FINAL

SITE INSPECTION REPORT

CAPE CANAVERAL AIR FORCE STATION, FL

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas Environmental Programs Worldwide

Contract FA8903-16-D-0027
Task Order 0004

Prepared for:

Air Force Civil Engineer Center
JBSA Lackland, Texas

December 2017

Submitted by:

amec foster wheeler

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SITE INSPECTION OF AQUEOUS FILM FORMING FOAM (AFFF) RELEASE AREAS ENVIRONMENTAL PROGRAMS WORLDWIDE

CAPE CANAVERAL AIR FORCE STATION, FLORIDA

Project No. RPMO20167118

Prepared for:
Air Force Civil Engineer Center
Joint Base San Antonio – Lackland, Texas

Prepared by:

Amec Foster Wheeler Programs, Inc.

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ACRONYMS

AEI	Amec Foster Wheeler Environment & Infrastructure, Inc.
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	Aqueous Film Forming Foam
Amec Foster Wheeler	Amec Foster Wheeler Programs, Inc. (API) and its affiliate Amec Foster Wheeler Environment & Infrastructure Inc. (AEI) collectively
API	Amec Foster Wheeler Programs, Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CCAAFB	Cape Canaveral Auxiliary Air Force Base
CCAFS	Cape Canaveral Air Force Station
CoC	Chain-of-Custody
DL	Detection Limit
DO	Dissolved Oxygen
DoD	Department of Defense
DPT	direct push technology
DQO	data quality objective
EC	Emerging Contaminants
FDEP	Florida Department of Environmental Protection
FTA	Fire Training Area
FTS	Fluorotelomer Sulfonate
HA	Health Advisory
HDPE	high-density polyethylene
HGL	HydroGeoLogic, Inc.
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
ISWP	Installation-Specific Work Plan
LC-MS/MS	Liquid Chromatography and Tandem Mass Spectrometry
LOQ	Limit of Quantification
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate

NASA	National Aeronautics and Space Administration
NEtFOSAA	N-Ethyl perfluorooctanesulfonamidoacetic acid
NMeFOSAA	N-Methyl perfluorooctanesulfonamidoacetic acid
ORP	Oxidation-Reduction Potential
PA	Preliminary Assessment
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutanesulfonic acid
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	Perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFTA	Perfluorotetradecanoic acid
PFTrDA	Perfluorotridecanoic acid
PFUnA	Perfluoroundecanoic acid
PPE	personal protective equipment
PT	proficiency testing
PVC	polyvinyl chloride
QPP	Quality Program Plan
RSL	Regional Screening Level
SCF	SES Construction and Fuel Services LLC
SI	Site Inspection
SIR	Site Inspection Report
SLC	Space Launch Complex
SOP	Standard Operating Procedure
S.U.	Standard Unit
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
UCLA	University of California at Los Angeles
ULA	United Launch Alliance
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

This Site Inspection (SI) Report (SIR) was prepared by Amec Foster Wheeler Programs, Inc. (API), together with our affiliate Amec Foster Wheeler Environment & Infrastructure, Inc. (AEI), herein collectively referred to as Amec Foster Wheeler, under Contract No. FA8903-16-D-0027, Task Order 0004, to document the results of SI activities conducted at an aqueous film forming foam (AFFF) release area located at Cape Canaveral Air Force Station (CCAFS). The purpose of the SI was to determine, through environmental media sampling, if a release of per- and polyfluorinated alkyl substances (PFAS) has occurred at potential AFFF release areas identified by others during a Preliminary Assessment (PA) (HydroGeologic Inc. [HGL], 2015) or installation scoping visit conducted by Amec Foster Wheeler on 15 November 2016. The data presented in this SIR were collected and evaluated in accordance with the Final Installation-Specific Work Plan (ISWP) (Amec Foster Wheeler, 2017a) and the General Quality Program Plan (QPP) (Amec Foster Wheeler, 2017b).

PFAS are a class of synthetic organofluorine compounds that possess a chemical structure that gives them unique properties, including thermal stability and the ability to repel both water and oil. These chemical properties make them useful components in a wide variety of consumer and industrial products, including non-stick cookware, food packaging, waterproof clothing, fabric stain protectors, lubricants, paints, and firefighting foams such as AFFF. AFFF concentrate contains fluorocarbon surfactants to meet required performance standards for fire extinguishing agents (Department of Defense [DoD] Military Specification MIL-F-24385F [SH], Amendment 1, 5 August 1984). The United States Air Force (USAF) began purchasing and using AFFF containing PFAS (perfluorooctanesulfonic acid [PFOS] and/or perfluorooctanoic acid [PFOA]) for extinguishing petroleum fires and during firefighting training activities in 1970. AFFF was primarily used on USAF installations at fire training areas (FTAs), but may have also been used, stored or released from hangar fire suppression systems, at firefighting equipment testing and maintenance areas, and during emergency response actions for fuel spills and/or aircraft incidents.

The United States Environmental Protection Agency (USEPA) Office of Water issued lifetime drinking water Health Advisory (HA) values for PFOS and PFOA in May 2016 that replaced the 2009 Preliminary HA values. The HA values for PFOS and PFOA are 0.07 micrograms per liter (µg/L) for each constituent; however, when these two chemicals co-occur in a drinking water source, a conservative and health-protective approach is recommended that compares the sum of the concentrations (PFOS + PFOA) to the HA value (0.07 µg/L). HA values are not to be construed as legally enforceable federal standards and are subject to change as new information becomes available (USEPA, 2016a and 2016b). Although the USEPA has not established HA values for PFAS in soil, the USAF calculated a residential screening level of 1.26 milligrams per kilogram (mg/kg) for PFOS and PFOA in soil using the USEPA Regional Screening Level (RSL) calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

While PFOS and PFOA are the focus of the HA and provide specific targets for the USAF to address in the SI, USEPA has also derived RSL values for perfluorobutanesulfonic acid (PFBS) for which there is a Tier 2 toxicity value (Provisional Peer Review Toxicity Value) (USEPA, 2017a). Concentrations of PFBS detected in groundwater and soil were compared to the RSLs of 400 µg/L and 1,300 mg/kg, respectively.

Neither the USEPA nor Florida Department of Environmental Protection (FDEP) have issued HA values or promulgated standards for any other PFAS constituents to date.

CCAFS is located along the east-central Florida coastline, approximately 11 miles north of Patrick Air Force Base (AFB), in Brevard County, Florida, and encompasses approximately 15,800 acres or 25 square miles. The installation is located on a barrier island bordered by the Atlantic Ocean to the east and the Banana River to the west (HGL, 2015).

CCAFS was established in 1949 by the USAF with the primary mission to provide a site for launching National Aeronautics and Space Administration (NASA), DoD, and commercial satellites into various earth orbits or deep space mission. CCAFS is currently operated by the 45th Space Wing, headquartered at Patrick AFB, which conducts and supports space and missile launches and operates the Eastern Test Range. The primary mission at CCAFS today includes providing the launch site, facilities hardware, and support required to assemble, process, test, and launch various types of space boosters, upper stage, satellites, and payloads (http://www.spaceline.org/capehistory/2a.html).

Four AFFF release areas were recommended for SI at CCAFS based on research conducted during a PA by HGL (2015), as well as one AFFF release area that was added based on supplemental groundwater quality data provided during the installation scoping visit on 15 November 2016. The following AFFF release area was sampled under this SI since it had not been previously investigated for PFAS:

- AFFF Release Area 1: Hangar F [redacted]

The following four AFFF release areas were not sampled under this SI since PFAS were identified at concentrations above regulatory screening levels during previous investigations:

- AFFF Release Area 2: Former FTA #2 (Solid Waste Management Unit [SWMU] C033, Installation Restoration Program [IRP] Site ID FT017) (Noblis, unpublished; University of California at Los Angeles [UCLA] and Arcadis, 2014).
- AFFF Release Area 3: Former Fire Station, Building 1608 (SWMU C088, IRP Site ID DP055) (UCLA and Arcadis, 2014).
- AFFF Release Area 4: Space Launch Complex (SLC)-17 (SWMU C055, IRP Site ID DP064) (SES Construction and Fuel Services LLC [SCF], 2014).
- AFFF Release Area 5: Regional Wastewater Treatment Facility (WWTF) Percolation Ponds (VZ Technologies, LLC, 2016).

The specific objectives of the SI activities at this release area were as follows:

- Determine if PFAS are present in soil, sediment, groundwater, and/or surface water at the AFFF release area selected for SI or investigated previously by others;
- Determine if PFOS and PFOA concentrations in soil exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario, and PFBS concentrations in soil exceed the USEPA RSL of 1,300 mg/kg, based on a residential exposure scenario;

- Determine if concentrations of PFOS, PFOA, or the sum of PFOS and PFOA, in groundwater and surface water exceed the USEPA HA value of 0.07 µg/L, and if PFBS concentrations in groundwater exceed the USEPA Tap Water RSL of 400 µg/L;
- Determine if concentrations of PFOS or PFOA in sediment exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario; and,
- Identify potential receptor pathways with immediate impacts to human health (immediate impact to human health is considered consumption of drinking water with PFOS/PFOA above the USEPA HA value, or PFBS above the USEPA Tap Water RSL).

PFAS Analytical Results

PFOS and/or PFOA were detected in soil and sediment samples collected at the Hangar F [redacted] at concentrations below the calculated RSL, based on a residential exposure scenario. PFOS and PFOA were detected in soil samples collected during previous SIs at Former FTA #2, with PFOS concentrations exceeding the calculated RSL, based on a residential exposure scenario. PFBS in soil was detected at Former FTA #2, but at concentrations below the USEPA RSL.

PFOS and PFOS+PFOA in groundwater exceeded the USEPA HA values at the Hangar F [redacted], while PFOS and/or PFOA in groundwater also exceeded the USEPA HA values at the four AFFF release areas investigated by others during previous SIs (Former FTA #2; Former Fire Station, Building 1608; SLC-17; and, Regional WWTF Percolation Ponds). PFBS in groundwater was either undetected or detected below the USEPA Tap Water value at all the AFFF release areas. PFAS concentrations in surface water at AFFF Release Area 4 exceeded the USEPA HA values for PFOA and PFOS+PFOA.

Potential human health pathways were identified during this SI. The potential receptors and targets vary by AFFF release area and are summarized below.

Surface and Subsurface Soil Receptors

Potential human exposure receptors from PFAS in surface and subsurface soil include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers. PFOS concentrations in subsurface soil at Former FTA #2 exceeded the calculated RSL, based on a residential exposure scenario; however, this soil would only be accessed via excavation or drilling activities in the impacted area.

Groundwater Receptors

Potential human exposure receptors from PFAS in groundwater include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers that may expose the shallow water table. Human groundwater receptors via the ingestion pathway are not present for any AFFF release area at or downgradient of CCAFS since the installation utilizes drinking water supplied by the city of Cocoa. Furthermore, the primary groundwater exposure point at CCAFS is the Banana River located along the

western installation boundary, which is not used as a drinking water source for the installation or surrounding area.

Sediment Receptors

Potential human exposure receptors from PFAS in sediment include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers that may come into contact with sediment in the drainage canal located downstream of the Hangar F [redacted] and the deluge basins at SLC-17. However, PFOS and PFOA concentrations were below the calculated RSLs, based on a residential exposure scenario.

Surface Water Receptors

Potential exposure receptors include USAF personnel, on-site workers, visitors, and trespassers that may come into contact with surface water within the Pad B deluge basin. PFOA was detected in surface water samples collected from the Pad B deluge basin at concentrations exceeding the USEPA HA value; however, the deluge basin is only used for the containment of bilge water from missiles launched at Pad B and is not considered a drinking water source.

1.0 INTRODUCTION

This Site Inspection (SI) Report (SIR) was prepared by Amec Foster Wheeler Programs, Inc. (API), together with our affiliate Amec Foster Wheeler Environment & Infrastructure, Inc. (AEI), herein collectively referred to as Amec Foster Wheeler, under Contract No. FA8903-16-D-0027, Task Order 0004, to document the results of SI activities conducted at five aqueous film forming foam (AFFF) release areas located at Cape Canaveral Air Force Station (CCAFS). The purpose of the SI was to determine, through environmental media sampling, if a release of per- and polyfluorinated alkyl substances (PFAS) has occurred at potential AFFF release areas identified by others during a Preliminary Assessment (PA) (HydroGeologic Inc. [HGL], 2015) or installation scoping visit conducted by Amec Foster Wheeler on 15 November 2016.

The data presented in this SIR were collected and evaluated in accordance with the Final Installation-Specific Work Plan (ISWP) (Amec Foster Wheeler, 2017a) and the General Quality Program Plan (QPP) (Amec Foster Wheeler, 2017b).

1.1 PER- AND POLY-FLUORINATED ALKYL SUBSTANCES OVERVIEW

PFAS are a class of synthetic organofluorine compounds that possess a chemical structure that gives them unique properties, including thermal stability and the ability to repel both water and oil. These chemical properties make them useful components in a wide variety of consumer and industrial products, including non-stick cookware, food packaging, waterproof clothing, fabric stain protectors, lubricants, paints, and firefighting foams such as AFFF. AFFF concentrate contains fluorocarbon surfactants to meet required performance standards for fire extinguishing agents (Department of Defense [DoD] Military Specification MIL-F-24385F [SH], Amendment 1, 5 August 1994). The United States Air Force (USAF) began purchasing and using AFFF containing PFAS (perfluorooctanesulfonic acid [PFOS] and/or perfluorooctanoic acid [PFOA]) for extinguishing petroleum fires and during firefighting training activities in 1970, as confirmed by the following federal government documents:

- Military Specification for AFFF (MIL-F-24385), formally issued in 1969 (DoD, 1969);
- General Accounting Office determination on sole source award protest to provide AFFF to the Navy in December 1969; and,
- *A History of USAF Fire Protection Training at Chanute Air Force Base*, 1964-1976 (Coates, 1977).

AFFF was primarily used on USAF installations at fire training areas (FTAs), but may have also been used, stored or released from hangar fire suppression systems, at firefighting equipment testing and maintenance areas, and during emergency response actions for fuel spills and/or aircraft incidents.

The United States Environmental Protection Agency (USEPA) Office of Water issued lifetime drinking water Health Advisory (HA) values for PFOS and PFOA in May 2016 that replaced the 2009 Preliminary HA values. The HA values for PFOS and PFOA are 0.07 micrograms per liter (µg/L) for each constituent; however, when these two chemicals co-occur in a drinking water source, a conservative and health-protective approach is recommended that compares the sum of the concentrations (PFOS + PFOA) to the

HA value (0.07 µg/L). The HA values are non-regulatory concentrations of drinking water contaminants at or below which adverse health effects are not anticipated to occur over specific exposure durations (e.g., 1 day, 10 days, and a lifetime). They serve as informal technical guidance to assist federal, state, and local officials, and managers of public or community water systems in protecting public health when emergency spills or other contamination situations occur. A HA document provides information on the environmental properties, health effects, analytical methodology, and treatment technologies for removing drinking water contaminants. HA values are not to be construed as legally enforceable federal standards and are subject to change as new information becomes available (USEPA, 2016a and 2016b).

The USEPA has not published Regional Screening Levels (RSLs) for PFOS or PFOA for soil or sediment; however; for this project, a residential screening level of 1.26 milligrams per kilogram (mg/kg) for soil and sediment was calculated using the USEPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search). The toxicity value input for the calculator is the Tier 3 value reference dose of 0.00002 mg/kg per day derived by USEPA in their Drinking Water HA values for both PFOS and PFOA (USEPA, 2016a and 2016b).

While PFOS and PFOA are the focus of the HA and provide specific targets for the USAF to address in the SI, USEPA has also derived RSL values for perfluorobutanesulfonic acid (PFBS) for which there is a Tier 2 toxicity value (Provisional Peer Review Toxicity Value) (USEPA, 2017a). PFBS concentrations detected in groundwater and soil were compared to the RSLs of 400 µg/L and 1,300 mg/kg, respectively.

Table 1.1-1 below presents the screening values for comparing analytical results for PFOS, PFOA, and PFBS. The USEPA and Florida Department of Environmental Protection (FDEP) have not issued HA values or promulgated standards for any other PFAS to date.

Table 1.1-1. Regulatory Screening Values.

Parameter	Chemical Abstract Number	USEPA Regional Screening Level Table (May 2016) [a]		Calculated RSL for Soils and Sediments[b] (µg/kg)	USEPA Health Advisory for Drinking Water (Surface Water or Groundwater) (µg/L)[c]
		Residential Soil (µg/kg)	Tap Water (µg/L)		
PFBS	375-73-5	1.3E+6	400	NL	NL
PFOA	335-67-1	NL	NL	1,260	0.07[d]
PFOS	1763-23-1	NL	NL	1,260	

Notes:

a USEPA Regional Screening Levels (June, 2017a) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].

b Screening levels, based on residential exposure, calculated using the USEPA Regional Screening Level calculator (https://epa-prgs.ornl.gov/cgi-bin/ chemicals/ csl_search).

c USEPA (May, 2016a) "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and USEPA (May, 2016b) "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."

d When both PFOA and PFOS are both present, the combined concentrations of PFOA and PFOS should be compared with the 0.07 µg/L Health Advisory level.

µg/kg - micrograms per kilogram
µg/L - micrograms per liter
NL - not listed
PFBS - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctanesulfonic acid
RSL - Regional Screening Level
USEPA – United States Environmental Protection Agency

1.2 PROJECT OBJECTIVES

In accordance with DoD Instruction 4715.18, "Emerging Contaminants (ECs)" (DoD, 2009), the *Interim AF Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and Base Realignment and Closure (BRAC) Installations* (USAF, 2012), and the *SAF/IE Policy on Perfluorinated Compounds of Concern* (USAF, 2016) the USAF will:

1) Identify locations where there is a reasonable expectation that there may have been a release of PFAS (defined below) associated with USAF actions;

2) Determine if there is unacceptable risk to human health and the environment; and,

3) Address releases that pose an unacceptable risk, including offsite migration.

The primary objectives of this SI were to:

- Determine if PFOS, PFOA, or PFBS are present in soil, groundwater, sediment, and/or surface water at the AFFF release area selected for SI or investigated previously by others;

- Determine if PFOS and PFOA concentrations in soil exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario, and if PFBS concentrations in soil exceed the RSL of 1,300 mg/kg, based on a residential exposure scenario,;
- Determine if PFOS, PFOA, or sum of PFOS and PFOA concentrations in groundwater and surface water exceed the USEPA HA value of 0.07 µg /L, and if PFBS concentrations in groundwater exceed the USEPA Tap Water RSL of 400 µg/L;
- Determine if PFOS or PFOA concentrations in sediment exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario; and,
- Identify potential receptor pathways with immediate impacts to human health (immediate impact to human health is considered consumption of drinking water with PFOS/PFOA above the USEPA HA value, or PFBS above the USEPA Tap Water RSL).

