>
		PFBS	0.77 J	130,000	3/0	No		
		PFOA	1.3 J	126	3/0	No		
		PFOS	100	126	3/0	No		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	1.7	130,000	3/0	No		
		PFOA	0.85 J	126	3/0	No		
		PFOS	26	126	3/0	No		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	1.2	40	3/0	No		
		PFOA	<b>0.50</b>	0.07	<b>3/1</b>	<b>Yes</b>		
		PFOS	<b>3.4</b>	0.07	<b>3/2</b>	<b>Yes</b>		
		PFOA + PFOS	<b>3.9</b>	0.07	<b>3/3</b>	<b>Yes</b>		

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

AFFF Area	IRP ID	Parameter	Maximum Detected Concentration	Screening Value	Number of Samples / Number of Exceedances*	Exceeds Screening Value	Potentially Complete DW Exposure Pathway	Recommendation
AFFF Area 8 NAAF Foam Test Area and Old C-141 (No RCRA Permit ID)	None (New Area)	<b>Surface Soil</b>	(µg/kg)	(µg/kg)			No	Advance area to RI
		PFBS	ND	130,000	3/0	No		
		PFOA	0.94	126	3/0	No		
		PFOS	<b>480</b>	126	<b>3/1</b>	<b>Yes</b>		
		<b>Subsurface Soil</b>	(µg/kg)	(µg/kg)				
		PFBS	3.6 J	130,000	3/0	No		
		PFOA	0.58 J	126	3/0	No		
		PFOS	22	126	3/0	No		
		<b>Groundwater</b>	(µg/L)	(µg/L)				
		PFBS	4.2	40	3/0	No		
		PFOA	<b>0.96</b>	0.07	<b>3/2</b>	<b>Yes</b>		
		PFOS	<b>6.8</b>	0.07	<b>3/2</b>	<b>Yes</b>		
		PFOA + PFOS	<b>7.02</b>	0.07	<b>3/2</b>	<b>Yes</b>		
		<b>Surface Water</b>	(µg/L)	(µg/kg)				
		PFBS	0.013 J	40	1/0	No		
		PFOA	0.025	0.07	1/0	No		
		PFOS	<b>0.38</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		PFOA + PFOS	<b>0.405</b>	0.07	<b>1/1</b>	<b>Yes</b>		
		<b>Sediment</b>	(µg/kg)	(µg/kg)				
		PFBS	ND	130,000	1/0	No		
PFOA	ND	126	1/0	No				
PFOS	5.7	126	1/0	No				

**Table 40 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances (continued)**

<b>AFFF Area</b>	<b>IRP ID</b>	<b>Parameter</b>	<b>Maximum Detected Concentration</b>	<b>Screening Value</b>	<b>Number of Samples / Number of Exceedances*</b>	<b>Exceeds Screening Value</b>	<b>Potentially Complete DW Exposure Pathway</b>	<b>Recommendation</b>
<b>AFFF Area 9 FT010 (No RCRA Permit ID, NAAF Fire Training Area)</b>	<b>None (New Area) FT010</b>	<b>Surface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>			<b>No</b>	<b>NFRAP</b>
		PFBS	ND	130,000	3/0	No		
		PFOA	0.18 J	126	3/0	No		
		PFOS	1.8	126	3/0	No		
		<b>Subsurface Soil</b>	<b>(µg/kg)</b>	<b>(µg/kg)</b>				
		PFBS	ND	130,000	3/0	No		
		PFOA	ND	126	3/0	No		
		PFOS	ND	126	3/0	No		
		<b>Groundwater</b>	<b>(µg/L)</b>	<b>(µg/L)</b>				
		PFBS	0.0073 J	40	3/0	No		
		PFOA	0.013 J	0.07	3/0	No		
		PFOS	0.043	0.07	3/0	No		
		PFOA + PFOS	0.056 J	0.07	3/0	No		

\*The number of samples does not include the field duplicate unless the field duplicate has a higher result than the primary sample; if the field duplicate is higher, then that result is used.

**Bold** concentrations exceeded screening levels.

AFFF = aqueous film forming foam

ID = identification

NAAF = North Auxiliary Airfield

ND = not detected

PFBS = perfluorobutane sulfonate

PFOA = perfluorooctanoic acid

RCRA = Resource Conservation and Recovery Act

SWMU = solid waste management unit

µg/L = micrograms per liter

µg/kg = micrograms per kilogram

µg/L = micrograms per liter

IRP = Installation Restoration Program

J = estimated concentration

NFRAP = No Further Response Action Planned

PFOS = perfluorooctane sulfonate

RI = remedial action

µg/kg = micrograms per kilogram

There is no immediate threat to public water supply wells or private drinking water sources from PFAS compounds in groundwater at AFFF Area 1. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 2.5 miles north (upgradient) of AFFF Area 1. The area is a mostly wooded lot in the eastern corner of JBCA. A residential area is approximately 0.1 mile to the south and downgradient to crossgradient from the investigation area. The closest drinking water supply well is approximately 2.75 miles southeast (downgradient) and set below a confining unit. Therefore, the groundwater pathway is incomplete at AFFF Area 1.

Sediment was not identified as a media of concern at SWMU 55 and was not sampled. PFBS and PFOA concentrations in surface and subsurface soil samples collected at AFFF Area 1 during this SI were below screening levels; however, PFOS concentrations in one surface soil sample and one subsurface soil sample were above screening levels. The soil could act as a continuing source of PFAS impacts to groundwater. However, exposure to impacted soil would be low because the area is heavily wooded and surrounded by a locked gate. Therefore, the soil and air pathways are incomplete at AFFF Area 1.

Based on PFAS impacts to groundwater and soil above screening levels, AFFF Area 1 is recommended for a remedial investigation (RI).

## **8.2 SOLID WASTE MANAGEMENT UNIT 52 (AT551, CURRENT FIRE TRAINING AREA) – AFFF AREA 2**

PFAS compounds were detected in groundwater and surface water above screening levels at SWMU 52 (AFFF Area 2). PFOA was in all four groundwater samples at concentrations above the EPA HA of 0.07 µg/L. PFOS was in all four groundwater samples at concentrations above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations exceeded the EPA HA of 0.07 µg/L in all four groundwater samples. On February 2, 2017, water levels were gauged in temporary wells, and monitoring wells were gauged on February 8, 2017. Groundwater elevations ranged from 20.54 feet to 24.27 feet amsl. Groundwater flow direction was not determined; however, flow generally appears to the south/southeast.

PFOS was in one surface water sample and one duplicate sample above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations exceeded the EPA HA of 0.07 µg/L in both samples. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water at AFFF Area 2 is directed to the lined pond adjacent to the area, and overflow goes to the lower-lying area to the south. Surface water at AFFF Area 2 flows to the south/southwest, toward Outfall 001, a stormwater feature that flows off-Base to the south. No storm drains or ditches are within the vicinity of SWMU 52, and surface water drains to the surrounding subsurface or evaporates. The nearest water body is Ashley River, 1.2 miles southwest of SWMU 52. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and residents of nearby communities can use local waterways for recreational fishing. Also, Goose Creek Reservoir is approximately 3.3 miles northeast (upgradient) of AFFF Area 2.

There is no immediate threat to public water supply wells or private drinking water sources from PFAS compounds in groundwater at AFFF Area 2. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 3.3 miles northeast (upgradient) of AFFF Area 2. The closest drinking water well is approximately 1.5 miles southwest (downgradient) and set below a confining unit. The closest residential area is upgradient to crossgradient from AFFF Area 2. A JBCA housing area is approximately 0.3 mile to the west.

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 2 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 2.

Based on PFAS impacts to groundwater and surface water above screening levels, AFFF Area 2 is recommended for an RI.

### **8.3 BUILDING 570 – AFFF AREA 3**

PFAS compounds were in groundwater and surface water above screening levels at Building 570 (AFFF Area 3). PFOA was in two of the three groundwater samples above the EPA HA of 0.07 µg/L. PFOS was in all three groundwater samples above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was above the EPA HA of 0.07 µg/L in all three samples. Based on water levels from the temporary wells gauged on February 7, 2017, shallow groundwater elevations ranged from 30.44 feet to 31.30 feet amsl and flowed west/southwest.

PFOA was in the surface water sample above the EPA HA of 0.07 µg/L. PFOS was in the surface water sample above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was above the EPA HA of 0.07 µg/L. Workers are within 1 mile, and wetlands are within 4 miles of the location. Surface water flows into a storm drain inlet south of Building 570. The drain discharges into underground piping that connects to a concrete-lined ditch. Water from the ditch discharges at Outfall 003 (AFFF Area 5) into an unnamed tributary of Popperdam Creek, then into Popperdam Creek, which flows into Ashley River. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and residents of nearby communities can use local waterways for recreational fishing. Also, Goose Creek Reservoir is approximately 2.6 miles northeast (upgradient) to AFFF Area 3.

There is no immediate threat to public water supply wells from PFAS compounds in groundwater at AFFF Area 3. JBICA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 2.6 miles northeast (upgradient) of AFFF Area 3. The closest drinking water well to AFFF Area 3 is approximately 1.1 miles to the northeast. The closest downgradient drinking water well is approximately 2.45 miles southwest and set below a confining unit. The closest residential area is upgradient to crossgradient from AFFF Area 3, approximately 0.8 mile east.

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 3 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 3.

Based on PFAS impacts to groundwater and surface water above screening levels, AFFF Area 3 is recommended for an RI.

### **8.4 2005 PRIVATE PLANE CRASH AREA – AFFF AREA 4**

PFAS compounds were in groundwater and surface water above screening levels at the plane crash area (AFFF Area 4). PFOS was in one primary groundwater sample and the duplicate above the EPA HA of 0.07 µg/L. Combined PFOA and PFOS was above the EPA HA of 0.07 µg/L in one primary sample and the duplicate.

PFOS was in the surface water sample above the EPA HA of 0.07 µg/L. Combined PFOA and PFOS was above the EPA HA of 0.07 µg/L. Workers are within 1 mile, and wetlands are within 4 miles of the

location. Surface water at the 2005 plane crash area flows primarily to the east/southeast. The storm ditches sampled are to the east and southeast of the crash area. No surface water intakes, downstream fisheries, or sensitive environments are adjacent to the surface water migration path within 15 miles downstream of the location; however, several wetlands may be present, and local waterways can be used for recreational fishing by residents of nearby communities.

Groundwater samples were collected using an SP-16 sampler, so groundwater levels could not be obtained. Therefore, groundwater flow direction has not been determined for AFFF Area 4 although groundwater flow direction is estimated to the southwest. Groundwater was observed in the soil during drilling at approximately 7.5 feet bgs.

There is no immediate threat to public water supply wells from PFAS compounds in groundwater at AFFF Area 4. JBCA has no drinking water wells; water is obtained from the Charleston Commission of Public Works. Goose Creek Reservoir is approximately 3 miles northeast (upgradient) of AFFF Area 4. The closest downgradient drinking water well is approximately 2 miles southwest and set below a confining unit. The closest residential area is upgradient from AFFF Area 4, approximately 0.9 mile east.

PFBS, PFOA, and PFOS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 4 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 4.

Based on PFAS impacts to groundwater and surface water above screening levels, AFFF Area 4 is recommended for an RI.