1.3 PROJECT SCOPE

Four AFFF release areas were recommended for SI at CCAFS based on research conducted during a PA by HGL (2015), as well as one AFFF release area that was added based on supplemental groundwater quality data provided during the installation scoping visit on 15 November 2016. The following AFFF release area was sampled under this SI since it had not been previously investigated for PFAS:

- AFFF Release Area 1: Hangar F [redacted]

The following four AFFF release areas were not sampled under this SI since PFAS were identified at concentrations above regulatory screening levels during previous investigations:

- AFFF Release Area 2: Former FTA #2 (Solid Waste Management Unit [SWMU] C033, Installation Restoration Program [IRP] Site ID FT017) (Noblis, unpublished; University of California at Los Angeles [UCLA] and Arcadis, 2014).
- AFFF Release Area 3: Former Fire Station, Building 1608 (SWMU C088, IRP Site ID DP055) (UCLA and Arcadis, 2014).
- AFFF Release Area 4: Space Launch Complex (SLC)-17 (SWMU C055, IRP Site ID DP064) (SES Construction and Fuel Services LLC [SCF], 2014).
- AFFF Release Area 5: Regional Wastewater Treatment Facility (WWTF) Percolation Ponds (VZ Technologies, LLC, 2016).

Media evaluated at each area included surface and subsurface (vadose zone) soil, sediment, and groundwater collected from temporary monitoring wells at AFFF Release Area 1. Surface and subsurface (vadose zone) soil, sediment, groundwater, and surface water analytical data were also evaluated from AFFF Release Areas 2 through 5, as provided or reported in site investigations completed by others as referenced above.

This SIR discusses and provides a comparison of the analytical results to screening values for PFOS, PFOA, and PFBS in soil, groundwater, sediment, and surface water. The remaining PFAS do not have screening values. As a result, only the results of PFOS, PFOA, and PFBS from AFFF Release Area 1 are discussed in

detail and presented in figures in the SIR; however, all data are presented in the soil, groundwater, sediment, and surface water analytical tables. Figures and tables from the previous site investigations completed by Noblis (unpublished), SCF (2014), UCLA and Arcadis (2014(, SCF (2014), and VZ Technologies, LLC (2016) are included in **Appendix A** of this SIR that document the detected PFAS results from AFFF Release Areas 2 through 5.

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2.0 AFFF RELEASE AREA BACKGROUND

2.1 SITE LOCATION AND SETTING

CCAFS is located along the east-central Florida coastline, approximately 11 miles north of Patrick Air Force Base (AFB), in Brevard County, Florida, and encompasses approximately 15,800 acres or 25 square miles (**Figure 2.1-1**). The installation is located on a barrier island bordered by the Atlantic Ocean to the east and the Banana River to the west (HGL, 2015).

2.2 SITE HISTORY

CCAFS was established in 1949 by the USAF with the primary mission to provide a site for launching National Aeronautics and Space Administration (NASA), DoD, and commercial satellites into various earth orbits or deep space mission. Construction began on instrumentation and missile handling facilities and the first launch sites for the testing of winged missiles on 9 May 1950. The Long Range Proving Ground Division was redesignated the Air Force Missile Test Center, and the range was renamed the Florida Missile Test Range, on 30 June 1951. The military-occupied portion of Cape Canaveral was designated as the Cape Canaveral Auxiliary Air Force Base (CCAAFB) - Station #1 of the Florida Missile Test Range on 5 October 1951. The CCAAFB was redesignated the Cape Canaveral Missile Test Annex on 16 December 1955, and the overall Florida Missile Test Range was renamed the Atlantic Missile Range in May 1958 (45th Civil Engineer Squadron, Installation Management Flight, Environmental Conservation Element [45 CES/CEIE], 2015). The name of the Cape Canaveral Missile Test Annex was officially changed to Cape Kennedy Air Force Station on 22 January 1964, but was re-named CCAFS in 1973 (http://www.spaceline.org/capehistory/2a.html).

CCAFS is currently operated by the 45th Space Wing, headquartered at Patrick AFB, which conducts and supports space and missile launches and operates the Eastern Test Range. Current active launch complexes include: SLC-37 supporting the United Launch Alliance (ULA) Delta IV launch program, SLC-40 supporting the SpaceX Falcon 9 launch program, and SLC-41 supporting the ULA Atlas V launch program. Other commercial operations are actively building launch facilities at SLC-11 and SLC-36 (Blue Origin) and SLC-17 and SLC-18 (Moon Express). Additionally, SpaceX recently constructed a landing facility (Landing Zone 1) at the former SLC-13 (45 CES/CEIE, 2015).

The primary mission at CCAFS today includes providing the launch site, facilities hardware, and support required to assemble, process, test, and launch various types of space boosters, upper stage, satellites, and payloads. CCAFS also provides the facilities, infrastructure, and ground support for the Eastern Test Range's launch-based instrumentation requirements, including radar, telemetry, optics, command and control, communications, and collection and processing of real-time data. CCAFS provides logistical support to major tenant organizations including the 17th Test Squadron (Detachment 3), Army Explosives Ordnance Disposal, 605th Test and Evaluations Squadron (Detachment 2), Naval Operations Test Unit, U.S. Coast Guard, Military Sealift Command, the National Reconnaissance Office, NASA, and various commercial organizations (http://www.spaceline.org/capehistory/2a.html).

2.3 PREVIOUS INVESTIGATIONS

HGL was contracted by the Air Force Civil Engineer Center (AFCEC) to prepare a PA of FTA and non-FTA sites at CCAFS to identify locations where PFAS may have been used and released into the environment, and to provide an initial assessment of possible migration pathways and receptors of potential contamination (HGL, 2015). Eleven potential AFFF release areas were identified during the PA research. However, the following four potential AFFF release areas recommended for SI (**Figure 2.3-1**):

1) Hangar F [redacted]: [redacted] testing is performed annually since 2013 in the concrete parking area located southeast of Hangar F using an unknown amount of AFFF.
2) Former FTA #2 (SWMU C033, IRP Site ID FT017): Fire training exercises were performed in an unlined burn pit and trench potentially using an unknown amount of AFFF from approximately 1970 to 1985.
3) Former Fire Station, Building 1608 (SWMU C088, IRP Site ID DP055): An estimated five gallons of AFFF were released annually during refilling operations, as well as during truck washing, from 1970 to 2003.
4) SLC-17 (SWMU C055, IRP Site ID DP064): An estimated five gallons of AFFF were released annually during [redacted] testing from 1985 to 1999, several fires were extinguished with AFFF on and around the launch pads as a result of multiple launches, and a large release of AFFF occurred while extinguishing a fire during a Delta II rocket launch explosion in 1997.

The Regional WWTF Percolation Ponds potential AFFF release area (**Figure 2.3-1**) was omitted from the PA; however, supplemental groundwater quality data provided during the installation scoping visit indicated the presence of PFOS in excess of USEPA the HA value in seven existing monitoring wells (VZ Technologies, LLC, 2016).

The following three AFFF release areas, in addition to the Regional WWTF Percolation Ponds, were not sampled under this SI since PFOS and/or PFOA were detected above the current USEPA HA values or RSLs in soil, groundwater sediment, and/or surface water during previous investigations:

- Former FTA #2: PFOS and PFOA in groundwater exceeded the USEPA HA values in January 2011, March 2012, and November and December 2012 (Noblis, unpublished; UCLA and Arcadis, 2014). Subsurface soil also exceeded the calculated RSL, based on a residential scenario, in November 2012 (UCLA and Arcadis, 2014).
- Former Fire Station, Building 1608: PFOS and PFOA in groundwater exceeded the USEPA HA values in March 2012 (UCLA and Arcadis, 2014).
- SLC-17: PFOA concentrations in groundwater and surface water exceeded the USEPA HA value in April 2014 (SES Fuel Construction Services LLC, 2014).

3.0 FIELD ACTIVITIES AND ANALYTICAL PROTOCOL

SI activities were conducted at CCAFS from 22 to 24 May 2017 at the Hangar F [redacted] (**Figure 2.3-1**). Sample locations were determined following discussions between Amec Foster Wheeler, CCAFS, and AFCEC personnel, and were documented in the Final ISWP (Amec Foster Wheeler, 2017a). Media sampled during the SI included surface soil, subsurface soil, sediment, and groundwater collected from temporary monitoring wells.

Photographic documentation of the SI activities is provided in **Appendix B** and field documentation is provided in **Appendix C**. Inspection activities were recorded by field personnel on field activity daily logs (**Appendix C-1**), and daily PFAS protocol checklists were completed to ensure PFAS were not introduced by Amec Foster Wheeler employees or subcontractors (**Appendix C-2**). A tailgate safety meeting was conducted each morning prior to beginning work, with the tailgate safety meeting reports provided in **Appendix C-3**.

Soil Boring Advancement and Soil Sample Collection

Three soil borings were advanced for the collection of soil samples and temporary monitoring well installation by a Florida-licensed driller, Amdrill, Inc. of Brooksville, Florida. Soil borings were initially cleared to a depth of five feet below ground surface (bgs) with a hand auger and completed using direct push technology (DPT) drilling methods. Soil samples were continuously collected from ground surface to approximately ten feet below first-encountered groundwater using a hand auger and decontaminated 5-foot Macro-Core® samplers with acetate liners in accordance with Standard Operating Procedure (SOP) AFW-02 (PFAS)–*Soil Sampling* and DEP-SOP-001/01, FS 3000 Soil, field-screened with a photoionization detector equipped with a 10.6 electron volt lamp for volatile organic vapors, and logged by a qualified geoscientist in accordance with the Unified Soil Classification System. The resulting soil boring information, photoionization detector readings, lithologic data, and soil sample locations are included on soil boring/monitoring well records provided in **Appendix C-4**, while the soil sample data (sample ID numbers, date/time collected, and depths) are included on soil sample collection logs in **Appendix C-5**. A cross-section illustrating lithologic data is presented on **Figure 3.0-1**.

Samples for laboratory analysis were extracted from the hand auger bucket or acetate liners with a decontaminated stainless steel spoon and transferred directly into laboratory-provided high-density polyethylene (HDPE) containers. Sample containers were sealed, labeled, packed into ice-filled coolers, and delivered under chain-of-custody (CoC) to SGS Accutest in Orlando, Florida for PFAS analysis or CT Laboratories in Baraboo, Wisconsin for physiochemical properties analysis.

Monitoring Well Installation and Development

Three temporary monitoring wells were installed during the SI through 3.75-inch outside-diameter rods using DPT, as per the FDEP's Monitoring Well Design and Construction Guidance Manual (FDEP, 2008). Monitoring well construction was based on observed depth to water at the time of drilling and geologic conditions encountered. All new monitoring wells were constructed in accordance with the ISWP and

SOP AFW-04 (PFAS)-*Monitoring Well Installation*, to effectively bracket the water table. The temporary monitoring wells were constructed of two-inch-diameter, Schedule 40 polyvinyl chloride (PVC) casing and a threaded 10-foot section of 0.010-inch slotted two-inch-diameter Schedule 40 PVC pre-pack well screen wrapped with a stainless steel wire mesh containing a 0.25-inch-thick filter pack and end cap. Well construction details for the three temporary monitoring wells are provided on well construction forms in **Appendix C-6**, while **Table 3.0-1** provides a summary of the well construction details for the temporary monitoring wells.

The monitoring wells were developed with a peristaltic pump outfitted with disposable HDPE tubing, in accordance with SOP AFW-05 (PFAS)–*Well Development* and the FDEP's Monitoring Well Design and Construction Guidance Manual (FDEP, 2008). Water quality parameters (pH, specific conductance, temperature, oxidation-reduction potential [ORP], dissolved oxygen [DO], and turbidity) of the development water were measured with water quality meters and recorded on Well Development Logs (**Appendix C-7**). A minimum of three saturated casing volumes of water were purged from each new well during development, and continued until the field water quality parameters stabilized. The aforementioned instrumentation was field calibrated as per DEP-SOP-001/01, FT 1000 General Field Testing and Measurement, and the results included on water quality sampling instrument calibration forms (**Appendix C-8**).

Groundwater Elevations

Depth to water measurements were recorded from each temporary monitoring well prior to groundwater purging and sampling, and groundwater elevations were calculated relative to the newly installed monitoring well top-of-casing elevations surveyed by a professionally licensed Florida surveyor from the Amec Foster Wheeler Orlando, Florida office. Depth to groundwater on 24 May 2017 ranged from 5.42 to 6.34 below top of casing, while groundwater elevations ranged from 0.63 to 0.69 feet above mean sea level (**Table 3.0-2**). Groundwater flow beneath the Hangar F [redacted] was generally to the west-southwest towards the Banana River at an average hydraulic gradient of 0.004 feet/feet (**Figure 3.0-2**)**.**

Groundwater Sampling

The groundwater sampling program included the collection of groundwater samples for laboratory chemical analysis of PFAS from the three temporary monitoring wells. Samples were collected using low-flow groundwater sampling methods with a peristaltic pump. The HDPE tubing was connected to a flow-through cell whereby recovered groundwater was monitored for pH, temperature, specific conductivity, DO, and ORP. Turbidity was measured with a separate turbidity meter. Groundwater sampling equipment was calibrated prior to use, with the resulting data recorded on water quality sampling instrument calibration forms contained in **Appendix C-8**. Depth to water measurements and field parameters were monitored until groundwater indicator parameters reached stabilization criteria in accordance with SOP AFW-03 (PFAS)-*Groundwater Sampling* and DEP-SOP-001/01, FS 2200 Groundwater Sampling. The flow-

through cell was then removed and groundwater samples were collected directly into laboratory-provided HDPE containers from the discharge tubing. The sample containers were sealed, labeled, packed on ice in an insulated cooler, and delivered to SGS Accutest under CoC protocol. Groundwater sampling activities were documented on Groundwater Sampling Logs provided in **Appendix C-9**.

Soil Boring Abandonment

The casings and screens from the three temporary monitoring wells were removed subsequent to groundwater sampling, steam cleaned, and disposed of in a dumpster at the installation. The three temporary monitoring well boreholes were abandoned with neat Portland cement via the tremie pipe method on 24 May 2017, as per SOP AFW-06 (PFAS)-*Borehole Abandonment*, the St. John's River Water Management District, Chapter 40C-3, Florida Administrative Code, and the FDEP's Monitoring Well Design and Construction Guidance Manual (FDEP, 2008).

Sediment Sampling

One sediment sample was collected to assess the presence or absence of PFAS within the drainage canal located downslope (south) of the parking area used for [redacted] testing. The sample was collected with a stainless steel scoop directly into laboratory-provided containers in accordance with SOP AFW-07 (PFAS)–*Sediment Sampling* and DEP-SOP-001/01, FS 2200. The sample container was sealed, labeled, packed on ice in an insulated cooler, and delivered to SGS Accutest under CoC protocol. Sample collection data was documented on a sediment sample collection log provided in **Appendix C-10**.

Total Sample Counts

The following total sample counts for each media (including field duplicate samples) during SI activities at CCAFS are listed below:

- Seven soil samples (including one field duplicate) were collected from three soil boring locations during the SI;
- Four groundwater samples (including one field duplicate) were collected from three temporary monitoring wells during the SI; and,
- Two sediment samples (including one field duplicate) were collected from the drainage canal during the SI.

Samples collected during the SI were analyzed for the following 16 PFAS compounds:

- PFOS;
- PFOA;
- PFBS;
- Perfluoroheptanoic acid (PFHpA);
- Perfluorohexanesulfonic acid (PFHxS);
- Perfluorononanoic acid (PFNA);

- N-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA);
- N-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA);
- Perfluorodecanoic acid (PFDA);
- Perfluorotetradecanoic acid (PFTA);
- Perfluorododecanoic acid (PFDoA);
- Perfluorohexanoic acid (PFHxA);
- Perfluorotridecanoic acid (PFTrDA);
- Perfluoroundecanoic acid (PFUnA);
- 6:2 fluorotelomer sulfonate (FTS); and,
- 8:2 FTS.

Soil, groundwater, and sediment samples were analyzed by SGS Accutest in Orlando, Florida, a DoD Environmental Laboratory Accreditation Program accredited laboratory. Samples were analyzed by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry (LC-MS-MS). The LC-MS-MS method provides acceptable detection limits to confirm the presence of PFAS listed above. The laboratory analytical reports for the PFAS samples collected during the SI are included in **Appendix D**.

Analytical results for PFOS, PFOA, and PFBS are discussed in the following sections, while the analytical results for the remaining PFAS constituents are provided in tables at the conclusion of this SIR.

Co-occurrence of PFOS and PFOA (PFOS + PFOA) in aqueous samples was reported using the following guidelines:

1. If PFOS and PFOA are both detected in concentrations at or above the laboratory detection limit (DL) in groundwater, then the reported concentration for PFOA was added to the reported concentration for PFOS.
2. If only PFOS or only PFOA is detected at or above the DL in groundwater, then the concentration of the detected analyte only is reported.
3. If neither PFOA nor PFOS are detected at concentrations at or above the DL, then co-occurrence was reported as *Not Detected*.

One composite surface soil sample and one composite subsurface soil sample were also collected at the AFFF release area on 22 May 2017 and submitted to CT Laboratories in Baraboo, Wisconsin for laboratory analysis of physiochemical properties, including soil pH (USEPA Method 9045B), particle size analysis (American Society for Testing and Materials International D422), and total organic carbon (TOC) content (Lloyd Kahn 9060A Method). The particle size analysis was subcontracted to Mi-Tech Services, Inc. in Weston, Wisconsin. The laboratory analytical reports for the physiochemical properties samples collected during the SI are included in **Appendix D**.

Data Validation and Usability Assessment

Analytical laboratory data from soil and groundwater samples analyzed for PFAS were validated in July 2017. Amec Foster Wheeler evaluated a total of 208 data records from field samples during the validation process and J or UJ qualified 72 records (35%) as estimated values because of field duplicate imprecision, low laboratory control sample recoveries, low matrix spike (MS) recoveries, high or low surrogate recoveries, and/or analyte concentrations between the detection limit (DL) and the Limit of Quantification (LOQ). During validation, Amec Foster Wheeler J qualified three PFOS results as being estimated concentrations because of low MS recoveries, indicating potentially low analytical bias. One of these results was a water sample with a PFOS concentration that exceeded the screening criteria of 0.07 µg/L. The potential low analytical bias in this result is not interpreted to adversely affect overall data usability. The other two PFOS results qualified because of low MS recoveries were soil samples with PFOS detections more than an order of magnitude lower than the screening criteria of 1.26 mg/kg and the low analytical bias is not interpreted to adversely affect overall data usability. Amec Foster Wheeler also J qualified three PFOA and five PFOS results as being estimated values because the detected concentrations were between the DL and the LOQ, and/or because of field duplicate imprecision. These results were orders of magnitude lower than the applicable screening criteria of 1.26 mg/kg and the uncertainty in the analytical results is not interpreted to adversely affect overall data usability.

For the areas sampled in this SI, the decision to advance each of the areas for further investigation was based on non-qualified data. A description of the data validation scope, procedures, observations and actions is presented in the Data Validation Report provided in **Appendix E**.

Surveying

The three temporary monitoring wells were surveyed by a Florida Licensed Professional Surveyor from the Amec Foster Wheeler, Orlando, Florida office for horizontal coordinates, and ground surface and top-of-casing elevations (**Table 3.0-1**). Horizontal coordinates were surveyed based on Florida State Plane Coordinate System, East Zone, United States Survey Feet, North American Datum of 1983. Groundwater surface and top-of-casing elevations were collected based on North American Vertical Datum of 1988.

Investigation-Derived Waste

Investigation-Derived Waste (IDW) consisted of soil cuttings from soil boring advancement, well development water, groundwater sampling purge water, equipment decontamination water, disposable personal protective equipment (PPE), and other miscellaneous refuse. Used PPE and other miscellaneous refuse was placed in plastic bags and discarded into an on-site sanitary trash container for disposal at a sanitary landfill. Soil and liquid IDW was containerized in Department of Transportation-approved 55-gallon steel drums. Composite grab samples were collected on 22 May 2017 from the one drum of soil IDW and three drums of liquid IDW generated during the SI. The samples were laboratory analyzed by SGS Accutest in Orlando, Florida for laboratory analysis of PFAS, volatile organic compounds, semi-volatile organic compounds, pesticides, herbicides, and metals, polychlorinated biphenyls, total petroleum

hydrocarbons (gasoline range organics and diesel range organics), flashpoint, pH, sulfide, and cyanide, to determine the applicable disposal options (**Appendix D**). The four drums of IDW were transported from the installation by Evergreen Waste LLC on 20 October 2017 for incineration at the Covanta Environmental Solutions facility in Augusta, Georgia. The non-hazardous waste manifest for the one drum of solid IDW and three drums of liquid IDW are found in **Appendix F**.

A detailed description of sampling locations and results at the Hangar F [redacted] is provided below.

3.1 AFFF RELEASE AREA 1: HANGAR F [redacted]

This AFFF release area, located in the concrete parking area southeast of Hangar F, has been used annually since 2013 for fire equipment testing. An unknown amount of AFFF is typically released to the parking area and either evaporates or drains to the surrounding ground surface via surface water runoff (HGL, 2015).

3.1.1 Sample Location and Methodologies

3.1.1.1 Soil Samples

Soil borings MW01001, MW01002, and MW01003 were advanced at the Hangar F [redacted] during the SI on 22 May 2017 (**Figure 3.1-1**). Surface soil samples were collected at 0 to 0.5 feet bgs, and subsurface soil samples were collected at depths ranging from 3 to 4 feet bgs, for PFAS analysis. Composite soil samples were also collected from each soil boring from 0 to 1 foot bgs and 3 to 4 feet bgs for TOC, pH, and particle size analysis. Groundwater was encountered at approximately 6 to 7 feet bgs during boring advancement.

3.1.1.2 Groundwater Samples

Temporary monitoring wells were installed in soil borings MW01001, MW01002, and MW01003 during the SI on 22 May 2017 to assess PFAS concentrations at the Hangar F [redacted] (**Figure 3.1-1**). Temporary monitoring wells MW01001 through MW01003 were screened from 4.8 and 14.8 feet bgs (**Table 3.0-1**). The temporary monitoring wells were developed on 22 May 2017 and sampled on 24 May 2017.

3.1.2 Analytical Results

3.1.2.1 Soil Results

Four surface soil samples and three subsurface soil samples (six normal and one field duplicate) were collected from borings MW01001, MW01002, and MW01003. PFAS results are provided in **Table 3.1-1**, illustrated on **Figure 3.1-2**, and summarized below.

MW01001:

- PFOS was detected below the RSL at the two sampling intervals at a maximum concentration of 0.00832 mg/kg (0 to 0.5 feet bgs).
- PFOA was not detected at either interval.
- PFBS was not detected at either interval.

MW01002:

- PFOS was positively identified below the RSL at an approximate concentration of 0.00127 mg/kg in the surface soil interval (0 to 0.5 feet bgs), but was not detected in the subsurface soil interval (3 to 4 feet).
- PFOA was not detected at either interval.
- PFBS was not detected at either interval.

MW01003:

- PFOS was positively identified below the RSL at the two sampling intervals at a maximum approximate concentration of 0.00327 mg/kg (0 to 0.5 feet bgs).
- PFOA was positively identified below the RSL at an approximate concentration of 0.000727 mg/kg in the surface soil interval (0 to 0.5 feet bgs), but was not detected in the subsurface soil interval (3 to 4 feet).
- PFBS was not detected at either interval.

The composite TOC concentrations ranged from 1590 mg/kg (3 to 4 feet bgs) to 5850 mg/kg (0 to 1 foot bgs), while the composite pH concentrations ranged from 8.31 Standard Unit (S.U.) (0 to 1 foot bgs) to 8.48 S.U. (3 to 4 feet bgs) (**Table 3.1-2**). The particle size analytical results for the 0 to 1 foot bgs sample was 5.1% fines (silt and clay), 83.0% sand (fine to coarse), and 11.9% gravel (fine), while the 3 to 4 feet bgs sample was 3.2% fines (silt and clay), 93.5% sand (fine to coarse), and 3.3% gravel (fine). The material description for the 0 to 1 foot bgs sample was a pale brown, fine to medium sand with trace fines and organics, while the 3 to 4 feet bgs sample was described as a very pale brown to yellowish brown, fine to medium sand with trace fines.

3.1.2.2 Groundwater Results

Four groundwater samples (three normal and one field duplicate) were collected from temporary monitoring wells MW01001, MW01002, and MW01003. PFAS results are provided in **Table 3.1-3**, illustrated in **Figure 3.1-3,** and summarized below.

MW01001:

- PFOS was detected below the USEPA HA value at a maximum concentration of 0.0421 µg/L in the field duplicate sample.

- PFOA was detected below the USEPA HA value at a concentration of 0.0281 µg/L in the field duplicate sample.
- PFOS+PFOA was detected above the USEPA HA value at a concentration of 0.0702 µg/L in the field duplicate sample.
- PFBS was detected below the USEPA Tap Water RSL at a concentration of 0.0211 µg/L in the field duplicate sample.

MW01002:

- PFOS was positively identified above the USEPA HA value at an approximate concentration of 0.0942 µg/L.
- PFOA was detected below the USEPA HA value at a concentration of 0.0377 µg/L.
- PFOS+PFOA was detected above the USEPA HA value at a concentration of 0.1319 µg/L.
- PFBS was not detected.

MW01003:

- PFOS was detected below the USEPA HA value at a concentration of 0.0659 µg/L.
- PFOA was detected below USEPA HA value at a concentration of 0.0339 µg/L.
- PFOS+PFOA was detected above USEPA HA value at a concentration of 0.0998 µg/L.
- PFBS was not detected.

3.1.2.3 Sediment Results

Two sediment samples (one normal and one field duplicate) were collected from the drainage canal located downstream (south) of the concrete parking area where AFFF was released for refractometer testing. PFAS results are provided in **Table 3.1-4**, illustrated in **Figure 3.1-4,** and summarized below.

SD01001:

- PFOS was positively identified below the RSL at an approximate concentration of 0.0303 mg/kg.
- PFOA was positively identified below the RSL at an approximate concentration of 0.00227 mg/kg.
- PFBS was not detected.

3.1.3 Conclusions

PFOS and PFOA were detected in soil and sediment at and downstream of the Hangar F [redacted] at concentrations below the RSLs, while PFBS was not detected in any of the soil or sediment samples. The PFOS groundwater concentration in MW01002 and the PFOS+PFOA groundwater concentrations in MW01001 through MW01003 exceeded the USEPA HA value for groundwater. PFBS was detected below the USEPA Tap Water RSL in MW01001, and was undetected in MW01002 and MW01003.

4.0 MIGRATION/EXPOSURE PATHWAYS AND TARGETS

An updated base-wide conceptual site model table is provided as **Table 4.0-1**. The table provides an overview of the facility, physical, release, land use, exposure, and ecological profiles at CCAFS. The table has been updated to include information collected during this SI, as well as the historical information collected from previous SIs. A more detailed description of source area conditions and exposure pathways is described in the following sections.

4.1 SOIL (SURFACE AND SUBSURFACE) EXPOSURE PATHWAY

4.1.1 Local Geologic Setting

The principle soil types at CCAFS include three prominent soils comprising the moderately well-drained Canaveral-Palm Beach-Welaka association that generally consist of a mixture of light-colored quartz sand grains and multicolored shell fragments (Shaw, 2006). Surficial sediments consist of 110 feet of undifferentiated Pleistocene and Holocene beach deposits underlain by coquina and sandy clay of the Anastasia Formation, the Caloosahatchee Marl Formation, and limestone of the Tamiami Formation (Shaw, 2006). The underlying Miocene Age Hawthorn Group is composed predominantly of clays, silts, and marls (Shaw, 2006). A geologic cross-section developed from the SI well installation activities are provided in **Figure 3.0-1**, indicating the uppermost deposits consist of fine to medium sands with trace fines alternating with silty fine to medium sands.

4.1.2 Soil Exposure Pathways and Targets

PFOS and PFOA were detected in soil samples collected at the one AFFF release area included in this SI (Hangar F [redacted]), but at concentrations below the respective RSLs. PFOS and PFOA were detected in soil samples collected by others during a previous SI at Former FTA #2, with PFOS concentrations exceeding the RSL. PFBS in soil was detected only at Former FTA #2, but at concentrations below the RSL.

Surface soil at CCAFS is potentially accessible by USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers. Subsurface soil is primarily accessible by utility or construction workers involved with excavating, drilling, or any activity that exposes them to subsurface soil. Access to source area soil is not expected to change in the future.

Potential exposure routes for soil include inhalation of impacted surface soil dust particles, and ingestion of and dermal contact with impacted soil.

4.1.3 Soil Exposure Conclusions

Potential human exposure receptors from PFAS in surface and subsurface soil include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers. PFOS concentrations in

subsurface soil at Former FTA #2 exceeded the calculated RSL, based on a residential exposure scenario; however, this soil would only be accessed via excavation or drilling activities in the impacted area.

4.2 GROUNDWATER MIGRATION PATHWAY

4.2.1 Local Hydrogeologic Setting

The surficial aquifer system near CCAFS is contained in undifferentiated Late Miocene, Pliocene, and Recent Pleistocene deposits composed primarily of medium to coarse quartz sands and coquina under unconfined conditions (Shaw, 2006). Groundwater is typically encountered at an average depth of 5 feet below land surface and generally flows to the west (Shaw, 2006).

The Floridan Aquifer is comprised of a series of highly permeable limestone formations of the Eocene Age Ocala Group and Avon Park Limestone that is separated from the surficial aquifer by the Hawthorn Group, which acts as an aquitard (Shaw, 2006).

4.2.2 Groundwater Exposure Pathways and Targets

PFAS, once in groundwater, are highly mobile and will migrate near the same velocity as groundwater due to their high solubility and low partition coefficient value. PFAS are chemically and biologically stable in the environment and resist typical environmental degradation processes. As a result, these chemicals are extremely persistent in the environment, with a half-life greater than 41 years for PFOS and greater than 92 years for PFOA (USEPA, 2014b). PFBS is generally less toxic and less bioaccumulative in wildlife and humans (USEPA, 2017b).

PFOS and PFOS+PFOA in groundwater exceeded the USEPA HA values at the Hangar F [redacted] while PFOS and/or PFOA in groundwater also exceeded the USEPA HA values at the four AFFF release areas investigated by others during previous SIs (Former FTA #2; Former Fire Station, Building 1608; SLC-17; and, Regional WWTF Percolation Ponds). PFBS in groundwater was detected below the USEPA Tap Water value at the Hangar F [redacted] and Former FTA #2. Based on the current and historical PFAS analytical results, the Hangar F [redacted], Former FTA #2, Former Fire Station/Building 1608, SLC-17, and Regional WWTF Percolation Ponds are considered as groundwater release areas for pathway analysis.

Groundwater flow from the Hangar F [redacted] is to the west-southwest towards the Banana River based on the current SI (**Figure 3.0-2**), and is anticipated to be in a similar direction for the Former FTA #2, Former Fire Station/Building 1608, SLC-17, and Regional WWTF Percolation Ponds AFFF release areas. No primary human groundwater receptors were identified at or downgradient of CCAFS from PFAS-impacted AFFF release areas since the drinking water supply to CCAFS is provided by the city of Cocoa (HGL, 2015), and the primary groundwater exposure point at CCAFS is the Banana River located along the western installation boundary.

4.2.3 Groundwater Migration Pathway Conclusions

PFOS, PFOA and/or PFOS+PFOA in groundwater exceeded the USEPA HA values at the Hangar F [redacted], Former FTA #2, Former Fire Station/Building 1608, SLC-17, and Regional WWTF Percolation Ponds. Groundwater flow from these AFFF release areas is generally to the west towards the Banana River. Human groundwater receptors via the ingestion pathway are not present for any AFFF release area at or downgradient of CCAFS since the installation utilizes drinking water supplied by the city of Cocoa (HGL, 2015), and the primary groundwater exposure point at CCAFS is the Banana River located along the western installation boundary.

4.3 SEDIMENT EXPOSURE PATHWAY

4.3.1 Sediment Exposure Pathways and Targets

PFOS was detected in sediments collected from the Hangar F [redacted] at concentrations below the RSL. Sediment at CCAFS is potentially accessible by USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers. Potential exposure routes for sediment include dermal contact with submerged or exposed sediment during work activities such as maintenance of drainage ditches and canals that contain PFAS-impacted sediment.

4.3.2 Sediment Exposure Conclusions

PFOS was detected in sediments collected from the Hangar F [redacted] at concentrations below the RSL. Potential exposure receptors include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers that may come into contact with sediment downstream of this AFFF release area.

4.4 SURFACE WATER EXPOSURE PATHWAY

4.4.1 Surface Water Exposure Pathways and Targets

PFOA was detected in surface water samples collected from the Pad B deluge basin at SLC-17 at concentrations exceeding the USEPA HA value of 0.07 µg/L during the previous site investigation by SCF (2014). However, the deluge basin is only used for the containment of bilge water from missiles launched at Pad B and is not considered a drinking water source. Potential exposure receptors include USAF personnel, on-site workers, visitors, and trespassers that may come into contact with surface water within the Pad B deluge basin at SLC-17.

4.4.2 Surface Water Exposure Conclusions

PFOA was detected in surface water at concentrations above the USEPA HA value from AFFF Release Area 9 during the previous site investigation by SCF (2014). However, the USEPA HA value for PFOS and PFOA is only applicable to drinking water sources, and the Banana River is not currently used as a drinking water

source for Patrick AFB or the surrounding community. Potential exposure receptors include USAF personnel, on-site workers, visitors, and trespassers that may come into contact with surface water within the drainage channel and at Outfall 21 to the Banana River.

5.0 SUMMARY AND CONCLUSIONS

As stated in the introduction, the objectives of this study were to:

- Determine if PFOS, PFOA, or PFBS are present in soil, groundwater, sediment and/or surface water at AFFF release areas selected for SI or investigated previously by others;
- Determine if PFOS and PFOA concentrations in soil exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario, and if PFBS concentrations in soil exceed the RSL of 1,300 mg/kg, based on a residential exposure scenario;
- Determine if PFOS, PFOA, or sum of PFOS and PFOA concentrations in groundwater and surface water exceed the USEPA HA value of 0.07 µg /L, and if PFBS concentrations in groundwater exceed the USEPA Tap Water RSL of 400 µg/L;
- Determine if concentrations of PFOS or PFOA in sediment exceed the calculated RSL of 1.26 mg/kg, based on a residential exposure scenario; and,
- Identify potential receptor pathways with immediate impacts to human health (immediate impact to human health is considered consumption of drinking water with PFOS/PFOA above the USEPA HA value, or PFBS above the USEPA Tap Water RSL).

Section 3 of this SI detailed the analytical results for PFAS at the Hangar F [redacted]. In addition, Section 2.3 included a description of the historical analytical results from previous SIs conducted by others. A summary table (**Table 5.0-1**) is also provided below which lists specific exceedances by AFFF release area and media, fulfilling the objectives of the SI.

Table 5.0-1. Summary of PFAS Screening Level Exceedances.

AFFF Release Area	Parameter	Maximum Detected Concentration	Screening Value	Units	Number of Samples*/ Number of Exceedances	Exceeds Screening Level
AFFF Release Area 1 Hangar F [redacted]	Surface Soil (0 to 0.5 feet)					
	PFOS	0.00832	1.26	mg/kg	3/0	No
	PFOA	0.000727 J	1.26	mg/kg	3/0	No
	PFBS	ND	1,300	mg/kg	3/0	No
	Subsurface Soil (3 to 4 feet)					
	PFOS	0.0017 J	1.26	mg/kg	3/0	No
	PFOA	ND	1.26	mg/kg	3/0	No
	PFBS	ND	1,300	mg/kg	3/0	No
	Groundwater					
	PFOS	**0.0942 J**	0.07	µg/L	3/1	**Yes**
	PFOA	0.0377	0.07	µg/L	3/0	No
	PFOS+PFOA	**0.1319 J**	0.07	µg/L	3/3	**Yes**
	PFBS	0.0211	400	µg/L	3/0	No
	Sediment					
	PFOS	0.0303 J	1.26	mg/kg	1/0	No
	PFOA	0.00227 J	1.26	mg/kg	1/0	No
AFFF Release Area 2 FTA #2	Surface Soil (0 to 1 feet)					
	PFOS	0.078	1.26	mg/kg	8/0	No
	PFOA	0.022	1.26	mg/kg	8/0	No
	PFBS	0.00036 J M	1,300	mg/kg	8/0	No
	Subsurface Soil (3 to 7 feet)					
	PFOS	**9.3 M**	1.26	mg/kg	10/1	**Yes**
	PFOA	0.022	1.26	mg/kg	10/0	No
	PFBS	0.00036 J M	1,300	mg/kg	10/0	No
	Groundwater					
	PFOS	**330 J**	0.07	µg/L	34/28	**Yes**
	PFOA	**7.1**	0.07	µg/L	34/20	**Yes**
	PFOS+PFOA	**337.1 J**	0.07	µg/L	34/28	**Yes**
	PFBS	4.2	400	µg/L	34/0	No
	Sediment					
	PFOS	0.0047	1.26	mg/kg	9/0	No
	PFOA	0.00036 J	1.26	mg/kg	9/0	No
AFFF Release Area 3 Former Fire Station, Building 1608	Groundwater					
	PFOS	**110**	0.07	µg/L	3/3	**Yes**
	PFOA	**12**	0.07	µg/L	3/3	**Yes**
	PFOS+PFOA	**122**	0.07	µg/L	3/3	**Yes**
	PFBS	0.53	400	µg/L	3/0	No

AFFF Release Area	Parameter	Maximum Detected Concentration	Screening Value	Units	Number of Samples*/ Number of Exceedances	Exceeds Screening Level
AFFF Release Area 4 SLC-17	Subsurface Soil (4 to 5 feet)					
	PFOS	ND	1.26	mg/kg	4/0	No
	PFOA	0.00049	1.26	mg/kg	4/0	No
	PFBS	ND	1,300	mg/kg	4/0	No
	Groundwater					
	PFOS	**0.12**	0.07	µg/L	3/1	**Yes**
	PFOA	**0.24**	0.07	µg/L	3/2	**Yes**
	PFOS+PFOA	**0.36**	0.07	µg/L	3/2	**Yes**
	PFBS	ND	400	µg/L	4/0	No
	Sediment					
	PFOS	0.0009 J	1.26	mg/kg	2/0	No
	PFOA	0.02 J	1.26	mg/kg	2/0	No
	Surface Water					
	PFOS	0.020 J	0.07	µg/L	1/0	No
	PFOA	**0.74 J**	0.07	µg/L	1/1	**Yes**
	PFOS+PFOA	**0.760 J**	0.07	µg/L	1/1	**Yes**
	PFBS	ND	400	µg/L	1/0	No
AFFF Release Area 5 Regional WWTF Percolation Ponds	Groundwater					
	PFOS	**0.612**	0.07	µg/L	10/7	**Yes**
	PFOA	0.0409	0.07	µg/L	10/0	No
	PFOS+PFOA	**0.6284 I**	0.07	µg/L	10/7	**Yes**
	PFBS	0.0288	400	µg/L	10/0	No

Notes:
* normal samples (count does not include QC samples)
AFFF – aqueous film forming foam
I – The reported value is between the laboratory method detection limit (MDL) and the practical quantitation limit (PQL)
J – The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample
M – Manual integrated compound
µg/L – micrograms per liter
mg/kg – milligrams per kilogram
ND – not detected

Potential human health pathways were identified and detailed in Section 4.0 of this SIR. Media-specific pathways and receptors are discussed below.