## **8.5   OUTFALL 003 – AFFF AREA 5**

PFAS compounds were in surface water at concentrations above screening levels at Outfall 003 (AFFF Area 5). Shallow groundwater has not been impacted by AFFF entering Outfall 003 at AFFF Area 5. PFOA, PFOS, and combined PFOA and PFOS detections were below the EPA HA 0.07 µg/L. Based on shallow groundwater results for AFFF Area 5, the groundwater pathway is incomplete.

PFOS was in the surface water sample above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS result was above the EPA HA of 0.07 µg/L. No surface water intakes were identified within 15 miles downstream.

One groundwater sample was collected using an SP-16 sampler; therefore, groundwater flow direction has not been determined for AFFF Area 5. Historical groundwater flow direction was estimated to the southeast. Groundwater was observed in the soil during drilling at approximately 3.5 feet bgs. Soil was not identified as a media of concern at Outfall 003 and was not sampled. PFBS, PFOA, and PFOS concentrations in sediment samples collected at AFFF Area 5 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 5. Although PFOS and PFOA are present at concentrations above EPA HAs in the surface water at AFFF Area 5, no surface water intakes were identified within 15 miles downstream; therefore, the human exposure pathway is incomplete.

Based on PFAS impacts to surface water above screening levels, AFFF Area 5 is recommended for an RI.

## **8.6 NORTH AUXILIARY AIRFIELD FIRE STATION – AFFF AREA 6**

PFAS compounds were in groundwater and surface water above screening levels at NAAF Fire Station (AFFF Area 6). PFOA, PFOS, and combined PFOA and PFOS were in all three groundwater samples above the EPA HA of 0.07 µg/L. PFOS and combined PFOA and PFOS were detected in the surface water sample above the EPA HA of 0.07 µg/L. Based on water levels from the temporary wells gauged on February 4, 2017, shallow elevations ranged from 272.39 feet to 272.73 feet amsl, and groundwater flowed southeast.

Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water intake is more than 15 river miles downstream. The closest drinking water well to AFFF Area 6 is approximately 1 mile northeast (sidegradient) and set within a confined aquifer. Two public supply wells are approximately 1.2 miles southeast (downgradient) of AFFF Area 6 and set within a confined aquifer. The town of North, South Carolina, is to the northwest (upgradient) and obtains drinking water from public supply wells (groundwater sources) approximately 2.5 miles northeast (upgradient) and 2 to 3 miles northwest (upgradient) of AFFF Area 6 that range in depth from 255 to 267 feet bgs and are set within a confined aquifer. Therefore, the groundwater and surface water pathways are incomplete.

PFBS and PFOA concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 6 during this SI were below screening levels. The PFOS concentration in one surface soil sample was above the calculated RSL. Exposure to impacted soil would be low because the area is covered in mature vegetation. Therefore, the soil and air pathways are incomplete at AFFF Area 6.

Based on PFAS impacts to surface soil, groundwater, and surface water above screening levels, AFFF Area 6 is recommended for an RI.

## **8.7 NORTH AUXILIARY AIRFIELD PUMP HOUSE – FOAM TRUCK FLUSH AREA – AFFF AREA 7**

PFAS compounds were in groundwater above screening levels at the NAAF Pump House (AFFF Area 7). PFOA was in one groundwater sample above the EPA HA of 0.07 µg/L. PFOS was in two groundwater samples above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations were above the EPA HA of 0.07 µg/L. Based on water levels from the temporary wells gauged on February 4, 2017, shallow groundwater elevations ranged from 275.45 feet to 275.88 feet amsl and flowed southeast.

There was no surface water at the NAAF Pump House, as indicated in Section 5.7. No storm drains or ditches are within the vicinity of the pump house, and surface water drains to the surrounding subsurface or evaporates; therefore, it is unlikely that any AFFF has migrated into surface water.

Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water intake is more than 15 river miles downstream. The closest drinking water well to AFFF Area 7 is approximately 0.7 mile to the northeast (sidegradient) and set within a confined aquifer. Two public supply wells owned by the USAF are approximately 1.1 miles southeast (downgradient) of AFFF Area 7 and set within a confined aquifer. The town of North, South Carolina, is northwest (upgradient) and obtains drinking water from public supply wells (groundwater sources) ranging in depth from 172 to 481 feet bgs within a confined aquifer. These wells are approximately 2 miles northeast (crossgradient) and 2 miles northwest (upgradient) of AFFF Area 7. Therefore, the groundwater pathway is incomplete.



Sediment was not identified as a media of concern at the Pump House and was not sampled. PFBS, PFOA, and PFOS concentrations in surface soil and subsurface soil samples collected at AFFF Area 7 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 7.

Based on PFAS impacts to groundwater above screening levels, AFFF Area 7 is recommended for an RI.

#### **8.8 NORTH AUXILIARY AIRFIELD FOAM TEST AREA AND OLD C-141 (TRAINING) – AFFF AREA 8**

PFAS compounds were in groundwater and surface water above screening levels at the NAAF Foam Test Area and Old C-141 (Training) (AFFF Area 8). PFOA was in two primary groundwater samples and the duplicate above the EPA HA of 0.07 µg/L. PFOS was in two primary groundwater samples and the duplicate above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentrations were above the EPA HA of 0.07 µg/L in two primary groundwater samples and the duplicate. Based on water levels from the temporary wells gauged on February 5, 2017, shallow groundwater elevations ranged from 211.23 feet to 211.92 feet amsl, and groundwater flowed southwest.

PFOS was in the surface water sample above the EPA HA of 0.07 µg/L. The combined PFOA and PFOS concentration was above the EPA HA of 0.07 µg/L.

Although the North Edisto River to the southeast is used as a drinking water source for Orangeburg, South Carolina, the water intake is more than 14 river miles downstream. The closest drinking water wells to AFFF Area 8 are approximately 1.0 mile northeast (sidegradient) and set within a confined aquifer. There are no downgradient drinking water wells. The town of North, South Carolina, is northwest (crossgradient) and obtains drinking water from public supply wells (groundwater sources) ranging from 172 to 481 feet bgs within a confined aquifer. The aquifer is approximately 2.8 miles northeast (upgradient) and 2.7 miles northwest (crossgradient to upgradient) of AFFF Area 8. Therefore, the groundwater and surface water pathways are incomplete.

PFBS and PFOA concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 8 during this SI were below screening levels. The PFOS concentration in one surface soil sample was above the calculated RSL. Exposure to impacted soil would be low because the area is covered in mature vegetation and is in a remote area on NAAF. Therefore, the soil and air pathways are incomplete at AFFF Area 8.

Based on PFAS impacts to surface soil, groundwater, and surface water above screening levels, AFFF Area 8 is recommended for an RI.

#### **8.9 FT010 (NORTH AUXILIARY AIRFIELD FIRE TRAINING AREA) – AFFF AREA 9**

PFAS compounds were not detected in soil or groundwater above screening levels at FT010 (AFFF Area 9). The analytical results for groundwater samples showed concentrations of PFOA and PFOS, and combined concentrations of PFOA and PFOS were detected in samples at concentrations below the EPA HA of 0.07 µg/L.

Based on water levels from the temporary wells gauged on February 6, 2017, shallow groundwater elevations ranged from 275.64 feet to 269.39 feet amsl, and groundwater flowed northeast.

The closest drinking water well to AFFF Area 9 is approximately 0.5 mile east (sidegradient/downgradient) and set within a confined aquifer. Two public supply wells are downgradient

approximately 1.6 and 1.9 miles northeast of AFFF Area 9 and set within a confined aquifer. There is no potential threat to public water supply wells from PFAS compounds in groundwater at AFFF Area 9.

Sediment was not identified as a media of concern at FT010 and was not sampled. PFBS, PFOA, and PFOS concentrations in surface soil and subsurface soil samples collected at AFFF Area 9 during this SI were below screening levels. Lacking concentrations of PFAS compounds above screening levels, the soil and air pathways are incomplete at AFFF Area 9.

PFAS concentrations in soil and groundwater at AFFF Area 9 were below screening levels. Therefore, AFFF Area 9 is recommended for no further response action planned.

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## **Appendix A**

### **Figures**

\\or-file01.sesllc.priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI Report\Figure\_1\_Location\_of\_Charleston\_AFB\_and\_NAAF\_SI.mxd; Date: 7/19/2017

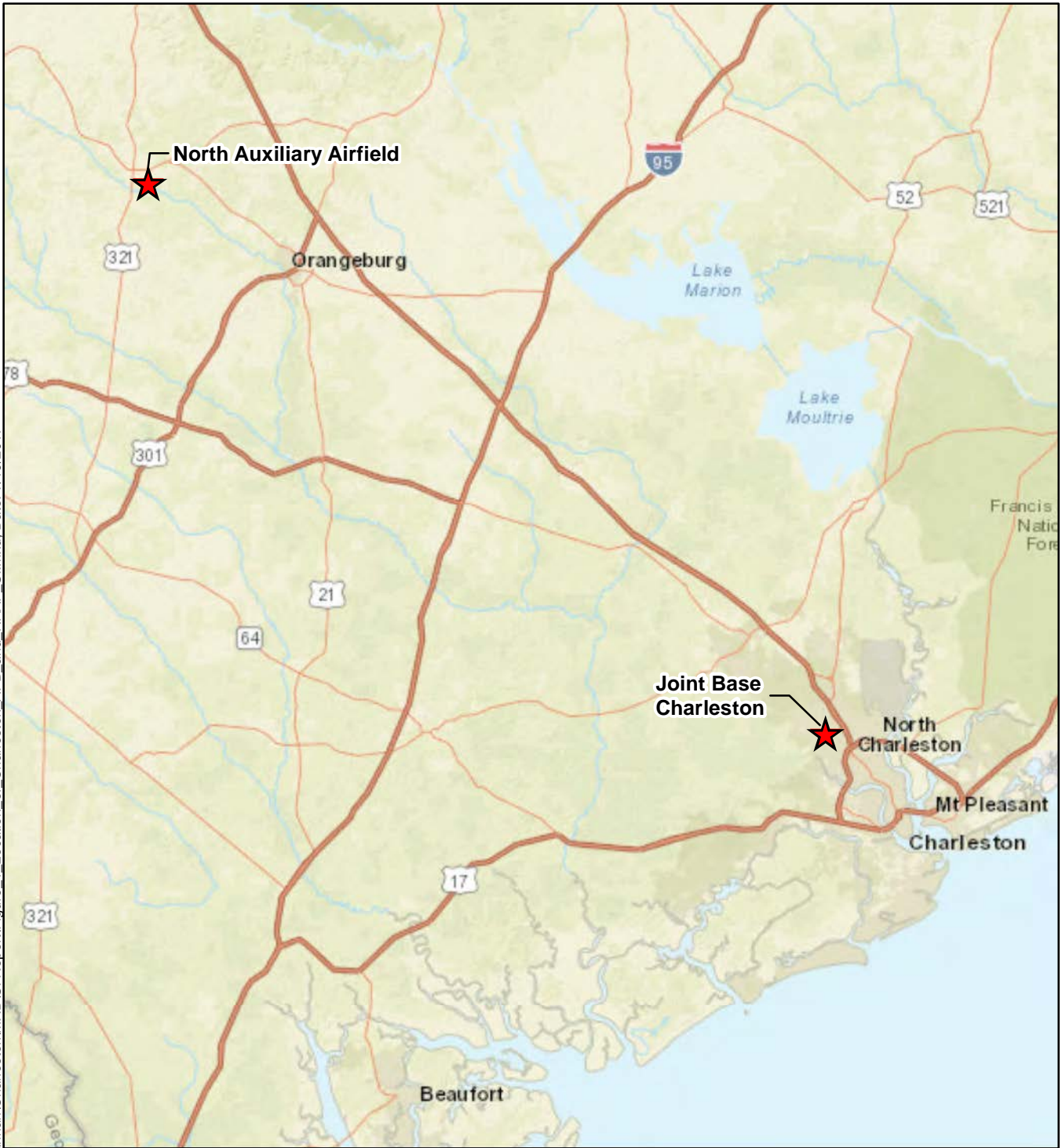


Figure 1 Location of Joint Base Charleston-Air and North Auxiliary Airfield, South Carolina