Surface and Subsurface Soil Receptors

Potential human exposure receptors from PFAS in surface and subsurface soil include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers. PFOS concentrations in

subsurface soil at Former FTA #2 exceeded the calculated RSL, based on a residential exposure scenario; however, this soil would only be accessed via excavation or drilling activities in the impacted area.

Groundwater Receptors

Potential human exposure receptors from PFAS in groundwater include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers that may expose the shallow water table. Human groundwater receptors via the ingestion pathway are not present for any AFFF release area at CCAFS since the installation utilizes drinking water supplied by the city of Cocoa. Furthermore, the primary groundwater exposure point at CCAFS is the Banana River located along the western installation boundary, which is not used as a drinking water source for the installation or surrounding area.

Sediment Receptors

Potential human exposure receptors from PFAS in sediment include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers who may come into contact with sediment in the drainage canal located downstream of the Hangar F [redacted] and the deluge basins at SLC-17. However, PFOS and PFOA concentrations were below the calculated RSLs, based on a residential exposure scenario.

Surface Water Receptors

Potential exposure receptors include USAF personnel, on-site workers, visitors, and trespassers that may come into contact with surface water within the Pad B deluge basin. PFOS and PFOA were detected in surface water samples collected from the Pad B deluge basin at concentrations exceeding the USEPA HA value; however, the deluge basin is only used for the containment of bilge water from missiles launched at Pad B and is not considered a drinking water source.

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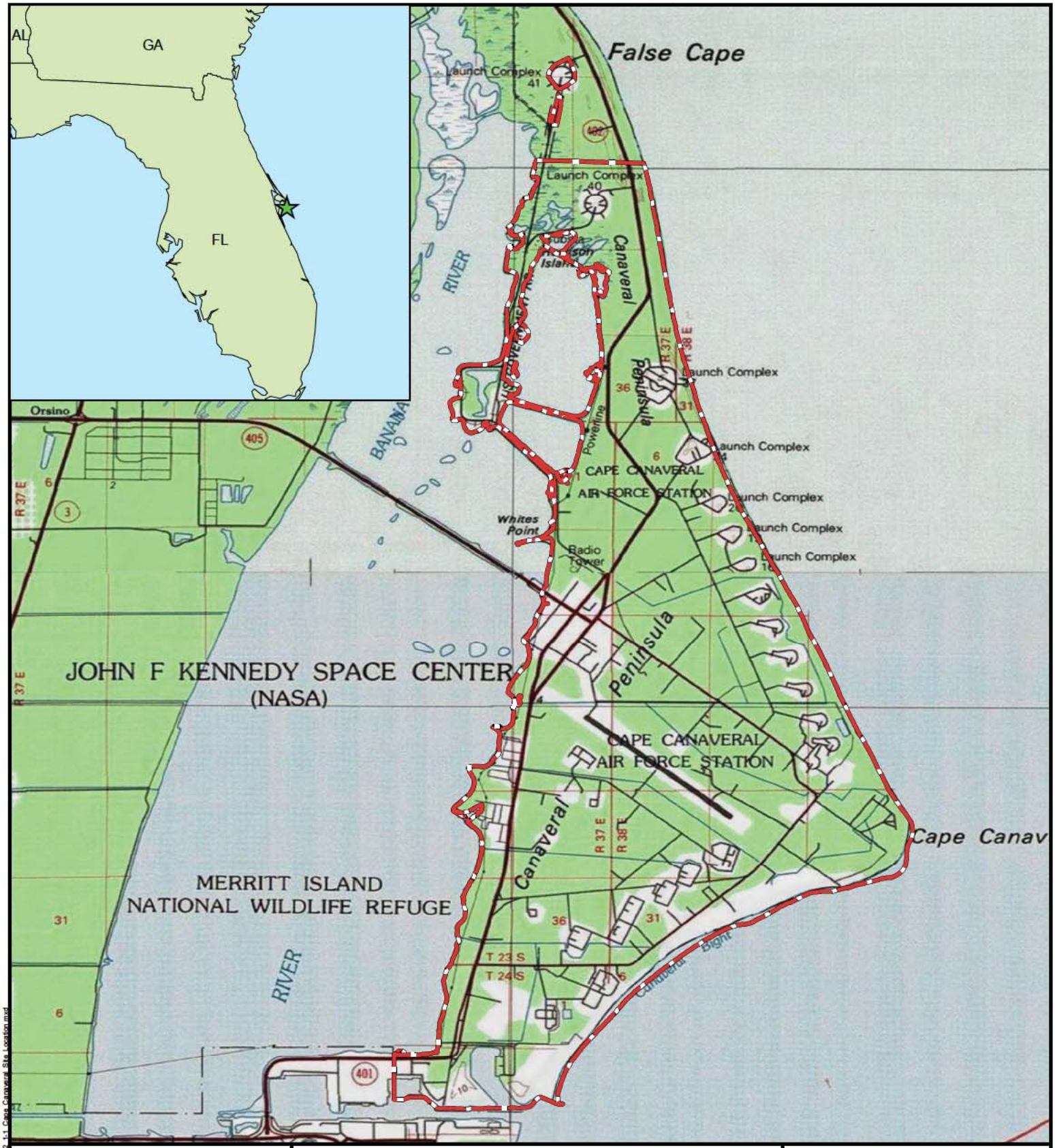
FIGURES

FIGURE ACRONYMS

AFFF	aqueous film forming foam
ft bgs	feet below ground surface
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
SB	soil boring
SD	sediment

FIGURE NOTES

Shaded = Exceeds USEPA Health Advisory Value
Groundwater elevations in NAVD88 (feet)
[A] Higher concentration observed in field duplicate sample
J = The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample
U = The analyte was analyzed for, but was not detected above the reported limit of detection
UJ = The reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample



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0 2,000 4,000 8,000 12,000 Feet

Symbol Key

Cape Canaveral AFS Installation Boundary

FIGURE 2.1-1
Installation Location Map
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide Site Inspection Report

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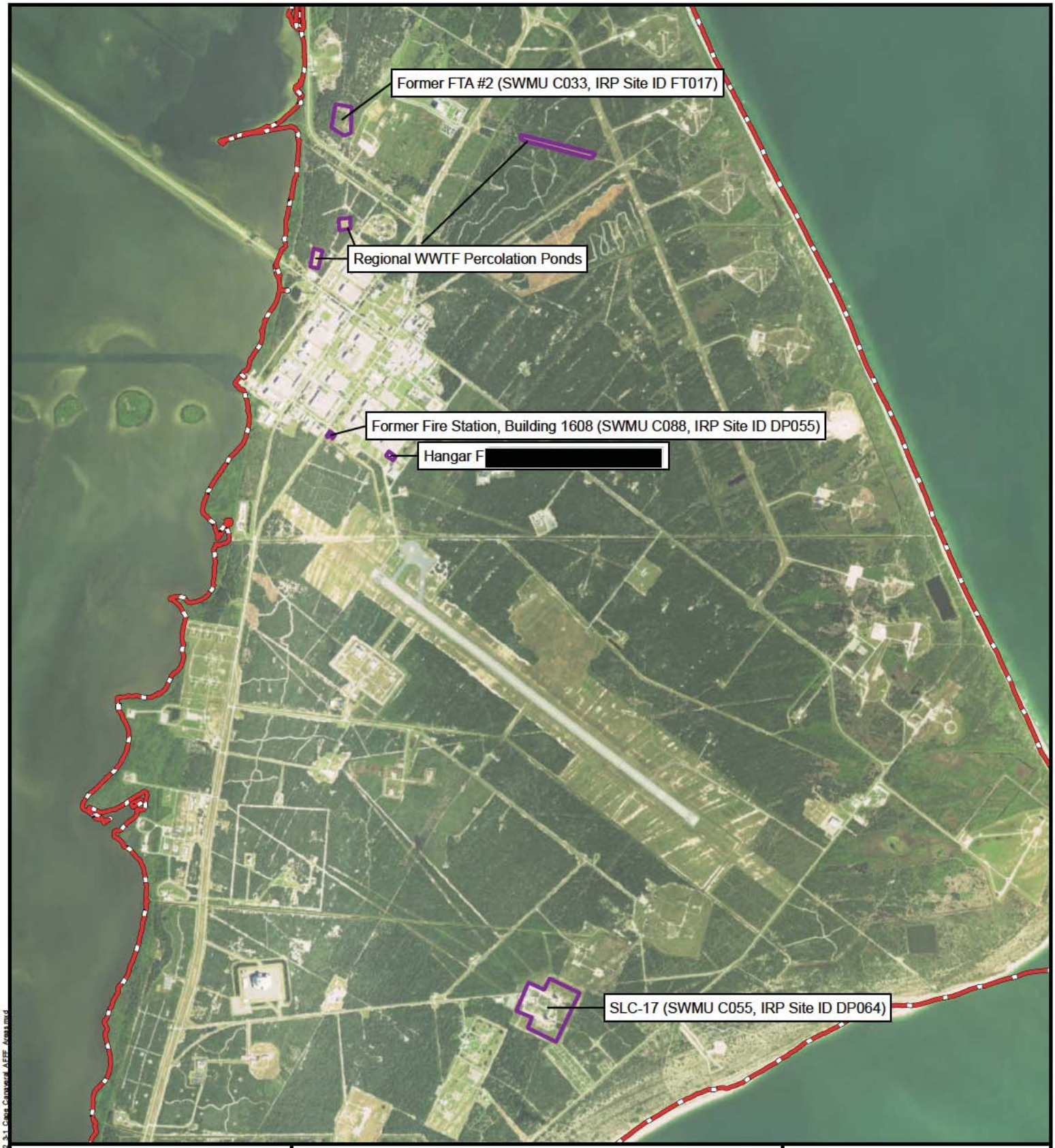

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0 1,000 2,000 4,000 Feet

Symbol Key

- AFFF Release Area
- Cape Canaveral AFS Installation Boundary

FIGURE 2.3-1
AFFF Release Areas
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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[redacted]

Distance Along Baseline (feet)

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By A Yorke | Date 07/12/2017

amec foster wheeler

Symbol Key

- Temporary Mon tor ng We
- Water Leve (May 24, 2017)
- Approx mate Ground Leve
- Approx mate Water Tab e
- Screen

- USCS Poor y graded Sand
- USCS Poor y graded Sand w th S t
- USCS S ty Sand

amsl = above mean sea level

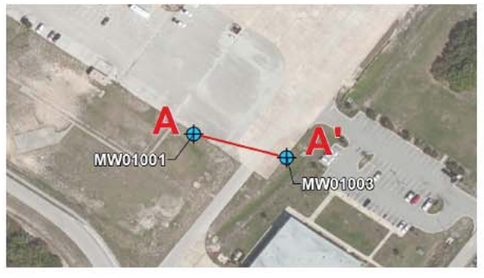

FIGURE 3.0-1
Cross-Section A-A'
AFFF Release Area 1
Hangar F [redacted]
Cape Canaveral Air Force Station
Cape Canaveral, FL

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Aqueous F m Form ng Foam (AFFF) Re ease Areas
Env ronmenta Programs Wor dw de
S te Inspect on Report

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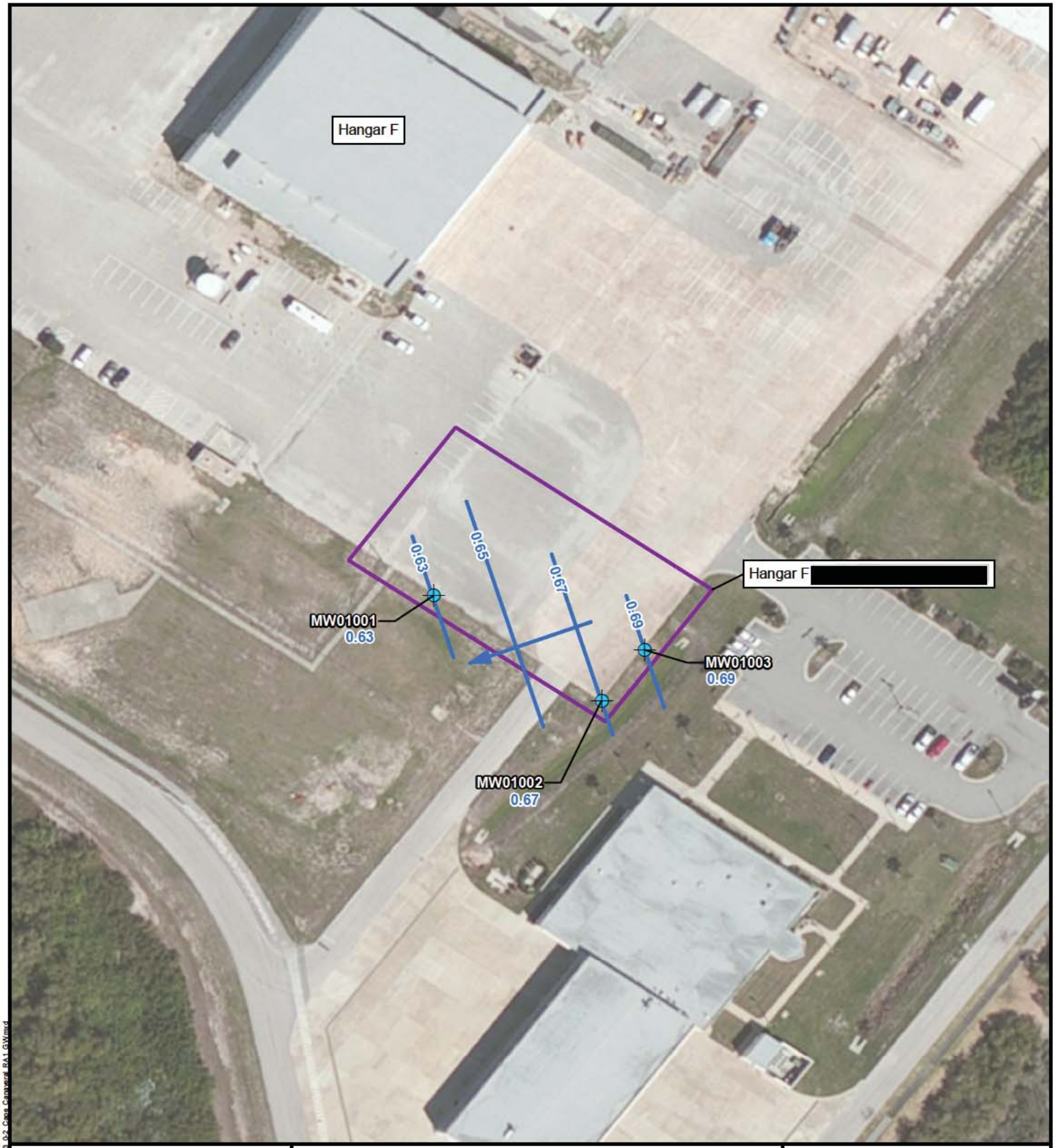

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0 50 100 Feet

Symbol Key

- Temporary Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- AFFF Release Area

FIGURE 3.0-2
Groundwater Elevations
Hangar F [redacted]
AFFF Release Area 1
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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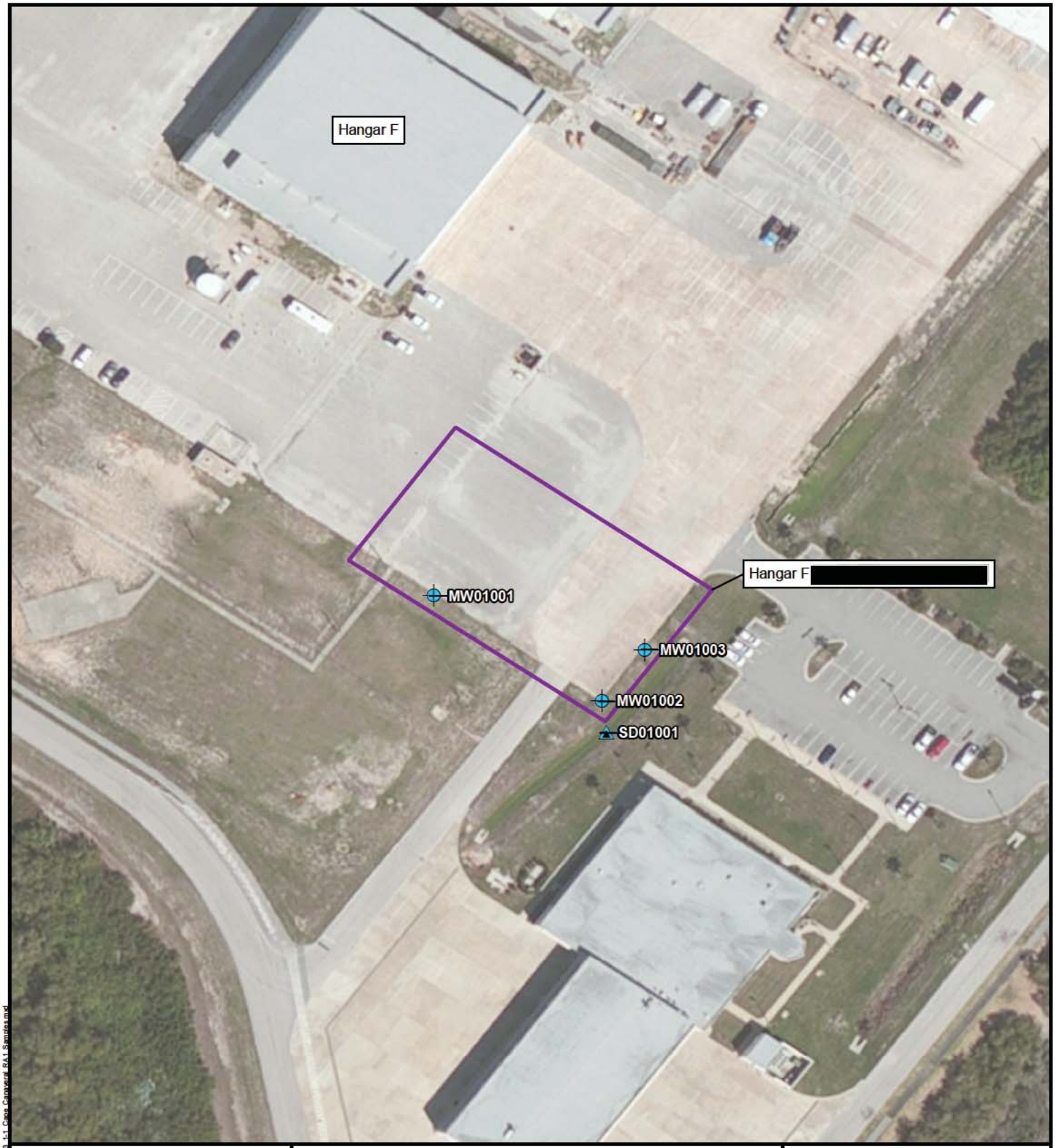