**Legend**

Service Layer Credits: Esri StreetMap North America

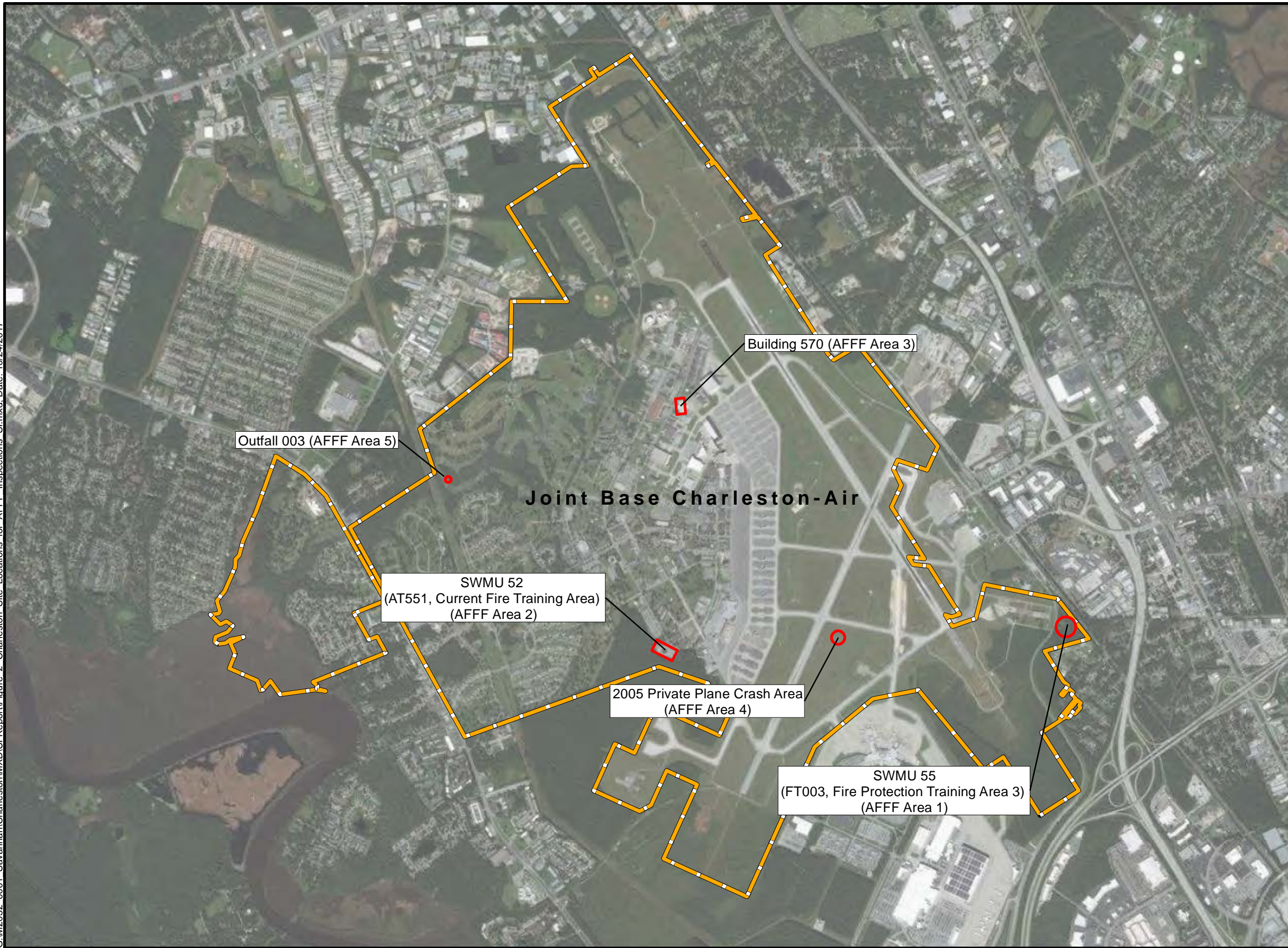
Drawn: B Baxter

Date: 7/19/2017

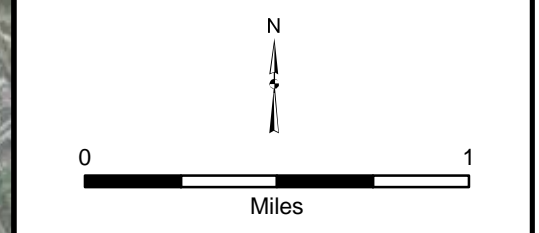




G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 2 Charleston Site Locations for AFFF Inspections.SI.mxd; Date: 10/24/2017



**Legend**  
 AFFF Inspection Area  
 Installation Boundary



Joint Base Charleston-Air  
 Charleston County, South Carolina

**Figure 2**  
 Joint Base Charleston-Air AFFF Area  
 Site Inspection Locations



Drawn: tmorse | Date: 10/24/2017  
 Service Layer Credits: Esri ArcGIS Online Aerial Photography



G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 3 NAAF Site Locations for AFFF Inspections\_S1.mxd Date: 8/18/2017



**Legend**

-  Wetland
-  AFFF Inspection Area
-  Installation Boundary

N

0      0.375      0.75  
Miles

North Auxiliary Airfield  
Orangeburg County, South Carolina

**Figure 3**  
**North Auxiliary Airfield AFFF**  
**Area Site Inspection Locations**

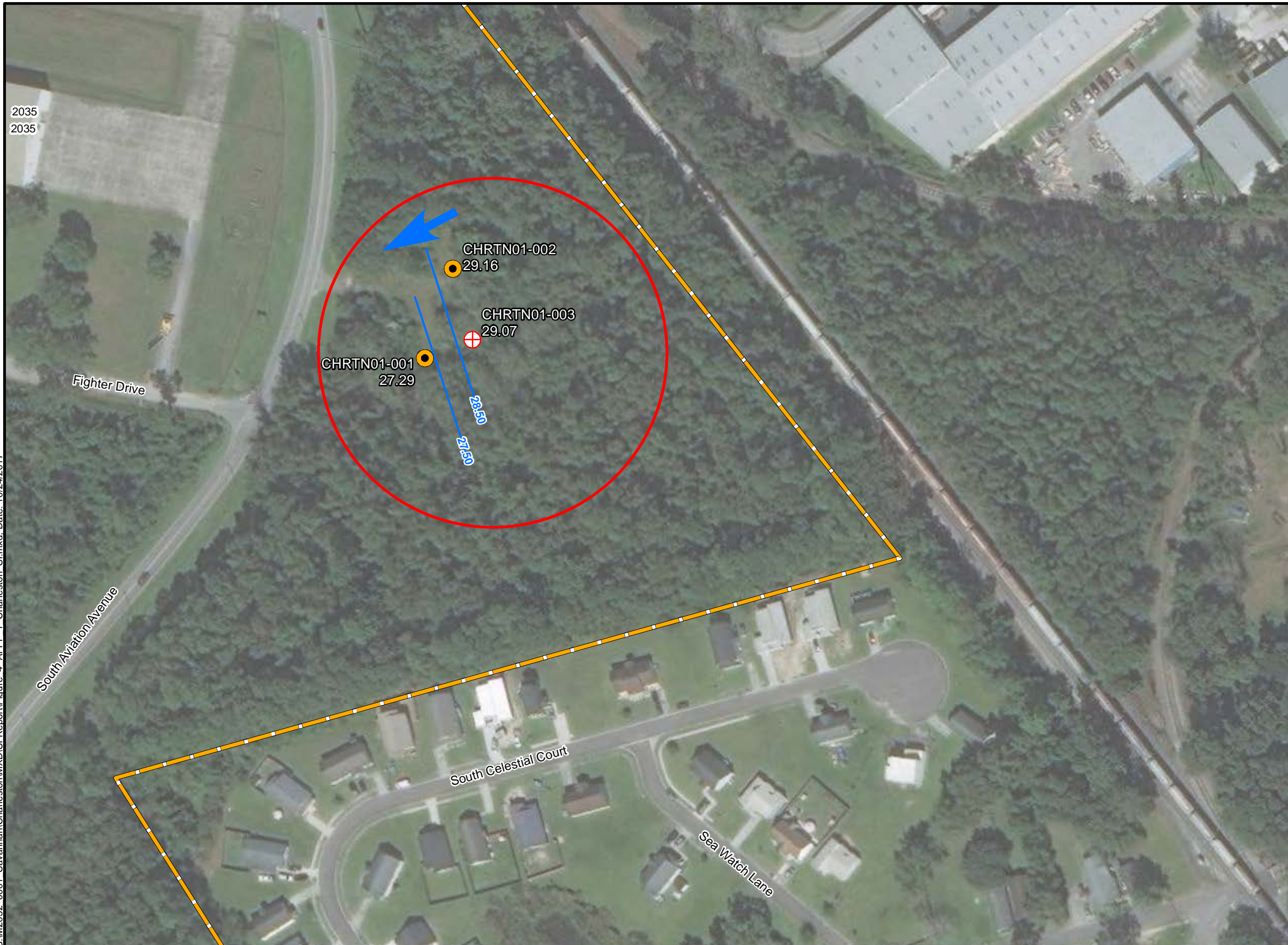


Drawn: B Baxter      Date: 8/18/2017  
Service Layer Credits: Esri ArcGIS Online Aerial Photography



2035  
2035

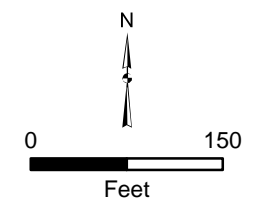
G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 4\_AFFF 1\_Charleston\_SI.mxd Date: 10/24/2017



**Legend**

- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
- DPT Boring Location for Collecting Groundwater Sample
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary
- Groundwater Elevation Contour

CHRTN01-001  
27.29 = Groundwater Elevation (ft)  
measured on February 3, 2017



Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 4**  
**SWMU 55 (FT003, Fire Protection Training Area 3) (AFFF Area 1) Sample Locations and Potentiometric Contours**