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0 50 100 Feet

Symbol Key

- Temporary Monitoring Well
- Sediment Sample
- AFFF Release Area

FIGURE 3.1-1
Sampling Locations
Hangar F [redacted]
AFFF Release Area 1
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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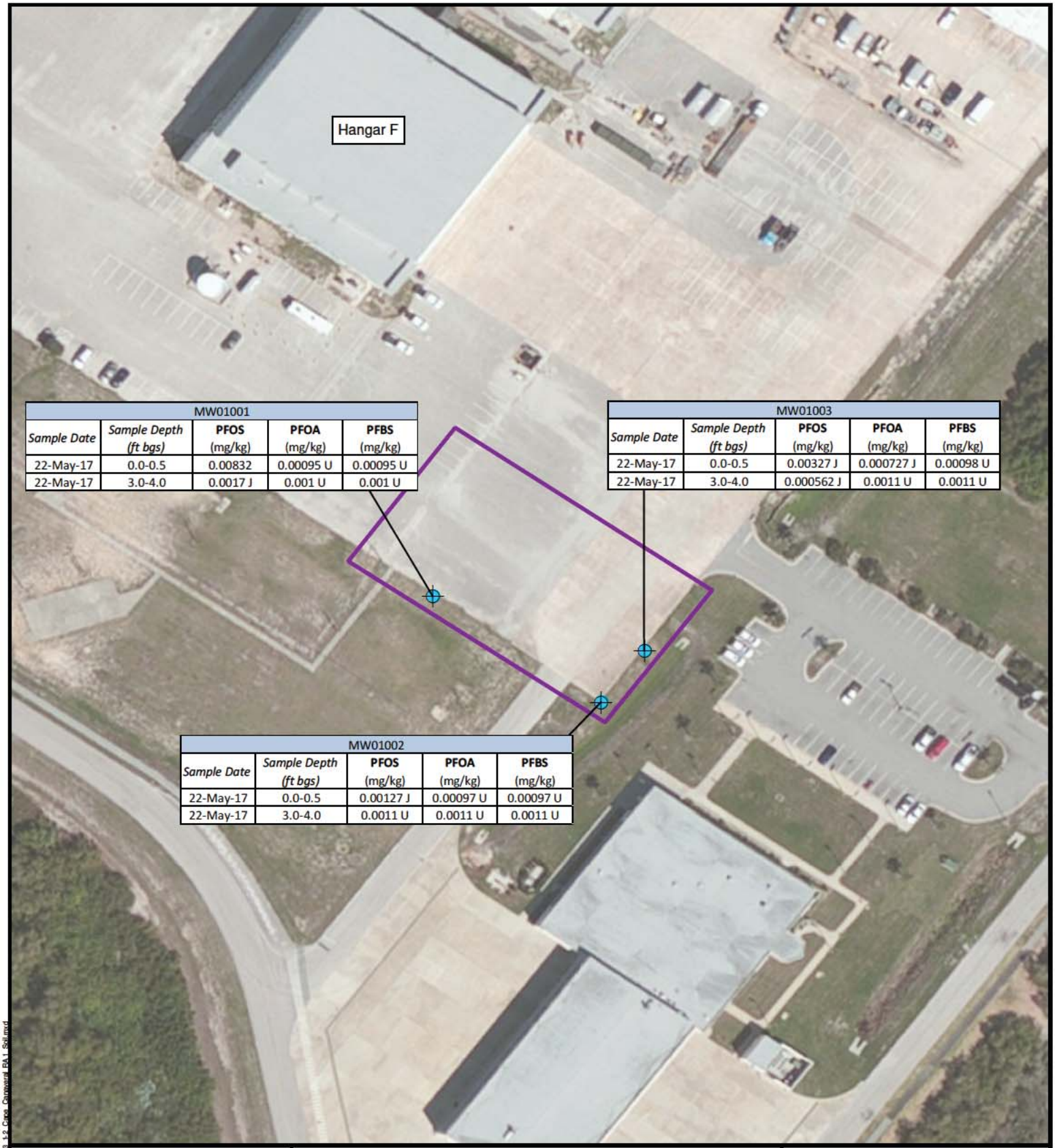

MW01001				
Sample Date	*Sample Depth (ft bgs)*	**PFOS** (mg/kg)	**PFOA** (mg/kg)	**PFBS** (mg/kg)
22-May-17	0.0-0.5	0.00832	0.00095 U	0.00095 U
22-May-17	3.0-4.0	0.0017 J	0.001 U	0.001 U

MW01003				
Sample Date	*Sample Depth (ft bgs)*	**PFOS** (mg/kg)	**PFOA** (mg/kg)	**PFBS** (mg/kg)
22-May-17	0.0-0.5	0.00327 J	0.000727 J	0.00098 U
22-May-17	3.0-4.0	0.000562 J	0.0011 U	0.0011 U

MW01002				
Sample Date	*Sample Depth (ft bgs)*	**PFOS** (mg/kg)	**PFOA** (mg/kg)	**PFBS** (mg/kg)
22-May-17	0.0-0.5	0.00127 J	0.00097 U	0.00097 U
22-May-17	3.0-4.0	0.0011 U	0.0011 U	0.0011 U

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0 50 100 Feet

Symbol Key

- Temporary Monitoring Well
- AFFF Release Area

FIGURE 3.1-2
PFAS In Soil
Hangar F[redacted]
AFFF Release Area 1
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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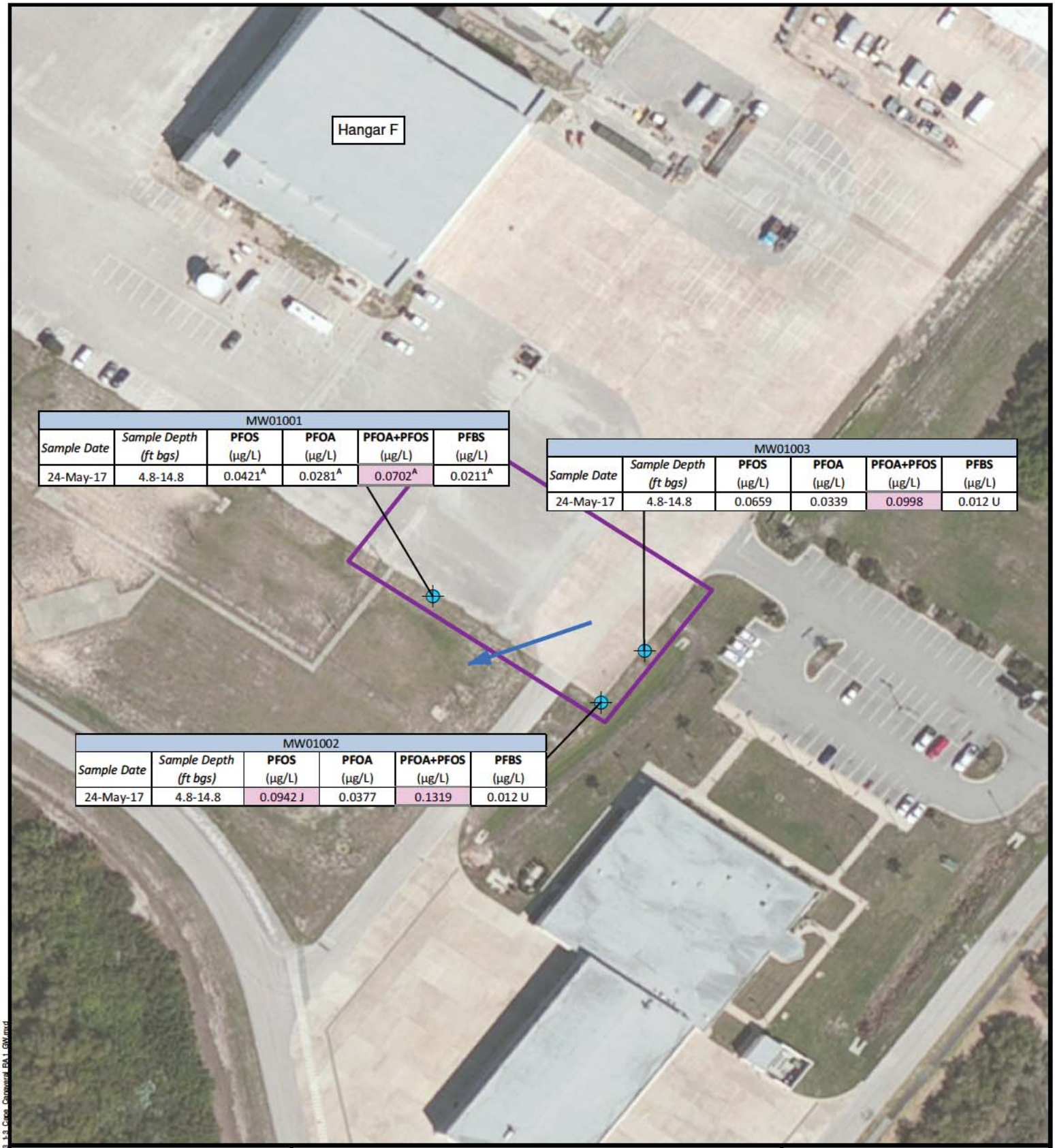

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0 50 100 Feet

Symbol Key

- Temporary Monitoring Well
- Approximate Groundwater Flow Direction
- AFFF Release Area

FIGURE 3.1-3
PFAS In Groundwater
Hangar F[redacted]
AFFF Release Area 1
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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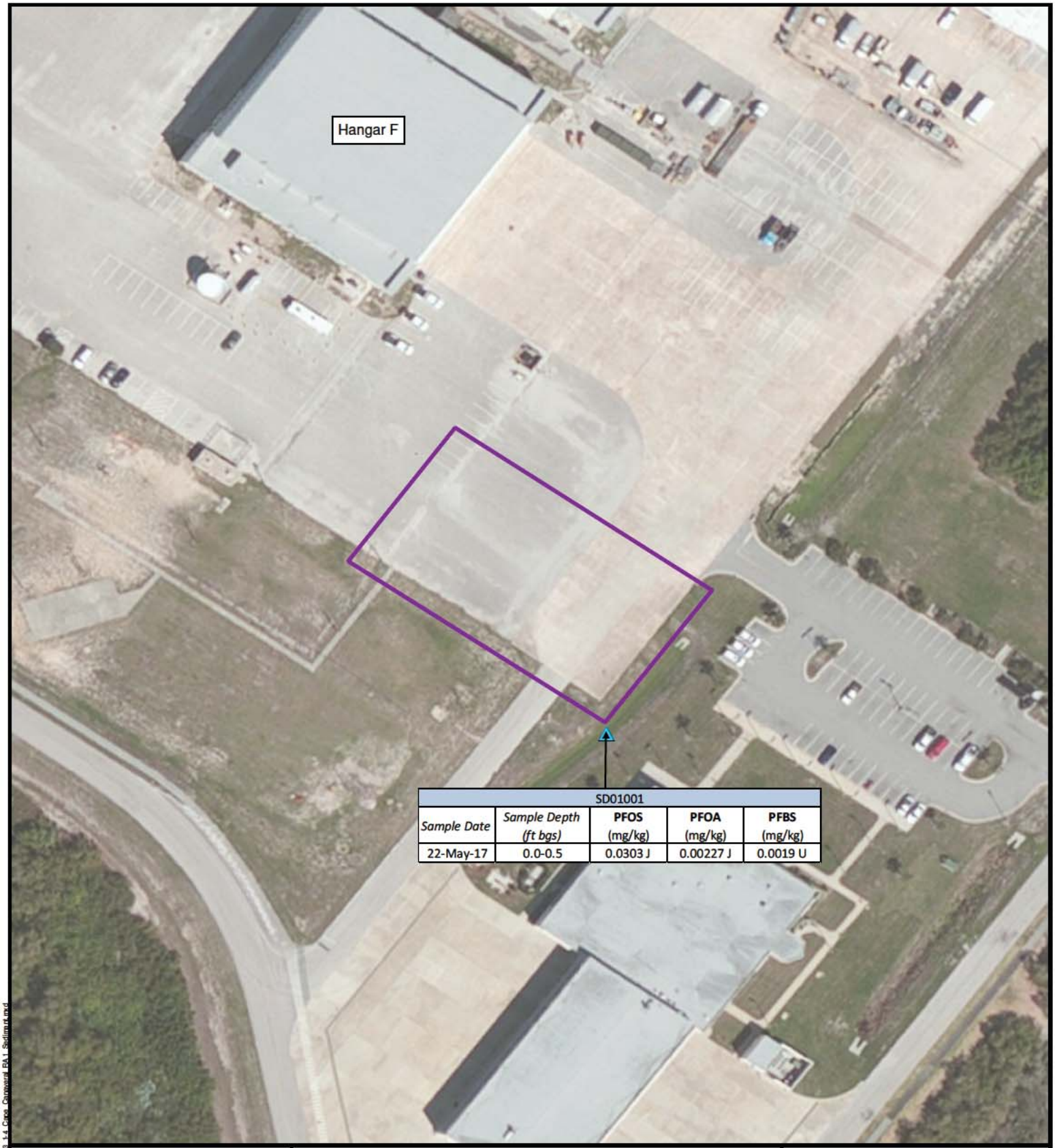

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0 50 100 Feet

Symbol Key

- Sediment Sample
- AFFF Release Area

FIGURE 3.1-4
PFAS In Sediment
Hangar F[redacted]
AFFF Release Area 1
Cape Canaveral Air Force Station
Cape Canaveral, Florida

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

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TABLES

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Table 3.0-1
Monitoring Well Construction Details
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral AFS, Florida

AFFF Release Area	Location ID	Installation Date	Well Material	Northing	Easting	Ground Elevation (ft amsl)	TOC Elevation (ft amsl)	Well Depth (ft bgs)	Well Diameter (in)	Screen Length (ft)	Screen Size (in)	Screen Interval (ft bgs)
1	MW01001	5/22/2017	PVC	[redacted]	[redacted]	7.0	6.97	15.0	2	10	0.01	4.8-14.8
	MW01002	5/22/2017	PVC	[redacted]	[redacted]	6.2	6.19	15.0	2	10	0.01	4.8-14.8
	MW01003	5/22/2017	PVC	[redacted]	[redacted]	6.1	6.11	15.0	2	10	0.01	4.8-14.8

Notes:
amsl - above mean sea level
bgs - below ground surface
ft - feet
in - inches
PVC - Polyvinyl Chloride
TOC - top of casing

Table 3.0-2
Groundwater Elevations
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral AFS, Florida

AFFF Release Area	Location ID	Well Depth (ft bgs)	Ground Surface Elevation (ft amsl)	TOC Elevation (ft amsl)	Date Measured	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft amsl)
1	MW01001	15.0	7.2	6.97	5/24/2017	6.34	0.63
	MW01002	15.0	6.3	6.19	5/24/2017	5.52	0.67
	MW01003	15.0	6.2	6.11	5/24/2017	5.42	0.69

Notes:
amsl - above mean sea level
bgs - below ground surface
btoc - below top of casing
ft - feet
TOC - top of casing

Table 3.1-1
Summary of Soil Analytical Testing Results
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral Air Force Station, Florida

						Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	6:2 Fluorotelomer sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate (8:2 FTS)	N-Ethyl perfluorooctanesulfonamido acetic acid (NETFOSAA)	N-Methyl perfluorooctanesulfonamido acetic acid (NMEFOSAA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnA)
						Screening Level:	1.26[1]	1.26[1]	1300[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AFFF Release Area	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	MW01001	CAPEC01-SO-001	22-May-17	0.0-0.5	N		0.00832	0.00095 U	0.00095 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.00095 U	0.00095 U	0.000826 J	0.00113 J	0.00162 J	0.00095 U	0.00095 U	0.00095 U	0.00095 U
		CAPEC01-SO-002	22-May-17	3.0-4.0	N		0.0017 J	0.001 U	0.001 U	0.004 U	0.004 U	0.004 U	0.004 U	0.001 U	0.001 U	0.001 U	0.000746 J	0.000414 J	0.001 U	0.001 U	0.001 U	0.001 U
	MW01002	CAPEC01-SO-003	22-May-17	0.0-0.5	N		0.00127 J	0.00097 U	0.00097 U	0.0039 U	0.0039 U	0.00192 J	0.00192 J	0.000864 J	0.0105	0.00097 U	0.00097 U	0.000502 J	0.00097 U	0.00518	0.00397	0.00157 J
		CAPEC01-SO-004	22-May-17	3.0-4.0	N		0.0011 U	0.0011 U	0.0011 U	0.0042 U	0.0042 U	0.0042 U	0.0042 U	0.0011 U	0.00102 J	0.0011 U	0.0011 U	0.000227 J	0.0011 U	0.0011 U	0.0011 U	0.0011 U
	MW01003	CAPEC01-SO-005	22-May-17	0.0-0.5	N		0.00327 J	0.000727 J	0.00098 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.00186 J	0.00118 J	0.0012 J	0.00098 U	0.00127 J	0.000738 J	0.000663 J	0.00053 J	0.00108 J
		CAPEC-FD-SO-001	22-May-17	0.0-0.5	FD		0.000897 J	0.001 U	0.001 U	0.004 U	0.004 U	0.004 U	0.004 U	0.001 U	0.000778 J	0.001 U	0.001 U	0.000373 J	0.001 U	0.001 U	0.001 U	0.001 U
		CAPEC01-SO-006	22-May-17	3.0-4.0	N		0.000562 J	0.0011 U	0.0011 U	0.0042 U	0.0042 U	0.0042 U	0.0042 U	0.0011 U	0.000864 J	0.0011 U	0.0011 U	0.000307 J	0.0011 U	0.0011 U	0.0011 U	0.0011 U

Notes:

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

[1]Screening levels, based on residential exposure, calculated using the EPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]

[2]USEPA Residential Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017]

Highlighted cells indicate concentrations exceeding the Screening Level.

FD - field duplicate sample

ft - feet

ID - identification

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

mg/kg - milligrams per kilogram

N - normal field sample

NA - not applicable

U - The analyte was analyzed for but was not detected above the reporting limit of detection (LOD).