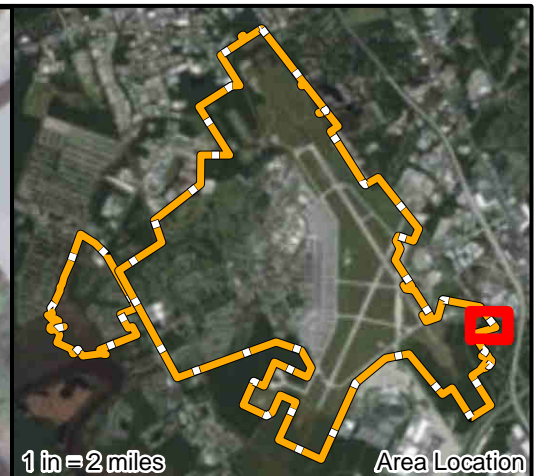
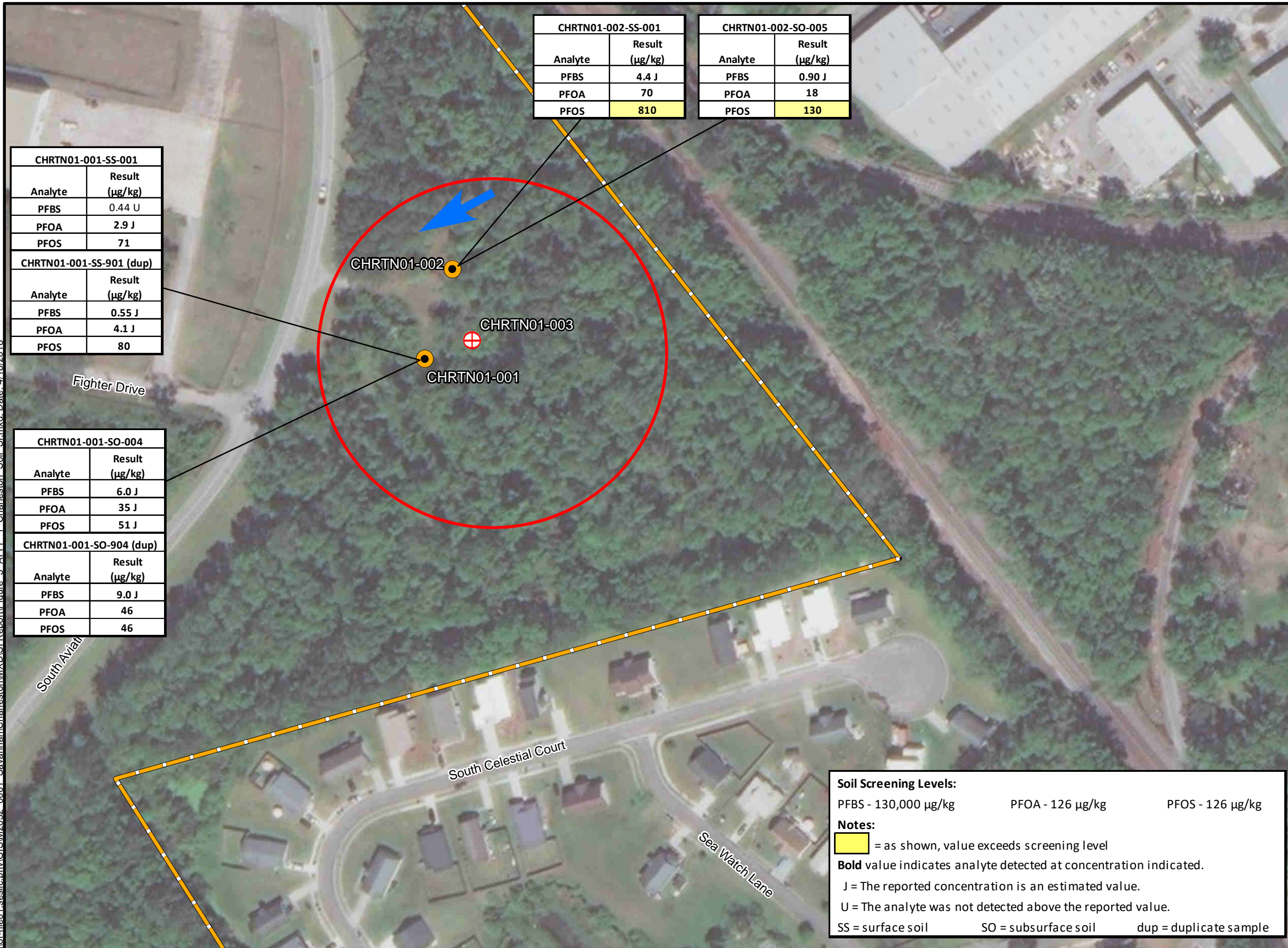


Drawn: tmorse | Date: 10/24/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

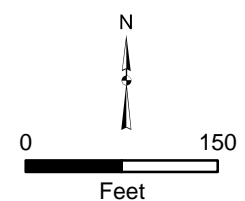


I:\or-file01\_seslic\_priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 5\_AFFF\_1\_Charleston\_Soil\_SI.mxd; Date: 4/18/2018



**Legend**

- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
- DPT Boring Location for Collecting Groundwater Sample
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary



Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 5**  
**SWMU 55 (FT003, Fire Protection Training Area 3) (AFFF Area 1)**  
**PFBS, PFOA, and PFOS in Soil**



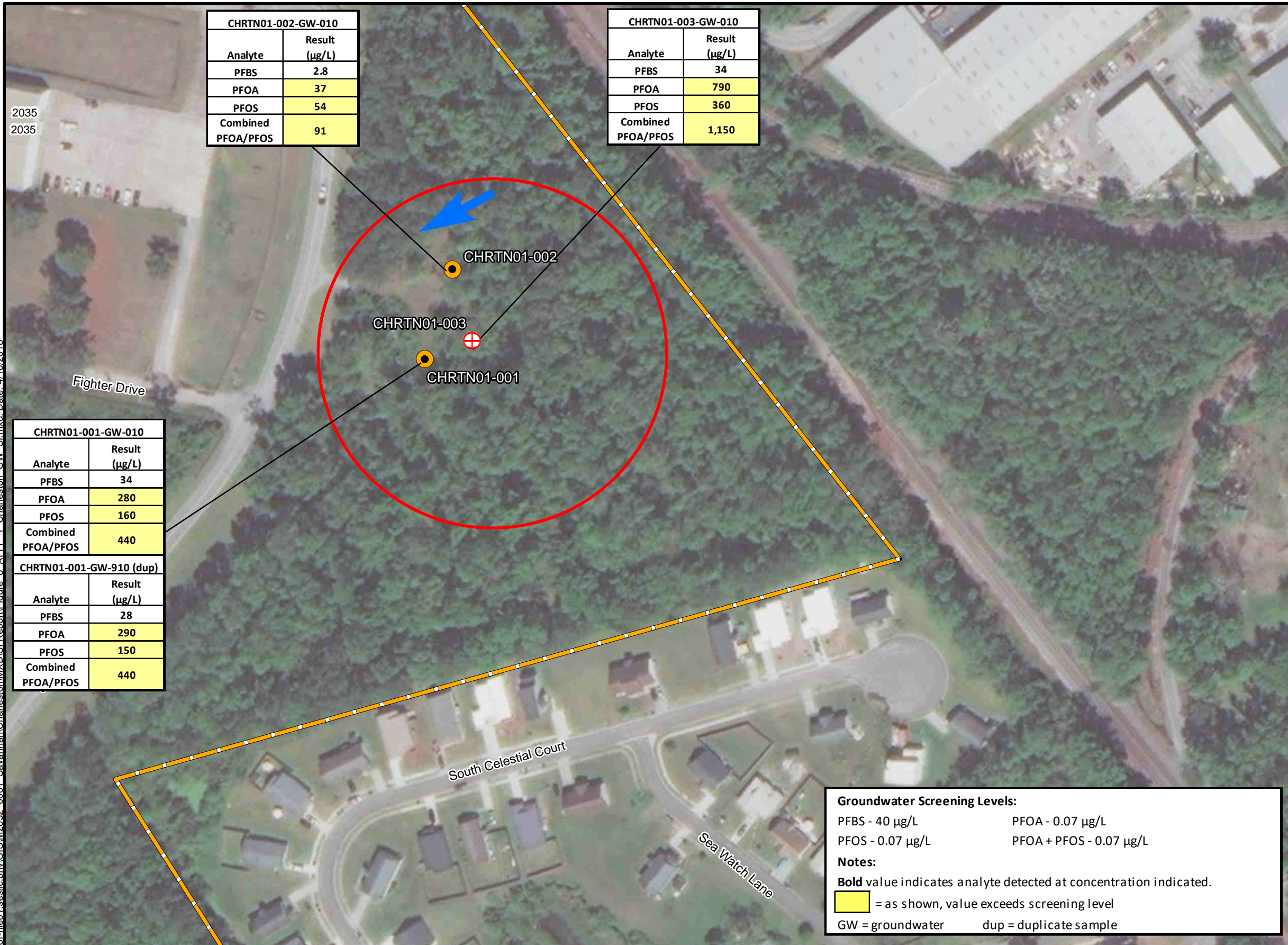
Drawn: LNatzke Date: 4/18/2018  
Service Layer Credits: Esri ArcGIS Online Aerial Photography

**Soil Screening Levels:**  
PFBS - 130,000 µg/kg      PFOA - 126 µg/kg      PFOS - 126 µg/kg

**Notes:**  
 = as shown, value exceeds screening level  
**Bold** value indicates analyte detected at concentration indicated.  
 J = The reported concentration is an estimated value.  
 U = The analyte was not detected above the reported value.  
 SS = surface soil      SO = subsurface soil      dup = duplicate sample



I:\or-file01\_seslic\_priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure\_6\_AFFF\_1\_Charleston\_GW\_SI.mxd, Date: 4/18/2018



CHRTN01-002-GW-010	
Analyte	Result (µg/L)
PFBS	2.8
PFOA	<b>37</b>
PFOS	<b>54</b>
Combined PFOA/PFOS	<b>91</b>

CHRTN01-003-GW-010	
Analyte	Result (µg/L)
PFBS	34
PFOA	<b>790</b>
PFOS	<b>360</b>
Combined PFOA/PFOS	<b>1,150</b>

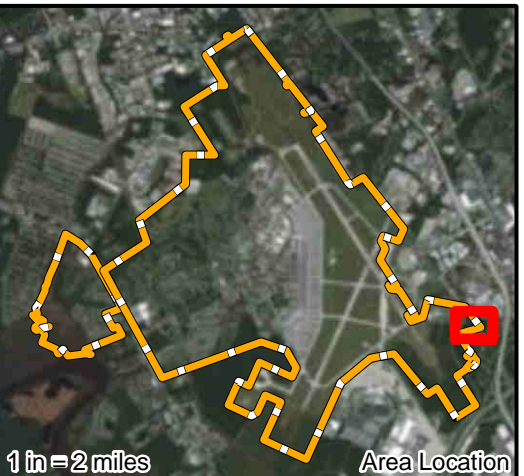
CHRTN01-001-GW-010	
Analyte	Result (µg/L)
PFBS	34
PFOA	<b>280</b>
PFOS	<b>160</b>
Combined PFOA/PFOS	<b>440</b>