Table 3.1-2
Summary of Soil General Chemistry Analytical Testing Results
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral Air Force Station, Florida

					Analyte:	pH	TOC
AFFF Release Area	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**	S. U.	mg/kg
1	CAPEC_AREA_01	CAPEC01-(0-1)	22-May-17	0.0-1.0	N	8.31	5850
		CAPEC01-(3-4)	22-May-17	3.0-4.0	N	8.48	1590

Notes:
ft - feet
ID - identification
N - normal field sample
mg/kg - milligrams per kilogram
S.U. - standard units
TOC - Total Organic Carbon

Table 3.1-3
Summary of Groundwater Analytical Testing Results
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral Air Force Station, Florida

Analyte:						Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	PFOS+PFOA	Perfluorobutanesulfonic acid (PFBS)	6:2 Fluorotelomer sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate (8:2 FTS)	N-Ethyl perfluorooctanesulfonamidoacetic acid (NETFOSAA)	N-Methyl perfluorooctanesulfonamidoacetic acid (NMEFOSAA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnA)
USEPA Health Advisory[1]:						0.07	0.07	0.07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
USEPA Tap Water RSL[2]:						NA	NA	NA	380	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AFFF Release Area	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1	MW01001	CAPEC01-GW-001	24-May-17	4.8-14.8	N	0.0409	0.0262	0.0671	0.0203	0.031 U	0.031 U	0.031 U	0.031 U	0.012 U	0.012 UJ	0.0141 J	0.0507	0.03	0.0062 U	0.012 UJ	0.012 UJ	0.012 U
		CAPEC-FD-GW-001	24-May-17	4.8-14.8	FD	0.0421	0.0281	0.0702	0.0211	0.032 U	0.032 U	0.032 U	0.032 U	0.012 U	0.012 UJ	0.0136 J	0.0539	0.0297	0.0064 U	0.012 UJ	0.012 UJ	0.012 U
	MW01002	CAPEC01-GW-002	24-May-17	4.8-14.8	N	0.0942 J	0.0377	0.1319 J	0.012 U	0.033 U	0.033 U	0.033 U	0.033 U	0.00836 J	0.012 UJ	0.103	0.0574	0.121	0.0136 J	0.012 UJ	0.012 UJ	0.012 U
	MW01003	CAPEC01-GW-003	24-May-17	4.8-14.8	N	0.0659	0.0339	0.0998	0.012 U	0.032 U	0.032 U	0.032 U	0.032 U	0.012 U	0.012 UJ	0.105	0.0367	0.12	0.00796 J	0.012 UJ	0.012 UJ	0.012 U

Notes:

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

[1]Health Advisory from USEPA Office of Water, 2016a and 2016b, Health Advisories (HAs) for drinking water.

[2]USEPA Residential Screening Levels (June 2017a) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017]

Highlighted cells indicate concentrations exceeding USEPA Health Advisory

Underlined results indicate concentrations exceeding the USEPA Tap Water RSL

PFOS+PFOA = Co-occurrence of PFOA and PFOS (PFOA + PFOS) in aqueous samples is reported using the following guidelines

1. If both PFOA and PFOS are detected at or above the detection limit (DL), then the sum of PFOA+ PFOS is reported
2. If only PFOS or only PFOA is detected at or above the DL in groundwater, then the concentration of the detected analyte only is reported
3. If neither PFOA nor PFOS is detected at or above the DL, then PFOA + PFOS is reported as "ND" representing Not Detected

FD - field duplicate sample

ft - feet

ID - identification

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

µg/L - micrograms per liter

N - normal field sample

NA - not applicable

U - The analyte was analyzed for but was not detected above the reporting limit of detection (LOD)

UJ - The reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample

Table 3.1-4
Summary of Sediment Analytical Testing Results
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral Air Force Station, Florida

					Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	6:2 Fluorotelomer sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate (8:2 FTS)	N-Ethyl perfluorooctanesulfonamido acetic acid (NETFOSAA)	N-Methyl perfluorooctanesulfonamido acetic acid (NMEFOSAA)	Perfluorodecanoic acid (PFDA)	Perfluorododecanoic acid (PFDoA)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorohexanoic acid (PFHxA)	Perfluorononanoic acid (PFNA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnA)
					Screening Level:	1.26[1]	1.26[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AFFF Release Area	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft)**	**Sample Type**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	SD01001	CAPEC01-SD-001	22-May-17	0.0-0.5	N	0.0303 J	0.00227 J	0.0019 U	0.0077 U	0.0077 U	0.0077 UJ	0.0077 UJ	0.00191 J	0.0019 UJ	0.00217 J	0.00136 J	0.00234 J	0.00133 J	0.0019 UJ	0.0019 UJ	0.00109 J
		CAPEC-FD-SD-001	22-May-17	0.0-0.5	FD	0.0259 J	0.00134 J	0.0019 U	0.0074 U	0.0074 U	0.0074 U	0.0074 UJ	0.00147 J	0.0019 UJ	0.00127 J	0.000969 J	0.00117 J	0.0019 U	0.0019 UJ	0.0019 UJ	0.000979 J

Notes:

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

[1]Screening levels, based on residential exposure, calculated using the EPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]

Highlighted cells indicate concentrations exceeding the Screening Level.

FD - field duplicate sample

ft - feet

ID - identification

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

mg/kg - milligrams per kilogram

N - normal field sample

NA - not applicable

U - The analyte was analyzed for but was not detected above the reporting limit of detection (LOD).

UJ - The reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 4.0-1
Conceptual Site Model: Installation-Wide Summary
Site Inspection Report of Aqueous Film Forming Foam (AFFF) Release Areas
Site Inspection Report, Cape Canaveral Air Force Station, Florida

Facility Profile	Physical Profile	Release Profile	Land Use and Exposure Profile	Ecological Profile

Installation Description/History:
• Years of operation: 1949 to present.
• Size: Approximately 15,800 acres (25 square miles).
• Location: East-central Florida coast, approximately 11 miles north of Patrick AFB, in Brevard County, Florida.
• Layout: Comprised of one active runway (CCAFS Skid Strip) in the central portion; maintenance, support, operational, and service facilities north of the runway/flightline; and numerous former and active space launch complexes in the coastal portions of the installation.
• History: CCAFS was established in 1949 by the USAF with the primary mission to provide a site for launching National Aeronautics and Space Administration, Department of Defense, and commercial satellites into various earth orbits or deep space mission. The installation was re-named Cape Kennedy Air Force Station on 22 January 1964, and CCAFS in 1973. A total of 36 launch complexes were constructed at CCAFS; however, only three are still active: SLC-37, SLC-40, and SLC-41.
• Current Mission: CCAFS is the primary launch facility associated with the Eastern Test Range, and is managed and operated by the 45 SW headquartered at Patrick AFB, located approximately 11 miles to the south.
AFFF Use:
• AFFF containing PFAS was used for firefighting training activities, testing of firefighting equipment, or extinguishing petroleum fires.
• The following AFFF release area was sampled under this Site Inspection (SI) since it had not been previously investigated for PFAS:
  • Hangar F[redacted]
• The following four AFFF release areas were evaluated, but not sampled, under this SI since PFAS were identified at concentrations above regulatory screening levels during previous investigations:
  • Former FTA #2.
  • Former Fire Station, Building 1608.
  • SLC-17.
  • Regional WWTF Percolation Ponds.
	Topography:
	• CCAFS lies within the within the Atlantic Barrier Chain Physiographic Province at a mean elevation of 10 feet above mean sea level (amsl), with dunal formations immediately inland of the Atlantic Ocean beach forming the highest ridges (10 to 15 feet) that slope gradually to the west to form a marshy shoreline along the Banana River (Shaw, 2006).
	Vegetation:
	• The major vegetative communities on CCAFS include the Banana River, estuarine tidal marshswamp, and brackish water impoundments (aquatic), and beach dune, coastal interdunal swale, oak scrub, and hammocks (terrestrial) (Shaw, 2006).
	Surface Water:
	• The surface water features at CCAFS consists of manmade ditches, culverts, and drainage canals that collect and divert rainwater westward into the Banana River (Shaw, 2006).
	Soils:
	• Eleven soil types were identified at CCAFS, with the three most prominent soils comprising the moderately well-drained Canaveral-Palm Beach-Welaka association generally consisting of a mixture of light-colored quartz sand grains and multicolored shell fragments (Shaw, 2006).
	Geology:
	• Surficial sediments consist of 110 feet of undifferentiated Pleistocene and Holocene beach deposits underlain by coquina and sandy clay of the Anastasia Formation, the Caloosahatchee Marl Formation, and limestone of the Tamiami Formation (Shaw, 2006).
	• The underlying Miocene Age Hawthorn Group is approximately 70 feet thick and is composed predominantly of clays (Shaw, 2006).
	Hydrogeology:
	• The surficial aquifer system is contained in undifferentiated Late Miocene, Pliocene, and Recent Pleistocene deposits composed primarily of medium to coarse quartz sands and coquina under unconfined conditions (Shaw, 2006).
	• Groundwater within the surficial aquifer was encountered during this SI at approximately 5 to 6 feet below ground surface, and flowed to the west-northwest at an average hydraulic gradient of 0.004 feet/feet.
	• The Floridan Aquifer is comprised of a series of highly permeable limestone formations of the Eocene Age Ocala Group and Avon Park Limestone that is separated from the surficial aquifer by the Hawthorn Group, which acts as an aquitard (Shaw, 2006).
	Meteorology:
	• Average annual rainfall is approximately 50 inches/year (Shaw, 2006).
	• Average high temperature of 81 degrees Fahrenheit (°F) occurs in July, while an average low of 64.4°F occurs in January (Shaw, 2006).
		Contaminants of Potential Concern:
		• PFAS are the contaminants of potential concern during this investigation.
		• Petroleum-related compounds, chlorinated solvents, metals, polychlorinated biphenyls (PCBs), and PFAS are historical site contaminants.
		Media of Potential Concern:
		• Soil, sediment, and groundwater.
		Confirmed AFFF Releases:
		• Hangar F[redacted]: PFOS and PFOS+PFOA concentrations in groundwater exceeded the USEPA HA values during this SI.
		• Former FTA #2: PFOS and PFOA concentrations in groundwater exceeded the USEPA HA values in January 2011, March 2012, and November and December 2012. Subsurface soil also exceeded the calculated RSL, based on a residential scenario, in November 2012.
		• Former Fire Station, Building 1608: PFOS and PFOA concentrations in groundwater exceeded the USEPA HA values in three existing monitoring wells in March 2012.
		• SLC-17: PFOA concentrations in groundwater and surface water exceeded the USEPA HA values in two of three existing monitoring wells in April 2014.
		• Regional WWTF Percolation Ponds: PFOS concentrations in groundwater exceeded the USEPA HA values in seven existing monitoring wells in October 2016.
		Primary Release Pathways:
		• Release or application of AFFF to the ground at potential source areas.
		• Infiltration of PFAS deeper into the soil column over time reaching groundwater.
		• AFFF washed into drainage, storm water, and sewer systems.
		Secondary Release Pathways:
		• Discharge of WWTF liquid effluent into percolation ponds that infiltrate to groundwater.
			Current Land Use:
			• Occupied by CCAFS.
			Future Land Use:
			• Land use is not expected to change in the future.
			Potential Receptors:
			• Potential receptors associated with current and future land use include USAF personnel, tenant unit personnel, commercial space operations personnel, contract personnel, grounds maintenance workers, utility workers, construction workers, visitors, and trespassers.
				Potential Ecological Receptors (HGL, 2015):
				• Inland and aquatic plant species, reptiles, birds, and mammals that inhabit or migrate through or adjacent to the installation.
				• Banana River.
				• Multiple wetlands on and adjacent to the installation.
				Threatened and Endangered Species (United States Fish and Wildlife Service, 2016):
				• Threatened species that were identified in Brevard County and may exist at CCAFS include the following:
				  • Wood stork - Bird (*Mycteria americana*).
				  • Audubon's crested caracara - Bird (*Polyborus plancas audubonii*)
				  • Florida scrub-jay – Bird (*Aphelocoma coerulescens*)
				  • Southeastern beach mouse – Mammal (*Peromyscus polionotus niveiventris*)
				  • Loggerhead sea turtle – Reptile (*Caretta caretta*)
				  • Atlantic salt marsh snake (*Nerodia clarkia taeniata*)
				  • Eastern Indigo Snake - Reptile (*Drymarchon corais couperi*)
				• Endangered species that were identified in Brevard County and may exist at CCAFS include the following:
				  • Everglade snail kite - Bird (*Rostrhamus sociabilis plumbeus*).
				  • West Indian Manatee – mammal (*Trichechus manatus*)
				  • Hawksbill sea turtle – Reptile (*Eretmochelys imbricata*)
				  • Leatherneck sea turtle – Reptile (*Dermochelys coriacea*)

APPENDIX A

NOBLIS (UNPUBLISHED), UCLA AND ARCADIS (2014), SCF (2014), AND VZ TECHNOLOGIES, LLC (2016) DATA TABLES AND FIGURES

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Client Sample ID	Sample Depth (ft bgs)	Matrix	Sample Information	Collected	Analyte	Result		Unit
TB-1		Water	trip blank	1/26/2011	13C8 PFOA	0.2		ug/L
TB-1		Water	trip blank	1/26/2011	13C8 PFOS	0.2		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorobutane Sulfonate (PFBS)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorobutanoic acid (PFBA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorodecanoic acid (PFDA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluoroheptanoic acid (PFHpA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorohexanoic acid (PFHxA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorononanoic acid (PFNA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorooctane Sulfonate (PFOS)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorooctanoic acid (PFOA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluoropentanoic acid (PFPA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
TB-1		Water	trip blank	1/26/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	13C8 PFOA	0.19		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	13C8 PFOA	0.19	D	ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	13C8 PFOS	0.21		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	13C8 PFOS	0.19	D	ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.67		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorobutanoic acid (PFBA)	0.31		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorodecane sulfonate (PFDS)	0.029		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorodecanoic acid (PFDA)	0.017	J	ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.18		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	24		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorohexanoic acid (PFHxA)	4.7		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorononanoic acid (PFNA)	0.11		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	0.015	J	ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonate (PFOS)	6.8		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorooctanoic acid (PFOA)	0.61		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluoropentanoic acid (PFPA)	0.7		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
CCFTA2-09S		Water	normal sample	1/26/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	13C8 PFOA	0.2		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	13C8 PFOA	0.2	D	ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	13C8 PFOA	0.191		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	13C8 PFOA	0.191		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	13C8 PFOA	0.189	D	ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	13C8 PFOA	0.186	D	ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	13C8 PFOS	0.218	D	ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	13C8 PFOS	0.2		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	13C8 PFOS	0.191		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	13C8 PFOS	0.19		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	13C8 PFOS	0.184	D	ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	13C8 PFOS	0.18	D	ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.256		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.208		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.04		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorobutanoic acid (PFBA)	0.209		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorobutanoic acid (PFBA)	0.209		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorobutanoic acid (PFBA)	0.039		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorodecane sulfonate (PFDS)	0.127		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorodecane sulfonate (PFDS)	0.111		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorodecanoic acid (PFDA)	ND		ug/L

Client Sample ID	Sample Depth (ft bgs)	Matrix	Sample Information	Collected	Analyte	Result		Unit
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorodecanoic acid (PFDA)	0.172		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorodecanoic acid (PFDA)	0.163		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorododecanoic acid (PFDoA)	0.161		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorododecanoic acid (PFDoA)	0.157		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.239		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.222		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.085		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	2.53	4	ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	2.33	4	ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	2.1		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorohexanoic acid (PFHxA)	0.415		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorohexanoic acid (PFHxA)	0.409		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorohexanoic acid (PFHxA)	0.23		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorononanoic acid (PFNA)	0.198		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorononanoic acid (PFNA)	0.196		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorononanoic acid (PFNA)	0.032	J	ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	0.178		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	0.168		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorooctane Sulfonate (PFOS)	4.61	4	ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonate (PFOS)	3.8		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorooctane Sulfonate (PFOS)	3.6	4 F	ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorooctanoic acid (PFOA)	0.429		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorooctanoic acid (PFOA)	0.378		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorooctanoic acid (PFOA)	0.23		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluoropentanoic acid (PFPA)	0.252		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluoropentanoic acid (PFPA)	0.237		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluoropentanoic acid (PFPA)	0.064		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	0.212		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	0.193		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	0.157		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	0.152		ug/L
CCFTA2-06S		Water	normal sample	1/26/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CCFTA2-06S		Water	matrix spike	1/26/2011	Perfluoroundecanoic acid (PFUnA)	0.176		ug/L
CCFTA2-06S		Water	matrix spike duplicate	1/26/2011	Perfluoroundecanoic acid (PFUnA)	0.168		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	13C8 PFOA	0.2		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	13C8 PFOA	0.19	D	ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	13C8 PFOS	0.19		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	13C8 PFOS	0.18	D	ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.043		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorobutanoic acid (PFBA)	0.041		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorodecanoic acid (PFDA)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.076		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	2.2		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorohexanoic acid (PFHxA)	0.23		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorononanoic acid (PFNA)	0.028	J	ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorooctane Sulfonate (PFOS)	3.9		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorooctanoic acid (PFOA)	0.21		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluoropentanoic acid (PFPA)	0.062		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
CCFTA2-06SDP		Water	duplicate sample	1/26/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	13C8 PFOA	0.2		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	13C8 PFOA	0.2	D	ug/L

Client Sample ID	Sample Depth (ft bgs)	Matrix	Sample Information	Collected	Analyte	Result		Unit
CCFTA2-07S		Water	normal sample	1/26/2011	13C8 PFOS	0.21		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	13C8 PFOS	0.16	D	ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorobutane Sulfonate (PFBS)	0.58		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorobutanoic acid (PFBA)	0.3		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorodecane sulfonate (PFDS)	0.041		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorodecanoic acid (PFDA)	0.033		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluoroheptanoic acid (PFHpA)	0.33		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorohexane Sulfonate (PFHxS)	12		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorohexanoic acid (PFHxA)	3.4		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorononanoic acid (PFNA)	0.21		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonamide (FOSA)	0.061		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorooctane Sulfonate (PFOS)	53		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorooctanoic acid (PFOA)	1.9		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluoropentanoic acid (PFPA)	0.88		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
CCFTA2-07S		Water	normal sample	1/26/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	13C8 PFOA	0.19		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	13C8 PFOS	0.2		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorobutane Sulfonate (PFBS)	0.05		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorobutanoic acid (PFBA)	0.031		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorodecanoic acid (PFDA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluoroheptanoic acid (PFHpA)	0.079		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorohexane Sulfonate (PFHxS)	1.4		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorohexanoic acid (PFHxA)	0.21		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorononanoic acid (PFNA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorooctane Sulfonate (PFOS)	1.9		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorooctanoic acid (PFOA)	0.15		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluoropentanoic acid (PFPA)	0.056		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
CCFTA2-17		Water	normal sample	1/27/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
FT17-N	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOA	21		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOS	20		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutane Sulfonate (PFBS)	0.27	J	ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutanoic acid (PFBA)	0.71	J	ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecane sulfonate (PFDS)	20		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecanoic acid (PFDA)	ND		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorododecanoic acid (PFDoA)	0.72	J	ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluoroheptanoic acid (PFHpA)	0.83		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexane Sulfonate (PFHxS)	4.6		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexanoic acid (PFHxA)	2.8		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorononanoic acid (PFNA)	ND		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonamide (FOSA)	7		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonate (PFOS)	42		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctanoic acid (PFOA)	1.6		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluoropentanoic acid (PFPA)	1.3		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/Kg
FT17-N	0-0.5	Solid	normal sample	1/27/2011	Perfluoroundecanoic acid (PFUnA)	0.99		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOA	19		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOS	19		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutane Sulfonate (PFBS)	0.28	J	ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutanoic acid (PFBA)	0.35	J	ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecanoic acid (PFDA)	ND		ug/Kg