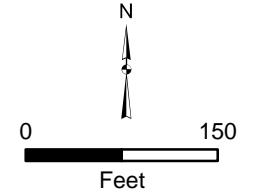
CHRTN01-001-GW-910 (dup)	
Analyte	Result (µg/L)
PFBS	28
PFOA	<b>290</b>
PFOS	<b>150</b>
Combined PFOA/PFOS	<b>440</b>

**Groundwater Screening Levels:**  
 PFBS - 40 µg/L                      PFOA - 0.07 µg/L  
 PFOS - 0.07 µg/L                    PFOA + PFOS - 0.07 µg/L

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 = as shown, value exceeds screening level  
 GW = groundwater      dup = duplicate sample



- Legend**
- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
  - ⊕ DPT Boring Location for Collecting Groundwater Sample
  - ← Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary



Joint Base Charleston-Air  
 Charleston County, South Carolina

**Figure 6**  
**SWMU 55 (FT003, Fire Protection Training Area 3) (AFFF Area 1)**  
**PFBS, PFOA, and PFOS**  
**in Groundwater**

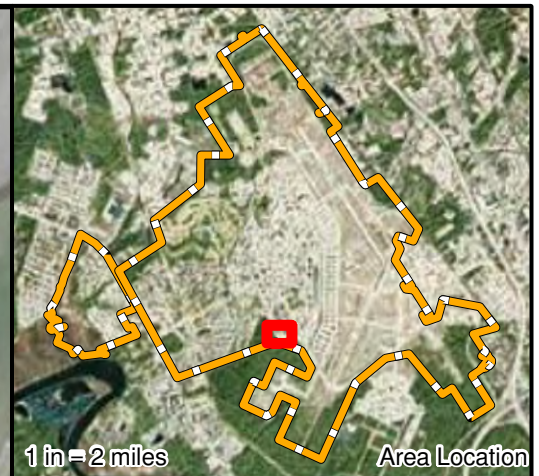


Drawn: LNatzke                      Date: 4/18/2018

Service Layer Credits: Esri ArcGIS Online Aerial Photography



G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 7\_AFFF\_2\_Charleston\_SI.mxd, Date: 10/24/2017



**Legend**

- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
- DPT Boring Location for Collecting Surface and Subsurface Soil Samples
- Surface Water and Sediment Samples
- Existing Groundwater Monitoring Well Sampled
- Storm Sewer
- Oil/Water Separator
- Historical Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0  200

Feet

Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 7**  
**SWMU 52 (AT551, Current**  
**Fire Training Area) (AFFF Area 2)**  
**Sample Locations**

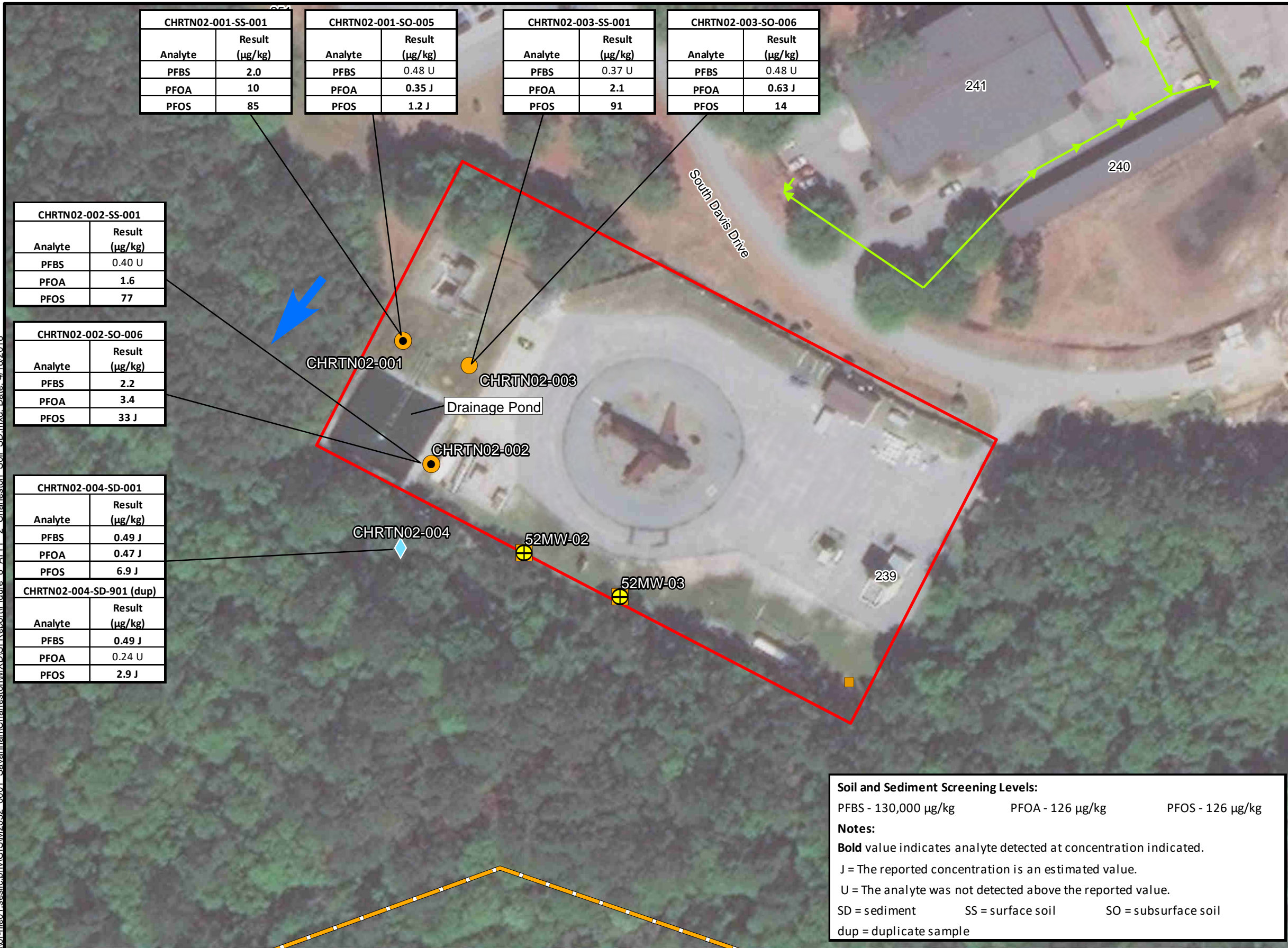


Drawn: tmorse      Date: 10/24/2017  
Service Layer Credits: Esri ArcGIS Online Aerial Photography

\*52MW-02 and 52MW-03 were gauged on February 2, 2017.  
CHRTN02-001 and CHRTN02-002 were gauged on February 8, 2017.



I:\or-file01\_seslic\_priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 8 - AFFF 2 Charleston\_Soil\_SD.mxd; Date: 4/18/2018



CHRTN02-001-SS-001	
Analyte	Result (µg/kg)
PFBS	2.0
PFOA	10
PFOS	85

CHRTN02-001-SO-005	
Analyte	Result (µg/kg)
PFBS	0.48 U
PFOA	0.35 J
PFOS	1.2 J

CHRTN02-003-SS-001	
Analyte	Result (µg/kg)
PFBS	0.37 U
PFOA	2.1
PFOS	91

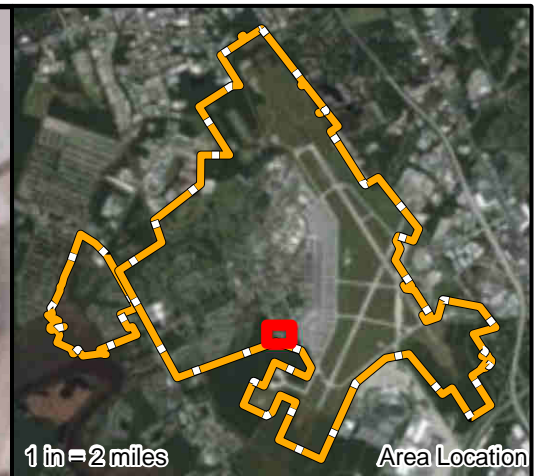
CHRTN02-003-SO-006	
Analyte	Result (µg/kg)
PFBS	0.48 U
PFOA	0.63 J
PFOS	14

CHRTN02-002-SS-001	
Analyte	Result (µg/kg)
PFBS	0.40 U
PFOA	1.6
PFOS	77

CHRTN02-002-SO-006	
Analyte	Result (µg/kg)
PFBS	2.2
PFOA	3.4
PFOS	33 J

CHRTN02-004-SD-001	
Analyte	Result (µg/kg)
PFBS	0.49 J
PFOA	0.47 J
PFOS	6.9 J

CHRTN02-004-SD-901 (dup)	
Analyte	Result (µg/kg)
PFBS	0.49 J
PFOA	0.24 U
PFOS	2.9 J



**Legend**

- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
- DPT Boring Location for Collecting Surface and Subsurface Soil Samples
- Surface Water and Sediment Samples
- Existing Groundwater Monitoring Well Sampled
- Storm Sewer (Underground)
- Oil/Water Separator
- Historical Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

0 200  
Feet

N

Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 8**  
**SWMU 52 (AT551, Current Fire Training Area) (AFFF Area 2)**  
**PFBS, PFOA, and PFOS in Soil and Sediment**

Drawn: LNatzke      Date: 4/18/2018

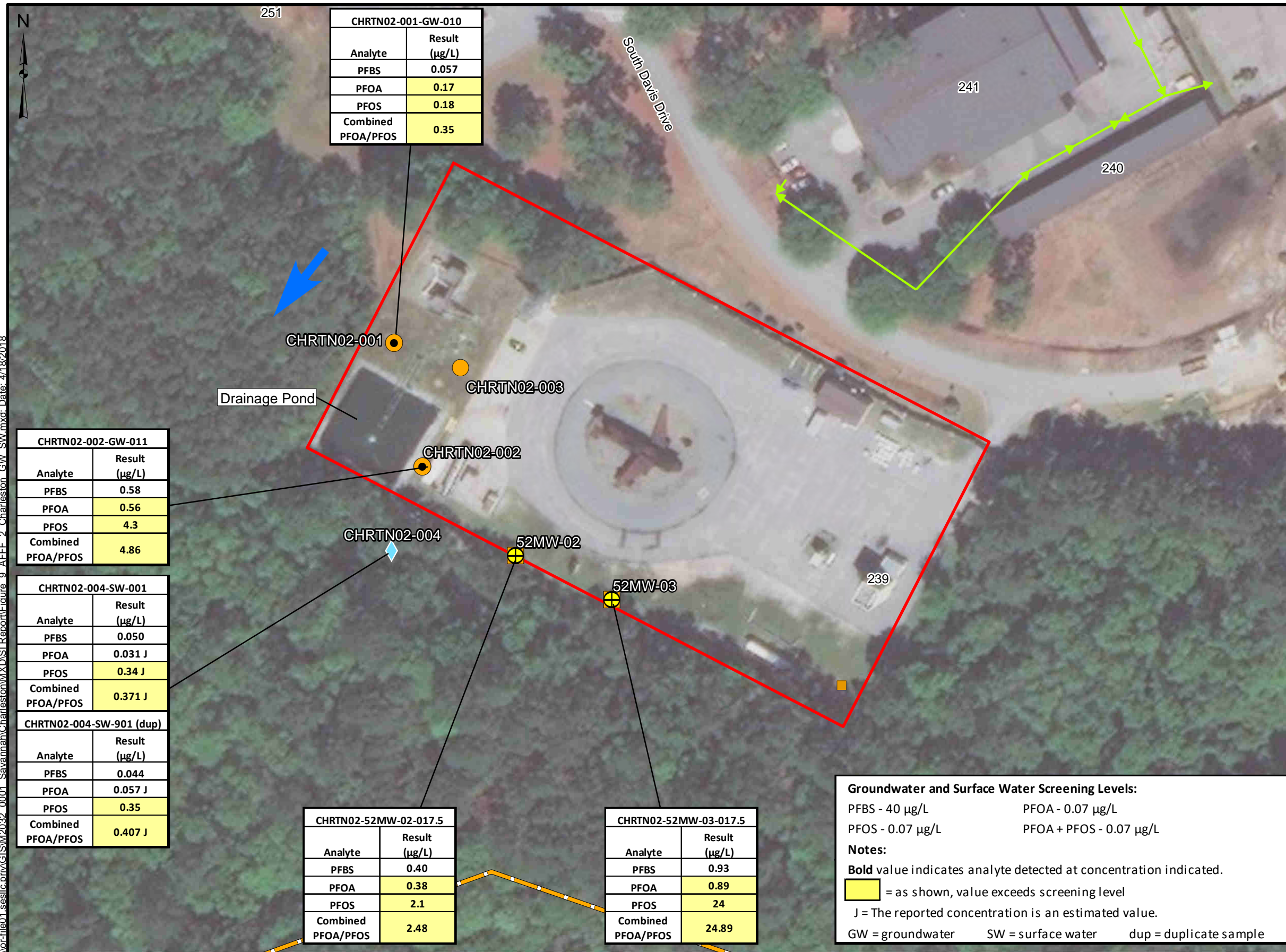
Service Layer Credits: Esri ArcGIS Online Aerial Photography