Client Sample ID	Sample Depth (ft bgs)	Matrix	Sample Information	Collected	Analyte	Result		Unit
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluoroheptanoic acid (PFHpA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexane Sulfonate (PFHxS)	3.5		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexanoic acid (PFHxA)	3.3		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorononanoic acid (PFNA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonamide (FOSA)	0.33	J	ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonate (PFOS)	2.3		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctanoic acid (PFOA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluoropentanoic acid (PFPA)	1.4		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/Kg
FT17-S	0-0.5	Solid	normal sample	1/27/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOA	20		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOS	20		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutane Sulfonate (PFBS)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutanoic acid (PFBA)	0.17	J	ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecane sulfonate (PFDS)	2		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecanoic acid (PFDA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluoroheptanoic acid (PFHpA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexane Sulfonate (PFHxS)	1.6		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexanoic acid (PFHxA)	0.7	J	ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorononanoic acid (PFNA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonamide (FOSA)	2		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonate (PFOS)	8		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctanoic acid (PFOA)	0.29	J	ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluoropentanoic acid (PFPA)	0.44	J	ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/Kg
FT17-E	0-0.5	Solid	normal sample	1/27/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOA	21		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	13C8 PFOS	19		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutane Sulfonate (PFBS)	0.32	J	ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorobutanoic acid (PFBA)	0.62	J	ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecane sulfonate (PFDS)	1.9		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorodecanoic acid (PFDA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluoroheptanoic acid (PFHpA)	0.89		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexane Sulfonate (PFHxS)	11		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorohexanoic acid (PFHxA)	4.7		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorononanoic acid (PFNA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonamide (FOSA)	11		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctane Sulfonate (PFOS)	78		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorooctanoic acid (PFOA)	2.7		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluoropentanoic acid (PFPA)	1		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/Kg
FT17-W	0-0.5	Solid	normal sample	1/27/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/Kg
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	13C8 PFOA	0.2		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	13C8 PFOS	0.194		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorobutane Sulfonate (PFBS)	0.147		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorobutanoic acid (PFBA)	0.177		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorodecane sulfonate (PFDS)	0.113		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorodecanoic acid (PFDA)	0.18		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorododecanoic acid (PFDoA)	0.177		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluoroheptanoic acid (PFHpA)	0.176		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorohexane Sulfonate (PFHxS)	0.163		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorohexanoic acid (PFHxA)	0.183		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorononanoic acid (PFNA)	0.183		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorooctane Sulfonate (PFOS)	0.177		ug/L

Client Sample ID	Sample Depth (ft bgs)	Matrix	Sample Information	Collected	Analyte	Result		Unit
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorooctanoic acid (PFOA)	0.181		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluoropentanoic acid (PFPA)	0.178		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorotetradecanoic acid (PFTeA)	0.119		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorotridecanoic Acid (PFTriA)	0.142		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluoroundecanoic acid (PFUnA)	0.183		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	13C8 PFOA	0.198		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	13C8 PFOS	0.199		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorobutane Sulfonate (PFBS)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorobutanoic acid (PFBA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorodecanoic acid (PFDA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluoroheptanoic acid (PFHpA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorohexane Sulfonate (PFHxS)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorohexanoic acid (PFHxA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorononanoic acid (PFNA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorooctane Sulfonate (PFOS)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorooctanoic acid (PFOA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluoropentanoic acid (PFPA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/L
CHECK SAMPLE		Water	LAB QA/QC	1/31/2011	Perfluorooctane Sulfonamide (FOSA)	0.207		ug/L
INTRA-LAB BLANK		Water	LAB QA/QC	1/31/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/L
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	13C8 PFOA	19.8		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	13C8 PFOS	20.4		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorobutane Sulfonate (PFBS)	15.9		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorobutanoic acid (PFBA)	17.1		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorodecane sulfonate (PFDS)	16.7		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorodecanoic acid (PFDA)	17.7		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorododecanoic acid (PFDoA)	17.7		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluoroheptanoic acid (PFHpA)	17		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorohexane Sulfonate (PFHxS)	17.1		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorohexanoic acid (PFHxA)	18.2		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorononanoic acid (PFNA)	17.6		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorooctane Sulfonamide (FOSA)	17.9		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorooctane Sulfonate (PFOS)	17.7		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorooctanoic acid (PFOA)	18.4		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluoropentanoic acid (PFPA)	17		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorotetradecanoic acid (PFTeA)	10.9		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluorotridecanoic Acid (PFTriA)	14.2		ug/Kg
CHECK SAMPLE		Solid	LAB QA/QC	2/1/2011	Perfluoroundecanoic acid (PFUnA)	17.8		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	13C8 PFOA	19.6		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	13C8 PFOS	19.5		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorobutane Sulfonate (PFBS)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorobutanoic acid (PFBA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorodecane sulfonate (PFDS)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorodecanoic acid (PFDA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorododecanoic acid (PFDoA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluoroheptanoic acid (PFHpA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorohexane Sulfonate (PFHxS)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorohexanoic acid (PFHxA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorononanoic acid (PFNA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorooctane Sulfonamide (FOSA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorooctane Sulfonate (PFOS)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorooctanoic acid (PFOA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluoropentanoic acid (PFPA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorotetradecanoic acid (PFTeA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluorotridecanoic Acid (PFTriA)	ND		ug/Kg
INTRA-LAB BLANK		Solid	LAB QA/QC	2/1/2011	Perfluoroundecanoic acid (PFUnA)	ND		ug/Kg

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Field Investigation to Characterize Perfluorinated Compounds (PFCs) at Air Force Sites

Findings from Cape Canaveral Air Force Station and Barksdale Air Force Base

AFCEC BAA 712, Task 3

March 15, 2014

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Tables

Table 1
CCAFS Analytical Results - PFCs in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample Location	Sample Date	Perfluorooctane Sulfonate (PFOS) µg/L	Perfluorooctanoic Acid (PFOA) µg/L	Perfluorobutane Sulfonate (PFBS) µg/L	Perfluorobutanoic Acid (PFBA) µg/L	Perfluoropentanoic Acid (PFPA) µg/L	Perfluorohexane Sulfonate (PFHxS) µg/L	Perfluorohexanoic Acid (PFHxA) µg/L	Perfluoroheptanoic Acid (PFHpA) µg/L	Perfluorooctane Sulfonamide (FOSA) µg/L	Perfluorononanoic Acid (PFNA) µg/L	Perfluorodecane Sulfonate (PFDS) µg/L	Perfluorodecanoic Acid (PFDA) µg/L
		C8S	C8A	C4S	C4A	C5A	C6S	C6A	C7A	C8FOSA	C9A	C10S	C10A
CCFTA2-MW07S	11/13/2012	**25**	**1.8**	**0.33**	**0.25**	**0.47**	**10**	**2.7**	**0.2**	**0.058 M**	**0.11**	**0.019 J M**	**0.015 J**
CCFTA2-MW07D	11/13/2012	0.02 U	0.01 U	0.0091 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-MW014S	11/13/2012	**4.4**	**0.56**	**0.27**	**0.14**	**0.27**	**6.8**	**1.4**	**0.11**	0.015 U M	**0.028 J**	0.01 U	0.01 U
CCFTA2-MW022I	11/13/2012	**0.04**	0.01 U	0.0092 U	0.01 U M	0.01 U	**0.019 J**	**0.0099 J**	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-MW022S	11/13/2012	**74**	**3.1**	**1**	**0.51**	**1.3**	**21**	**5.4**	**0.48**	**0.14 M**	**0.24**	**0.038**	**0.041**
CCFTA2-MW023S	11/13/2012	**120 M**	**4.2**	**1.6**	**0.63**	**1.7**	**43**	**5.8**	**0.8**	**0.31 M**	**0.37**	**0.081**	**0.047**
CCFTA2-BKG1	11/15/2012	**0.07**	0.01 U	0.0092 U	0.01 U	0.01 U	**0.036**	**0.0084 J**	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-TW1	11/8/2012	**7.6**	**6.6**	**4.2**	**0.76**	**3.4**	**45**	**22**	**0.26**	**0.033 J M**	**0.21**	0.011 U	**0.021 J M**
CCFTA2-TW2	11/12/2012	**53**	**4.7**	**2.3**	**1.5**	**3.2**	**100**	**11**	**3.8**	**0.5**	**1.1**	**0.77 M**	**0.25**
CCFTA2-TW3	11/12/2012	**1.4**	**0.12**	**0.054**	**0.043**	**0.066**	**1.5**	**0.27**	**0.066**	**0.0059 J M**	0.019 U	0.0096 U	0.0096 U
CCFTA2-TW4	11/12/2012	**8.6**	**0.25**	**0.088**	**0.057**	**0.13**	**2.8**	**0.5**	**0.058**	**0.057 J M**	**0.03 J**	0.0099 U	0.0099 U
CCFTA2-VP1-10	11/7/2012	**330 J**	**7.1**	**2.4**	**1.6**	**3**	**40**	**13**	**1.3**	**0.66 M**	**0.47**	**0.17 M**	**0.068**
CCFTA2-VP1-20	11/7/2012	**1.1**	**0.025**	**0.0085 J**	**0.025**	**0.02 J**	**0.32**	**0.071**	0.021 U	**0.016 J M**	0.021 U	0.01 U	0.01 U
CCFTA2-VP1-30	12/17/2012	**2.6**	**0.021**	**0.011 J**	0.011 U	0.011 U	**0.26**	**0.044**	0.021 U M	**0.016 J M**	0.021 U	0.011 U	0.011 U
CCFTA2-VP1-40	12/17/2012	**1.1**	0.011 U	0.0095 U	0.011 U	0.011 U	**0.05**	**0.011 J**	0.021 U	**0.061**	0.021 U	0.011 U	0.011 U
CCFTA2-VP1-50	12/17/2012	**2.5**	**0.012 J**	0.0096 U	0.011 U	0.011 U	**0.11**	**0.017 J**	0.021 U	**0.017 J**	0.021 U	0.011 U	0.011 U
CCFTA2-VP1-60	12/17/2012	**0.58**	0.011 U	0.0096 U	0.011 U	0.011 U	**0.016 J**	**0.0046 J**	0.021 U	**0.023 J M**	0.021 U	0.011 U	0.011 U M
CCFTA2-VP2-10	11/14/2012	**0.42**	**0.17**	**0.056**	**0.054**	**0.065**	**1.7**	**0.32**	**0.029 J**	0.015 U M	0.02 U	0.01 U	0.01 U
CCFTA2-VP2-20	11/14/2012	**1.9**	**0.44**	**0.13**	**0.087 M**	**0.17**	**4.2**	**0.95**	**0.082**	**0.015 J M**	**0.022 J**	0.01 U	0.01 U
CCFTA2-VP2-30	11/14/2012	**0.077**	0.02 J M	0.0096 U	**0.016 J**	**0.019 J**	**0.27**	**0.096**	**0.015 J**	0.015 U	0.021 U	0.011 U	0.011 U
CCFTA2-VP2-40	11/14/2012	**0.044**	0.01 U	0.0092 U	0.01 U	0.01 U	**0.04**	**0.0088 J**	0.02 U	0.016 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP2-50	11/14/2012	**0.041**	0.011 U	0.0095 U	0.011 U	0.011 U	**0.034**	**0.0089 J**	0.021 U	0.016 U M	0.021 U	0.011 U	0.011 U
CCFTA2-VP2-60	11/14/2012	**0.044**	0.012 U	0.011 U	0.012 U	0.012 U	**0.011 J**	0.012 U	0.023 U	0.015 U	0.023 U	0.012 U	0.012 U
CCFTA2-VP3-10	11/15/2012	**0.98**	**0.24**	**0.12**	**0.084 M**	**0.12**	**4.1**	**0.68**	**0.05**	0.017 U M	0.023 U	0.012 U	0.012 U
CCFTA2-VP3-20	11/15/2012	**4.6**	**0.52**	**0.15**	**0.18**	**0.24**	**5.9**	**1.5**	**0.1**	**0.019 J M**	**0.037 J**	0.01 U	**0.011 J**
CCFTA2-VP3-30	11/15/2012	**0.28**	**0.088**	**0.015 J**	**0.013 J**	**0.028 J**	**0.3**	**0.12**	**0.017 J**	0.016 U M	0.021 U	0.01 U	0.01 U
CCFTA2-VP3-40	11/15/2012	**0.17**	0.012 J	0.0097 U	0.011 U	0.011 U	**0.11**	**0.036**	0.021 U	0.016 U M	0.021 U	0.011 U	0.011 U
CCFTA2-VP3-50	11/15/2012	**0.027 J**	0.01 U	0.0093 U	0.01 U	0.01 U	**0.0083 J**	0.01 U M	0.021 U	0.016 U M	0.021 U	0.01 U	0.01 U
CCFTA2-VP3-60	11/14/2012	**0.37**	**0.03**	0.011 U	**0.014 J M**	**0.017 J**	**0.4**	**0.094**	0.024 U	0.019 U M	0.024 U	0.012 U	0.012 U
CCFTA2-VP4-10	11/16/2012	**1.1**	**0.096**	**0.015 J**	**0.03**	**0.093**	**0.58**	**0.25**	**0.04**	0.015 U M	0.02 U	0.01 U	0.01 U
CCFTA2-VP4-20	11/16/2012	**24**	**1.9**	**0.36**	**0.26**	**0.47**	**16**	**2.9**	**0.23**	**0.059 M**	**0.11**	0.01 U	0.01 U
CCFTA2-VP4-30	11/16/2012	**0.12 M**	**0.2**	**0.045**	**0.033 M**	**0.071**	**0.69**	**0.2**	**0.045**	0.016 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP4-40	11/15/2012	**0.11**	0.01 U	0.0094 U	0.01 U	0.01 U M	**0.068**	**0.019 J**	0.021 U	0.015 U	0.021 U	0.01 U	0.01 U
CCFTA2-VP4-50	11/15/2012	**0.025 J**	0.01 U	0.0091 U	0.01 U	0.01 U M	**0.0092 J**	**0.0055 J**	0.02 U	**0.016 U M**	0.02 U	0.01 U	0.01 U
CCFTA2-VP4-60	11/15/2012	**0.061**	0.01 U	0.009 U	0.01 U	0.01 U	**0.019 J**	0.01 U M	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP5-10	12/18/2012	**2**	**0.012 J**	0.0093 U	0.01 U	**0.014 J**	**0.066**	**0.042**	**0.015 J**	**0.015 J M**	0.021 U	0.01 U M	0.01 U
CCFTA2-VP5-15	12/18/2012	**13**	**0.44**	**0.13**	**0.11**	**0.23**	**4**	**0.98**	**0.18**	**0.065 M**	**0.086**	**0.017 J M**	**0.015 J**
CCFTA2-VP5-19	12/18/2012	**24**	**1.2 (19')**	**0.42**	**0.29**	**0.57**	**8.2**	**2.3**	**0.34**	**0.24 M**	**0.19**	**0.036 M**	**0.024**
CCFTA2-VP5-23	12/18/2012	**7.1**	**0.3**	**0.12**	**0.11**	**0.19**	**3.3**	**0.76**	**0.14**	**0.11 M**	**0.073**	**0.012 J M**	0.011 U
CCFTA2-VP5-28	12/18/2012	**1.1**	**0.14**	**0.03**	**0.032**	**0.056**	**0.57**	**0.18**	**0.046**	**0.013 J**	0.022 U	0.011 U M	0.011 U
CCFTA2-VP5-34	12/18/2012	**0.32**	**0.012 J**	**0.0094 J**	0.011 U	**0.017 J**	**0.13**	**0.055**	**0.017 J**	0.015 U M	0.022 U	0.011 U	0.011 U
CCFTA2-VP5-40	12/18/2012	**1**	**0.022**	0.0095 U	0.011 U	**0.018 J**	**0.2**	**0.061**	**0.015 J**	**0.017 J M**	0.021 U	0.011 U	0.011 U
CCFTA2-VP5-55	12/18/2012	**0.15**	0.011 U	0.0098 U	0.011 U	0.011 U	**0.021 J**	**0.0076 J M**	0.022 U	**0.018 J M**	0.022 U	0.011 U	0.011 U
CCFTA2-VP5-60	12/18/2012	**2**	**0.049**	**0.022**	**0.019 J**	**0.034**	**0.47**	**0.14**	**0.02 J**	**0.0066 J M**	0.02 U	0.0099 U	0.0099 U