**Soil and Sediment Screening Levels:**  
 PFBS - 130,000 µg/kg      PFOA - 126 µg/kg      PFOS - 126 µg/kg

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 J = The reported concentration is an estimated value.  
 U = The analyte was not detected above the reported value.  
 SD = sediment      SS = surface soil      SO = subsurface soil  
 dup = duplicate sample



I:\or-file01\_seslic\_priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure\_9\_AFFF\_2\_Charleston\_GW\_SW.mxd: Date: 4/18/2018



CHRTN02-001-GW-010	
Analyte	Result (µg/L)
PFBS	0.057
PFOA	0.17
PFOS	0.18
Combined PFOA/PFOS	0.35

CHRTN02-002-GW-011	
Analyte	Result (µg/L)
PFBS	0.58
PFOA	0.56
PFOS	4.3
Combined PFOA/PFOS	4.86

CHRTN02-004-SW-001	
Analyte	Result (µg/L)
PFBS	0.050
PFOA	0.031 J
PFOS	0.34 J
Combined PFOA/PFOS	0.371 J

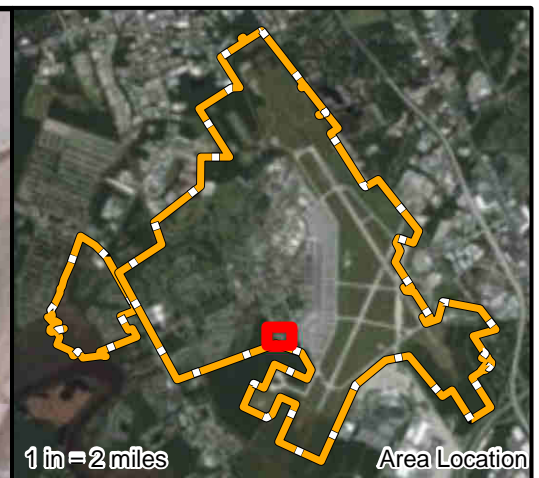
CHRTN02-004-SW-901 (dup)	
Analyte	Result (µg/L)
PFBS	0.044
PFOA	0.057 J
PFOS	0.35
Combined PFOA/PFOS	0.407 J

CHRTN02-52MW-02-017.5	
Analyte	Result (µg/L)
PFBS	0.40
PFOA	0.38
PFOS	2.1
Combined PFOA/PFOS	2.48

CHRTN02-52MW-03-017.5	
Analyte	Result (µg/L)
PFBS	0.93
PFOA	0.89
PFOS	24
Combined PFOA/PFOS	24.89

**Groundwater and Surface Water Screening Levels:**  
 PFBS - 40 µg/L      PFOA - 0.07 µg/L  
 PFOS - 0.07 µg/L      PFOA + PFOS - 0.07 µg/L

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 = as shown, value exceeds screening level  
 J = The reported concentration is an estimated value.  
 GW = groundwater    SW = surface water    dup = duplicate sample



**Legend**

- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
- DPT Boring Location for Collecting Surface and Subsurface Soil Samples
- Surface Water and Sediment Samples
- Existing Groundwater Monitoring Well Sampled
- Storm Sewer (Underground)
- Oil/Water Separator
- Historical Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

0      200  
Feet

Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 9**  
**SWMU 52 (AT551, Current Fire Training Area) (AFFF Area 2) PFBS, PFOA, and PFOS in Groundwater and Surface Water**

Drawn: LNatzke      Date: 4/18/2018  
 Service Layer Credits: Esri ArcGIS Online Aerial Photography

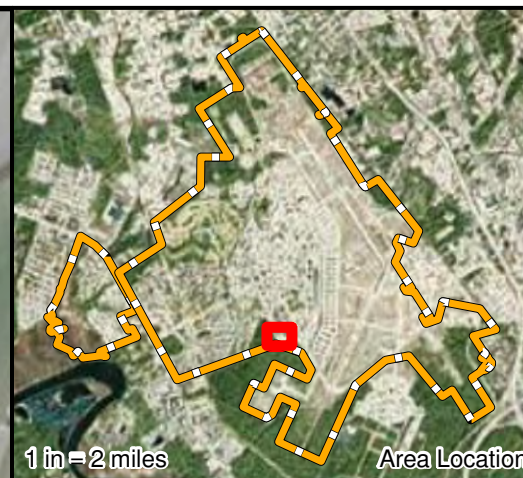


G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 10\_AFFF\_2\_Release\_Charleston\_SI.mxd Date: 10/24/2017

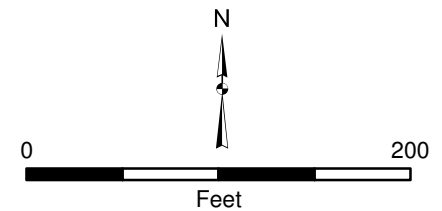


Drainage Pond

Approximate location of AFFF flow toward propane tank. Did not reach the fence line or surface water ditch. AFFF and grassy/soil areas were dry after discovery the next day. No soil was removed, as reported by AFCEC.



- Legend**
- Storm Sewer (Underground)
  - Oil/Water Separator
  - Approximate Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary



Joint Base Charleston-Air  
Charleston County, South Carolina

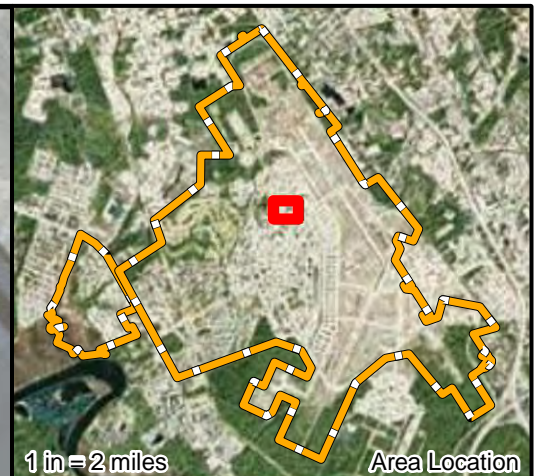
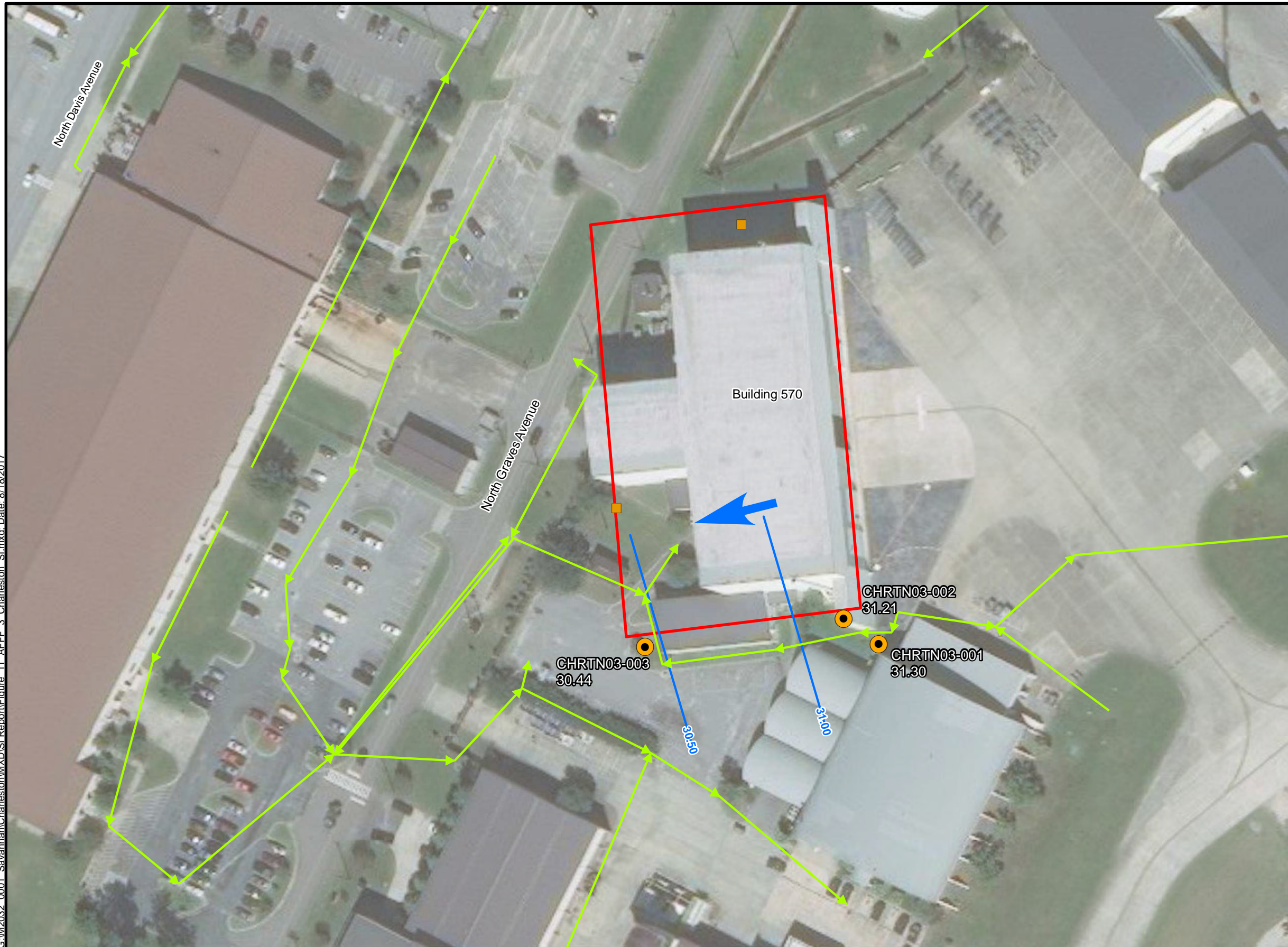
**Figure 10**  
**SWMU 52 (AT551, Current**  
**Fire Training Area) (AFFF Area 2)**  
**AFFF Release in June 2017**



Drawn: tmorse      Date: 10/24/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

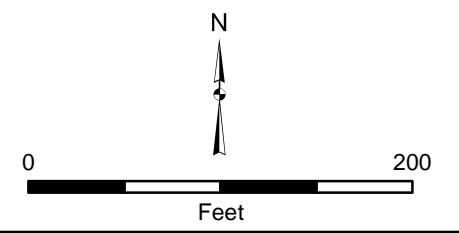




- Legend**
- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
  - Oil/Water Separator
  - Storm Sewer (Underground)
  - Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary
  - Groundwater Elevation Contour

CHRTN03-001  
31.30 = Groundwater Elevation (ft)  
measured on February 7, 2017.

Note: Surface Water and Sediment samples for AFFF Area 3 are shown on Figure 17.



Joint Base Charleston-Air  
Charleston County, South Carolina

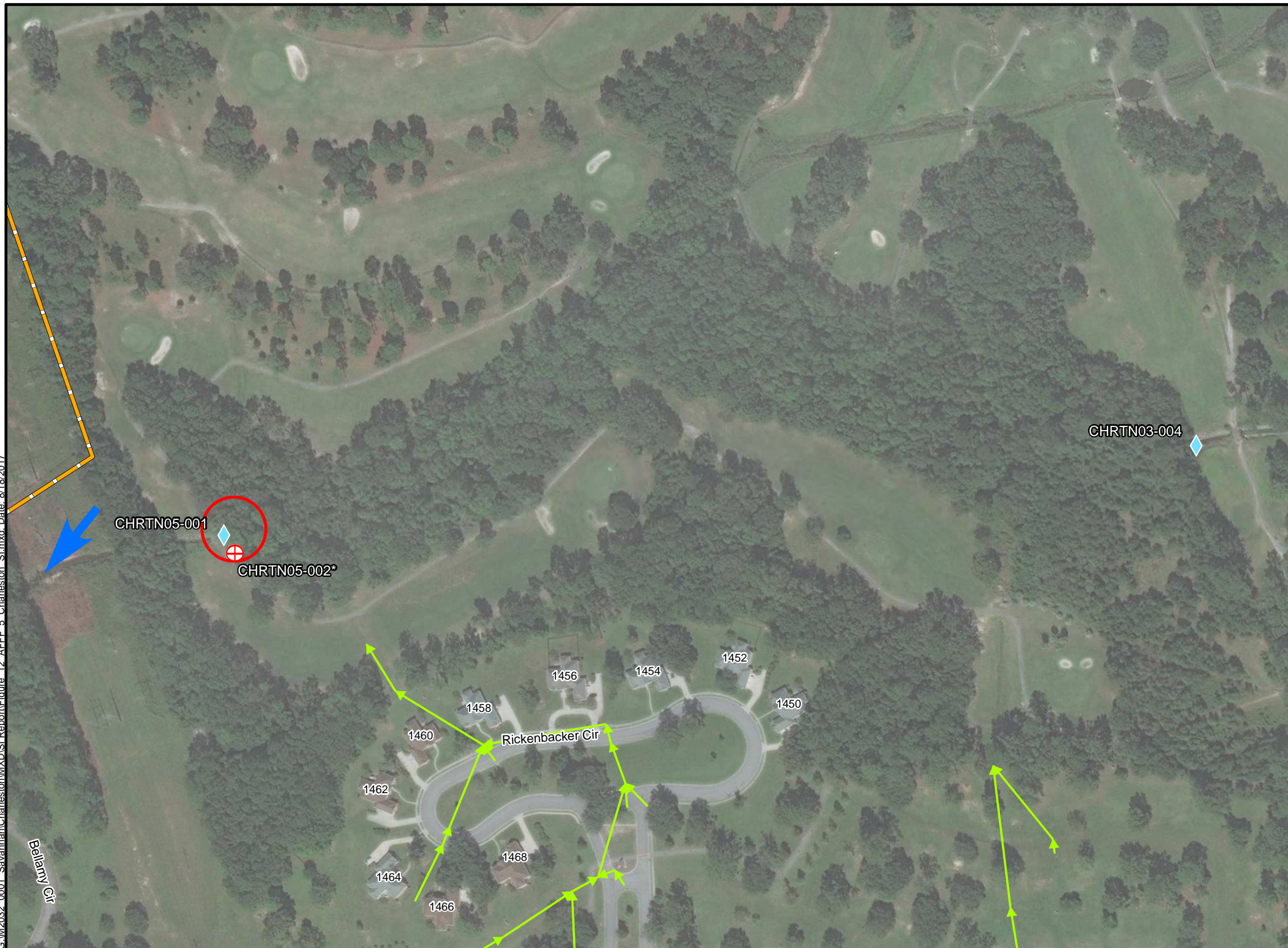
**Figure 11**  
**Building 570 (AFFF Area 3)**  
**Sample Locations**  
**and Potentiometric Contours**



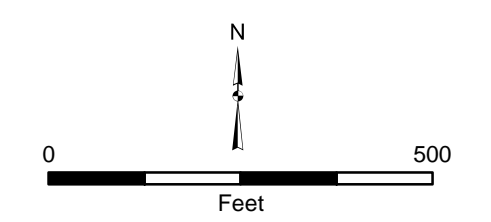
Drawn: LNatzke      Date: 8/18/2017  
Service Layer Credits: Esri ArcGIS Online Aerial Photography



G:\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure\_12\_AFFF\_5\_Charleston\_SI.mxd; Date: 8/18/2017



- Legend**
- DPT Boring Location for Collecting Groundwater Sample
  - Surface Water and Sediment Samples
  - Storm Sewer (Underground)
  - Approximate Groundwater Flow Direction, November 1994 (Haliburton NUS Corporation, June 1995)
  - AFFF Inspection Area
  - Installation Boundary
- \* Hydropunch sample at this location.



Joint Base Charleston-Air  
Charleston County, South Carolina

**Figure 12**  
**Building 570 (AFFF Area 3)**  
**Surface Water and Sediment Sample**  
**Locations and Outfall 003**  
**(AFFF Area 5) Sample Locations**

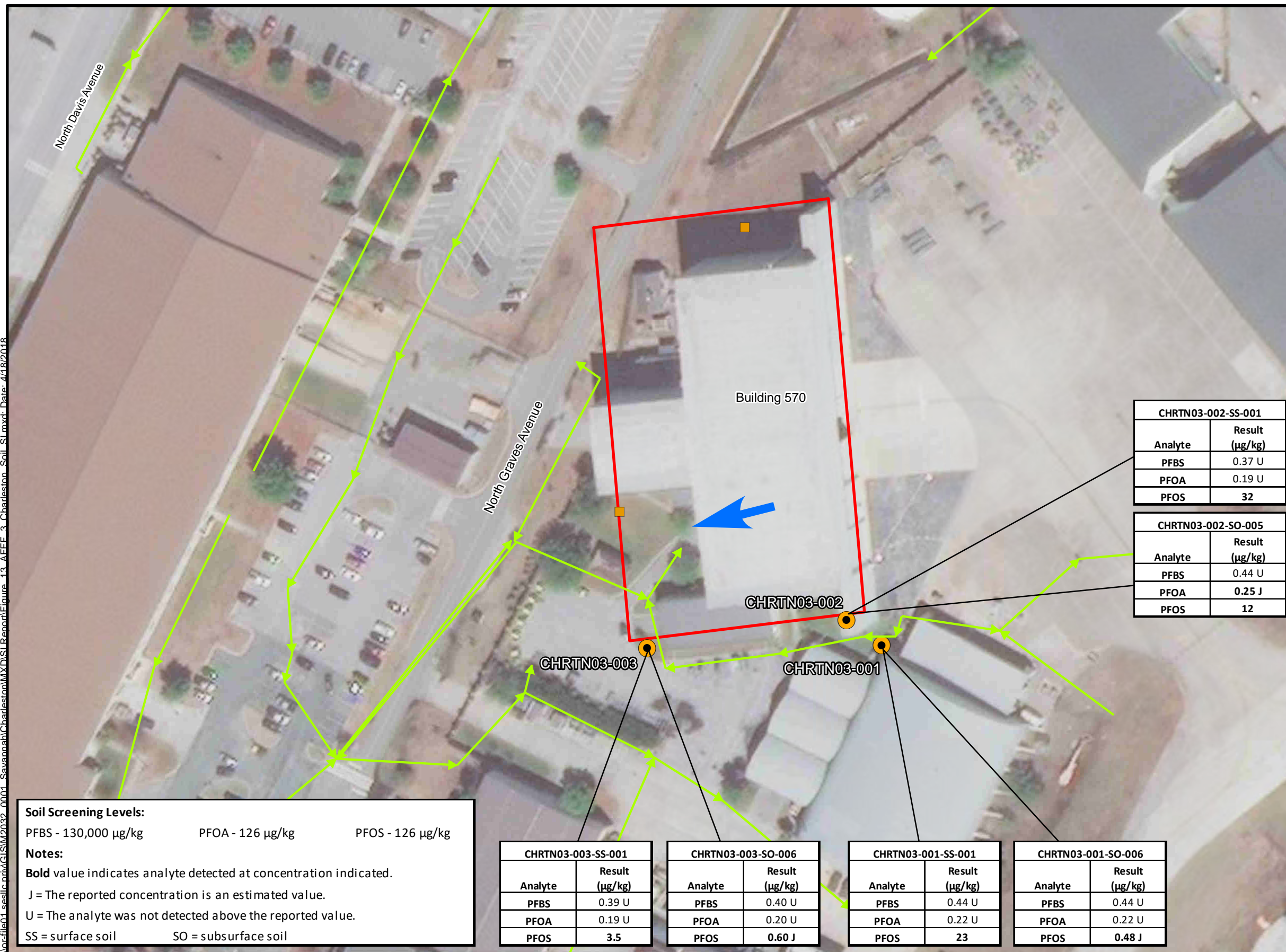


Drawn: LNatzke      Date: 8/18/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography



M2032.0001\_SavannahCharlestonMXD\SI\_Report\Figure\_13\_AFFF\_3\_Charleston\_Soil\_SLM\rd\_Date\_4/18/2018



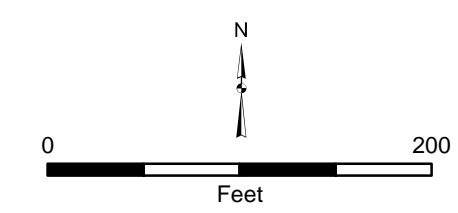
- Legend**
- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
  - Oil/Water Separator
  - Storm Sewer (Underground)
  - Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary

Note: Sediment sample for AFFF Area 3 shown on Figure 18.

CHRTN03-002-SS-001	
Analyte	Result (µg/kg)
PFBS	0.37 U
PFOA	0.19 U
PFOS	32

CHRTN03-002-SO-005	
Analyte	Result (µg/kg)
PFBS	0.44 U
PFOA	0.25 J
PFOS	12



**Soil Screening Levels:**  
 PFBS - 130,000 µg/kg      PFOA - 126 µg/kg      PFOS - 126 µg/kg

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 J = The reported concentration is an estimated value.  
 U = The analyte was not detected above the reported value.  
 SS = surface soil      SO = subsurface soil

CHRTN03-003-SS-001	
Analyte	Result (µg/kg)
PFBS	0.39 U
PFOA	0.19 U
PFOS	3.5

CHRTN03-003-SO-006	
Analyte	Result (µg/kg)
PFBS	0.40 U
PFOA	0.20 U
PFOS	0.60 J

CHRTN03-001-SS-001	
Analyte	Result (µg/kg)
PFBS	0.44 U
PFOA	0.22 U
PFOS	23

CHRTN03-001-SO-006	
Analyte	Result (µg/kg)
PFBS	0.44 U
PFOA	0.22 U
PFOS	0.48 J

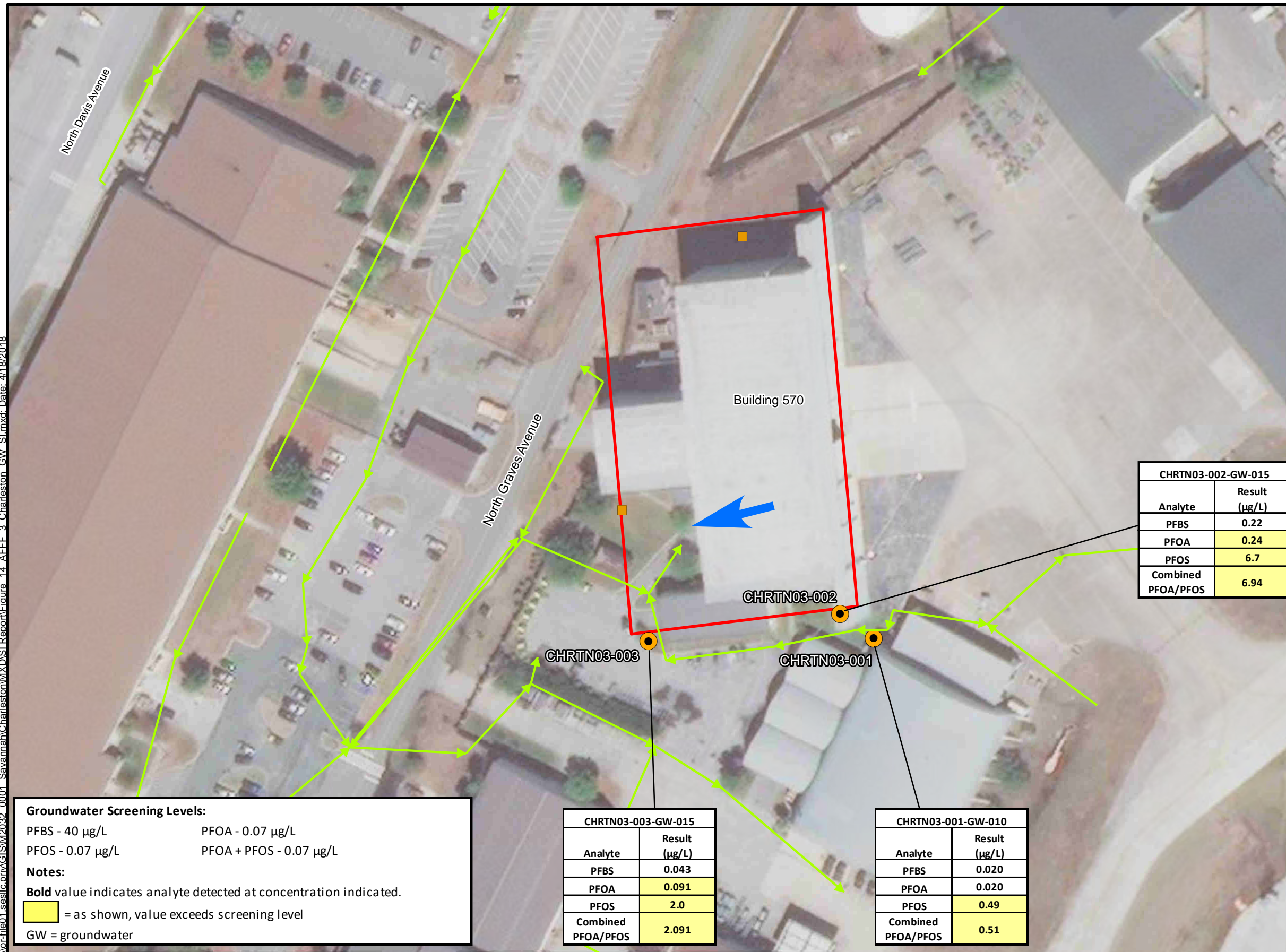
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**Figure 13**  
**Building 570 (AFFF Area 3)**  
**PFBS, PFOA, and**  
**PFOS in Soil**

Drawn: LNatzke      Date: 4/18/2018  
 Service Layer Credits: Esri ArcGIS Online Aerial Photography



I:\or\file01\_ses\ic\priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure\_14\_AFFF\_3\_Charleston\_GW\_SI.mxd, Date: 4/18/2018



- Legend**
- DPT Boring Location for Collecting Surface Soil, Subsurface Soil, and Groundwater Samples
  - Oil/Water Separator
  - Storm Sewer (Underground)
  - Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary

Note: Surface Water sample for AFFF Area 3 shown on Figure 19.

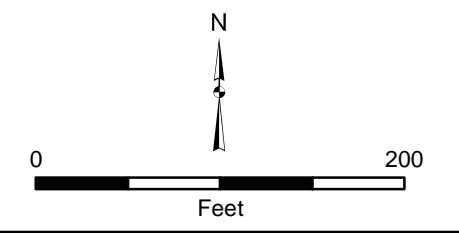
CHRTN03-002-GW-015	
Analyte	Result (µg/L)
PFBS	0.22
PFOA	0.24
PFOS	6.7
Combined PFOA/PFOS	6.94

**Groundwater Screening Levels:**  
 PFBS - 40 µg/L      PFOA - 0.07 µg/L  
 PFOS - 0.07 µg/L      PFOA + PFOS - 0.07 µg/L

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 = as shown, value exceeds screening level  
 GW = groundwater

CHRTN03-003-GW-015	
Analyte	Result (µg/L)
PFBS	0.043
PFOA	0.091
PFOS	2.0
Combined PFOA/PFOS	2.091

CHRTN03-001-GW-010	
Analyte	Result (µg/L)
PFBS	0.020
PFOA	0.020
PFOS	0.49
Combined PFOA/PFOS	0.51



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**Figure 14**  
**Building 570 (AFFF Area 3)**  
**PFBS, PFOA, and PFOS**  
**in Groundwater**



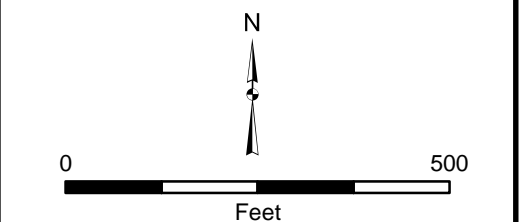
Drawn: LNatzke      Date: 4/18/2018  
 Service Layer Credits: Esri ArcGIS Online Aerial Photography



I:\or-file01\_seslic\priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure\_15\_AFFF\_5\_Charleston\_SD\_SI.mxd; Date: 4/18/2018



- Legend**
- DPT Boring Location for Collecting Groundwater Sample
  - Surface Water and Sediment Samples
  - Storm Sewer (Underground)
  - Approximate Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary



CHRTN05-001-SD-001	
Analyte	Result (µg/kg)
PFBS	0.48 U
PFOA	0.24 U
PFOS	<b>0.84 J</b>

CHRTN03-004-SD-001	
Analyte	Result (µg/kg)
PFBS	0.48 U
PFOA	0.24 U
PFOS	<b>0.52 J</b>

**Sediment Screening Levels:**  
 PFBS - 130,000 µg/kg      PFOA - 126 µg/kg      PFOS - 126 µg/kg

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 J = The reported concentration is an estimated value.  
 U = The analyte was not detected above the reported value.  
 SD = sediment

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**Figure 15**  
**Building 570 (AFFF Area 3) and**  
**Outfall 003 (AFFF Area 5)**  
**Sample Locations**  
**PFBS, PFOA, and PFOS in Sediment**



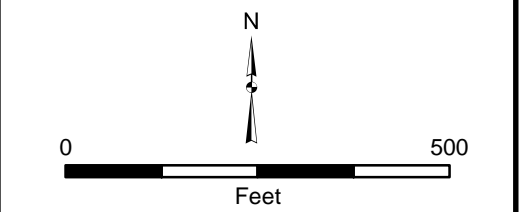
Drawn: LNatzke      Date: 4/18/2018  
 Service Layer Credits: Esri ArcGIS Online Aerial Photography



I:\or-file01\_seslic\priv\GIS\M2032\_0001\_Savannah\Charleston\MXD\SI\_Report\Figure 16\_AFFF\_5\_Charleston\_GW\_SW\_SI.mxd Date: 4/18/2018



- Legend**
- DPT Boring Location for Collecting Groundwater Sample
  - Surface Water and Sediment Samples
  - Storm Sewer (Underground)
  - Approximate Groundwater Flow Direction
  - AFFF Inspection Area
  - Installation Boundary



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**Figure 16**  
**Building 570 (AFFF Area 3) and**  
**Outfall 003 (AFFF Area 5)**  
**PFBS, PFOA, and PFOS in**  
**Groundwater and Surface Water**



Drawn: LNatzke Date: 4/18/2018  
Service Layer Credits: Esri ArcGIS Online Aerial Photography

CHRTN05-001-SW-001	
Analyte	Result (µg/L)
PFBS	0.065
PFOA	0.041
PFOS	<b>0.82</b>
Combined PFOA/PFOS	<b>0.861</b>

CHRTN05-002-GW-008	
Analyte	Result (µg/L)
PFBS	0.0052 J
PFOA	0.0072 J
PFOS	0.014 J
Combined PFOA/PFOS	0.0212 J

CHRTN03-004-SW-001	
Analyte	Result (µg/L)
PFBS	0.12
PFOA	<b>0.081</b>
PFOS	1.9
Combined PFOA/PFOS	<b>1.981</b>

**Groundwater and Surface Water Screening Levels:**  
 PFBS - 40 µg/L      PFOA - 0.07 µg/L  
 PFOS - 0.07 µg/L      PFOA + PFOS - 0.07 µg/L

**Notes:**  
**Bold** value indicates analyte detected at concentration indicated.  
 = as shown, value exceeds screening level  
 J = The reported concentration is an estimated value.  
 GW = groundwater      SW = surface water