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Sample Location	Sample Date	Perfluorooctane Sulfonate (PFOS) µg/L	Perfluorooctanoic Acid (PFOA) µg/L	Perfluorobutane Sulfonate (PFBS) µg/L	Perfluorobutanoic Acid (PFBA) µg/L	Perfluoropentanoic Acid (PFPA) µg/L	Perfluorohexane Sulfonate (PFHxS) µg/L	Perfluorohexanoic Acid (PFHxA) µg/L	Perfluoroheptanoic Acid (PFHpA) µg/L	Perfluorooctane Sulfonamide (FOSA) µg/L	Perfluorononanoic Acid (PFNA) µg/L	Perfluorodecane Sulfonate (PFDS) µg/L	Perfluorodecanoic Acid (PFDA) µg/L
		C8S	C8A	C4S	C4A	C5A	C6S	C6A	C7A	C8FOSA	C9A	C10S	C10A
CCFTA2-VP6-10	12/19/2012	**0.2**	0.0097 U	0.0087 U	**0.016 J**	0.0097 U	**0.075**	**0.024**	0.019 U	0.093 U	0.019 U	0.0097 U	0.0097 U
CCFTA2-VP6-15	12/19/2012	**0.25**	0.0096 U	0.0087 U	0.0096 U	0.0096 U	**0.09**	**0.014 J**	0.019 U	0.015 U M	0.019 U	0.0096 U	0.0096 U
CCFTA2-VP6-19	12/19/2012	**0.4**	**0.025**	**0.014 J**	**0.012 J**	**0.019 J**	**0.32**	**0.051**	**0.017 J**	0.035 U	0.02 U	0.0098 U	0.0098 U
CCFTA2-VP6-23	12/19/2012	**0.13**	**0.012 J**	**0.012 J**	**0.011 J M**	**0.013 J**	**0.18**	**0.048**	**0.02 J**	0.046 U	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP6-28	12/19/2012	**0.04**	0.0098 U	0.0089 U	0.0098 U	0.0098 U	**0.02 J**	**0.0063 J**	0.02 U	0.032 U M	0.02 U	0.0098 U	0.0098 U
CCFTA2-VP6-34	12/19/2012	**0.064**	0.01 U	0.0093 U	0.01 U	0.01 U	**0.04**	**0.014 J**	0.021 U	0.043 U	0.021 U	0.01 U	0.01 U
CCFTA2-VP6-40	12/19/2012	**0.2**	0.012 U M	0.011 U	0.012 U	0.012 U	**0.016 J**	**0.013 J**	0.025 U	0.016 U M	0.025 U	0.012 U	0.012 U
CCFTA2-VP6-55	12/19/2012	**0.061**	0.01 U	0.0094 U	0.01 U	0.01 U	0.01 U	**0.0036 J**	0.021 U	0.036 U	0.021 U	0.01 U	0.01 U
CCFTA2-VP6-60	12/19/2012	**0.059**	0.0099 U	0.0089 U	0.0099 U	0.0099 U	0.0099 U	**0.0029 J**	0.02 U	0.017 U M	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP7-10	12/21/2012	**0.11**	**0.031**	**0.02**	**0.022 M**	**0.035**	**0.12**	**0.038**	**0.035**	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP7-15	12/20/2012	**0.25**	**0.058**	**0.018 J**	**0.026**	**0.036**	**0.11**	**0.053**	**0.022 J**	0.015 U	0.02 U	0.0098 U	0.0098 U
CCFTA2-VP7-19	12/20/2012	**0.049**	**0.014 J**	**0.011 J**	0.0099 U	0.0099 U	**0.03 M**	**0.022**	0.02 U	0.015 U M	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP7-23	12/20/2012	**0.07**	**0.018 J**	0.0092 U	0.01 U	0.01 U	**0.038**	**0.022**	0.021 U	0.015 U M	0.021 U	0.01 U	0.01 U
CCFTA2-VP7-28	12/20/2012	**0.018 J**	0.01 U	0.0093 U	0.01 U	0.01 U	0.01 U	**0.0037 J M**	0.021 U	0.016 U	0.021 U	0.01 U	0.01 U
CCFTA2-VP7-34	12/20/2012	**0.023 J**	0.01 U	0.0094 U	0.01 U	0.01 U	0.01 U	**0.0051 J M**	0.021 U	0.015 U M	0.021 U	0.01 U	0.01 U M
CCFTA2-VP7-40	12/20/2012	**0.042**	0.011 U	0.01 U	0.011 U	0.011 U	**0.0079 J**	**0.005 J M**	0.022 U	0.016 U	0.022 U	0.011 U	0.011 U
CCFTA2-VP7-55	12/20/2012	0.019 U	0.0097 U	0.0087 U	0.0097 U	0.0097 U	0.0097 U	0.0097 U	0.019 U	0.015 U	0.019 U	0.0097 U	0.0097 U
CCFTA2-VP7-60	12/20/2012	**0.071**	0.011 U	0.0097 U	0.011 U	0.011 U	0.011 U	**0.0074 J**	0.021 U	0.015 U	0.021 U	0.011 U	0.011 U
CCFTA2-VP8-10	12/21/2012	**1.2**	**0.13 M**	**0.019 J**	**0.03**	**0.071**	**0.13**	**0.11**	**0.052**	**0.0084 J M**	0.022 U	0.011 U	0.011 U
CCFTA2-VP8-15	12/21/2012	**0.39**	**0.072**	**0.041**	**0.039 M**	**0.059**	**0.17**	**0.081**	**0.031 J**	**0.0057 J M**	0.022 U	0.011 U	0.011 U
CCFTA2-VP8-19	12/21/2012	**0.54**	**0.024**	0.01 U	0.011 U	**0.023 J**	**0.15**	**0.037**	0.022 U	0.015 U M	0.022 U	0.011 U	0.011 U
CCFTA2-VP8-23	12/21/2012	**1.4**	**0.051**	**0.01 J M**	**0.013 J**	**0.025 J**	**0.38**	**0.088**	**0.029 J**	**0.0086 J M**	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP8-28	12/21/2012	**0.12**	0.0099 U	0.0089 U	0.0099 U	0.0099 U	**0.014 J**	**0.0072 J**	0.02 U	0.015 U M	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP8-34	12/21/2012	**0.065**	0.01 U	0.0094 U	0.01 U	0.01 U	**0.01 U**	**0.0051 J**	0.021 U	0.015 U	0.021 U	0.01 U	0.01 U
CCFTA2-VP8-40	12/20/2012	**0.1**	0.011 U	0.01 U	0.011 U	0.011 U	**0.011 J**	**0.0067 J M**	0.022 U	0.015 U M	0.022 U	0.011 U	0.011 U
CCFTA2-VP8-55	12/20/2012	0.021 U	0.01 U	0.0094 U	0.01 U	0.01 U	0.01 U	0.01 U	0.021 U	0.015 U M	0.021 U	0.01 U	0.01 U
CCFTA2-VP8-60	12/20/2012	**0.026 J**	0.01 U	0.0091 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.016 U M	0.02 U	0.01 U	0.01 U
CCFTA2-VP9-10	12/21/2012	**0.067**	0.0096 U	0.0086 U	0.0096 U M	0.0096 U	**0.015 J**	**0.0086 J**	0.019 U	0.015 U M	0.019 U	0.0096 U	0.0096 U
CCFTA2-VP9-15	12/21/2012	**0.2**	**0.051**	**0.0098 J**	**0.027**	**0.025 J**	**0.071**	**0.038**	**0.02 J**	0.015 U M	0.02 U	0.0098 U	0.0098 U
CCFTA2-VP9-19	12/21/2012	**0.25**	**0.024**	0.0086 U	**0.013 J**	**0.013 J**	**0.073**	**0.022**	**0.015 J**	**0.0086 J M**	0.019 U	0.0096 U	0.0096 U
CCFTA2-VP9-23	12/21/2012	**0.15**	**0.012 J**	0.0097 U	0.011 U	0.011 U	**0.051**	**0.021**	0.021 U	0.015 U M	0.021 U	0.011 U	0.011 U
CCFTA2-VP9-28	12/21/2012	0.02 U	0.0099 U	0.0089 U	0.0099 U	0.0099 U	**0.017 J**	**0.0063 J**	0.02 U	0.015 U	0.02 U	0.0099 U	0.0099 U
CCFTA2-VP9-34	12/21/2012	0.02 U	0.01 U	0.0091 U	0.01 U M	0.01 U	**0.0085 J**	**0.0068 J**	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP9-40	12/21/2012	**0.029 J**	0.011 U	0.0099 U	0.011 U	0.011 U	0.011 U	**0.011 J**	0.022 U	0.015 U	0.022 U	0.011 U	0.011 U
CCFTA2-VP9-55	12/21/2012	0.023 U M	0.011 U	0.01 U	0.011 U	0.011 U	0.011 U	0.011 U M	0.023 U	0.015 U	0.023 U	0.011 U	0.011 U
CCFTA2-VP9-60	12/21/2012	**0.025 J**	0.012 U	0.011 U	0.012 U	0.012 U	0.012 U	**0.0044 J M**	0.024 U	0.015 U M	0.024 U	0.012 U	0.012 U
CCFTA2-EQB	11/8/2012	0.021 U	0.011 U	0.0095 U	0.011 U	0.011 U	**0.0085 J**	0.011 U	0.021 U	0.016 U	0.021 U	0.011 U	0.011 U
CCFTA2-TW2-EQB	11/12/2012	0.019 U	0.0096 U	0.0086 U	0.0096 U	0.0096 U	0.0096 U M	0.0096 U	0.019 U	0.015 U	0.019 U	0.0096 U	0.0096 U
CCFTA2-VP1-EQB	11/8/2012	0.02 U	0.01 U	0.009 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP3-EQB	11/14/2012	0.02 U	0.01 U	0.0092 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-VP4-EQB	11/9/2012	0.02 U	0.01 U	0.009 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U		0.02 U	0.01 U	0.01 U
CCFTA2-BKG1-EQB	11/15/2012	0.021 U	0.01 U	0.0093 U	0.01 U	0.01 U	0.01 U	0.01 U	0.021 U	0.015 U	0.021 U	0.01 U	0.01 U
CCFTA2-MW022S-EQB	11/13/2012	0.02 U	0.01 U	0.0091 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.015 U	0.02 U	0.01 U	0.01 U
CCFTA2-EQB-20121218	12/18/2012	0.022 U	0.011 U	0.0097 U	0.011 U	0.011 U	0.011 U	0.011 U	0.022 U	0.015 U	0.022 U	0.011 U	0.011 U

Table 1
CCAFS Analytical Results - PFCs in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample Location	Sample Date	Perfluoroundecanoic Acid (PFUnA) µg/L	Perfluorododecanoic Acid (PFDoA) µg/L	Perfluorotridecanoic Acid (PFTriA) µg/L	Perfluorotetradecanoic Acid (PFTeA) µg/L
		C11A	C12A	C13A	C14A
CCFTA2-MW07S	11/13/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-MW07D	11/13/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-MW014S	11/13/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-MW022I	11/13/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-MW022S	11/13/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-MW023S	11/13/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-BKG1	11/15/2012	0.01 U	0.02 U	0.02 U M	0.02 U
CCFTA2-TW1	11/8/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-TW2	11/12/2012	**0.017 J M**	0.019 U	0.019 U	0.019 U
CCFTA2-TW3	11/12/2012	0.0096 U	0.019 U	0.019 U	0.019 U
CCFTA2-TW4	11/12/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP1-10	11/7/2012	0.0095 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP1-20	11/7/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP1-30	12/17/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP1-40	12/17/2012	0.011 U M	0.021 U	0.021 U	0.021 U
CCFTA2-VP1-50	12/17/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP1-60	12/17/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP2-10	11/14/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP2-20	11/14/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP2-30	11/14/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP2-40	11/14/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP2-50	11/14/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP2-60	11/14/2012	0.012 U	0.023 U	0.023 U	0.023 U
CCFTA2-VP3-10	11/15/2012	0.012 U	0.023 U	0.023 U	0.023 U
CCFTA2-VP3-20	11/15/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP3-30	11/15/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP3-40	11/15/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP3-50	11/15/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP3-60	11/14/2012	0.012 U	0.024 U	0.024 U	0.024 U
CCFTA2-VP4-10	11/16/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP4-20	11/16/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP4-30	11/16/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP4-40	11/15/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP4-50	11/15/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP4-60	11/15/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP5-10	12/18/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP5-15	12/18/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP5-19	12/18/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP5-23	12/18/2012	0.011 U	0.023 U	0.023 U	0.023 U
CCFTA2-VP5-28	12/18/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP5-34	12/18/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP5-40	12/18/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP5-55	12/18/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP5-60	12/18/2012	0.0099 U	0.02 U	0.02 U	0.02 U

Table 1
CCAFS Analytical Results - PFCs in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample Location	Sample Date	Perfluoroundecanoic Acid (PFUnA) µg/L	Perfluorododecanoic Acid (PFDoA) µg/L	Perfluorotridecanoic Acid (PFTriA) µg/L	Perfluorotetradecanoic Acid (PFTeA) µg/L
		C11A	C12A	C13A	C14A
CCFTA2-VP6-10	12/19/2012	0.0097 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP6-15	12/19/2012	0.0096 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP6-19	12/19/2012	0.0098 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP6-23	12/19/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP6-28	12/19/2012	0.0098 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP6-34	12/19/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP6-40	12/19/2012	0.012 U M	0.025 U	0.025 U	0.025 U
CCFTA2-VP6-55	12/19/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP6-60	12/19/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP7-10	12/21/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP7-15	12/20/2012	0.0098 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP7-19	12/20/2012	0.0099 U M	0.02 U	0.02 U	0.02 U
CCFTA2-VP7-23	12/20/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP7-28	12/20/2012	0.01 U M	0.021 U	0.021 U	0.021 U
CCFTA2-VP7-34	12/20/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP7-40	12/20/2012	0.011 U M	0.022 U	0.022 U	0.022 U
CCFTA2-VP7-55	12/20/2012	0.0097 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP7-60	12/20/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP8-10	12/21/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP8-15	12/21/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP8-19	12/21/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP8-23	12/21/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP8-28	12/21/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP8-34	12/21/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP8-40	12/20/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP8-55	12/20/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP8-60	12/20/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP9-10	12/21/2012	0.0096 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP9-15	12/21/2012	0.0098 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP9-19	12/21/2012	0.0096 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP9-23	12/21/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-VP9-28	12/21/2012	0.0099 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP9-34	12/21/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP9-40	12/21/2012	0.011 U	0.022 U	0.022 U	0.022 U
CCFTA2-VP9-55	12/21/2012	0.011 U M	0.023 U	0.023 U	0.023 U
CCFTA2-VP9-60	12/21/2012	0.012 U	0.024 U	0.024 U	0.024 U
CCFTA2-EQB	11/8/2012	0.011 U	0.021 U	0.021 U	0.021 U
CCFTA2-TW2-EQB	11/12/2012	0.0096 U	0.019 U	0.019 U	0.019 U
CCFTA2-VP1-EQB	11/8/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-VP3-EQB	11/14/2012	0.01 U M	0.02 U	0.02 U	0.02 U
CCFTA2-VP4-EQB	11/9/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-BKG1-EQB	11/15/2012	0.01 U	0.021 U	0.021 U	0.021 U
CCFTA2-MW022S-EQB	11/13/2012	0.01 U	0.02 U	0.02 U	0.02 U
CCFTA2-EQB-20121218	12/18/2012	0.011 U	0.022 U	0.022 U	0.022 U

Notes:
J - Estimated: The analyte was positively identified; the quantitation is an estimation
M - Manual integrated compound
D - Sample results are obtained from a dilution; the surrogate or matrix sp ke recoveries reported are calculated from diluted samples
U - Undetected at the Limit of Detection
C#S - Indicates that the perfluorinated compound has # carbons and a sulfonyl group
C#A - Indicates that the perfluorinated compound has # carbons and a sulfonic acid group

Table 5
CCAFS Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Perfluoroalkyl Carboxylates											Sum PFAAs	Perfluoroalkyl Sulfonates							Sum PFAS	Ratio A/S	Ratio S/A
	C4 PFBA	C5 PFPeA	C6 PFHxA	C7 PFHpA	C8 PFOA	C9 PFNA	C10 PFDA	C11 PFUdA	C12 PFDoA	C13 PFTrDA	C14 PFTeDA		C4 PFBS	C5 PFPeS	C6 PFHxS	C7 PFHpS	C8 PFOS	C9 PFNS	C10 PFDS			
CCFTA2-VP1-10	1700	2800	10000	1800	7500	390	52	ND	ND	ND	ND	24242	2000	2100	**75000**	1600	**190000**	250	ND	270,950	0.09	11
CCFTA2-VP1-20	ND	40	67	9	23	<LOR	ND	ND	ND	ND	ND	139	ND	<LOR	400	ND	730	ND	ND	1,130	0.12	8
CCFTA2-VP3-20	140	274	1200	100	360	21	5.2	ND	ND	ND	ND	2100	120	130	**5300**	71	2400	<LOR	ND	8,021	0.26	4
CCFTA2-VP3-30	ND	35.9	99	17	66	<LOR	ND	ND	ND	ND	ND	218	30	ND	410	5.1	170	ND	ND	615	0.35	3
CCFTA2-VP3-40	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	13	ND	ND	54	<LOR	52	ND	ND	106	0.12	8
CCFTA2-VP3-50	ND	ND	ND	ND	5.8	ND	ND	ND	ND	ND	ND	6	ND	ND	10	ND	15	ND	ND	25	0.23	4
CCFTA2-VP3-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	25	ND	42	ND	ND	67	-	-
CCFTA2-VP4-40	ND	ND	23	ND	8.5	ND	ND	ND	ND	ND	ND	32	ND	ND	63	ND	83	ND	ND	146	0.22	5
CCFTA2-VP4-50	ND	ND	ND	ND	6.8	ND	ND	ND	ND	ND	ND	7	ND	ND	11	ND	23	ND	ND	34	0.20	5
CCFTA2-VP4-60	ND	ND	ND	ND	5.6	ND	ND	ND	ND	ND	ND	6	ND	ND	15	ND	31	ND	ND	46	0.12	8
Limit of Quantitation (LOQ)	5	5	5	5	5	5	5	5	5	5	5		5	5	5	5	5	5	5			
Limit of Detection (LOD)	4.1	1.1	1.4	1.8	1.5	1	0.94	0.93	1	1.2	1.7		1.2	1.7	1.7	0.88	0.81	0.81	0.71			
QC Results																						
Solvent Spike 10 ng/L	15	14	9.2	10	12	10	11	6.9*	10	7.1*	10		8	N/A	7	9.4	10	N/A	7.8			
Solvent Spike 30 ng/L	27	25	17	20	23	25	27	23	26	31	21		19*	N/A	20*	25	25	N/A	24			
Extraction Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD		<LOR*	<LOD	<LOR	<LOD	<LOR*	<LOD	<LOD			
Solvent Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD		ND	<LOD	2	<LOD	14*	<LOD	<LOD			
Linearity (R^2)^	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		0.99	N/A	0.99	0.99	0.99	N/A	0.99			

Table 5
CCAFS Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Fluorotelomer Sulfonates			Perfluoroalkyl Sulfonamido Amines					Perfluoroalkyl Sulfonamide Amino Carboxylates					Fluorotelomer Thioamido Sulfonates		
	4:2 FtS	6:2 FtS	8:2 FtS	C4 PFBSaAm	C5 PFPeSaAm	C6 PFHxSaAm	C7 PFHpSaAm	C8 PFOSaAm	C4 PFBSaAmA	C5 PFPeSaAmA	C6 PFHxSaAmA	C7 PFHpSaAmA	C8 PFOSaAmA	4-2 FtTAoS	6-2 FtTAoS	8-2 FtTAoS
CCFTA2-VP1-10	ND	400	2100	810	420	1600	ND	ND	ND	ND	ND	640	ND	ND	ND	ND
CCFTA2-VP1-20	ND	<LOR	>LOR	ND	<LOR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-20	ND	<LOR	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Limit of Quantitation (LOQ)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Limit of Detection (LOD)	1.6	0.84	1.9													
QC Results																
Solvent Spike 10 ng/L	6.5*	11	11	N/A, uses PFOS cal curve					N/A, uses PFOS cal curve					N/A	6*	N/A
Solvent Spike 30 ng/L	35	39	33											N/A	32	N/A
Extraction Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Solvent Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Linearity (R^2)^	0.99	0.99	0.99	N/A, uses PFOS cal curve					N/A, uses PFOS cal curve					N/A	0.99	N/A

*Did not pass

^Ranged from 20-6000 ng/L. 1/x weighted. Reporting limit of 10 for LOQ is due to concentration

of sample through the extraction process

Reporting limit of 10 for LOQ is due to concentration of sample through
the extraction process and correspond to the lowest cal bration standard of 20 ng/L

Table 5
CCAFS Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Fluorotelomer Thio Hydroxy Ammonium	Fluorotelomer Sulfonamido Betaines				Fluorotelomer Sulfamido Amines		Fluorotelomer Betaines					
	6-2 FtTHN	6-2 FtSaB	8-2 FtSaB	10-2 FtSaB	12-2 FtSaB	6-2 FtSaAm	8-2 FtSaAm	5-1-2 FtB	7-1-2 FtB	9-1-2 FtB	5-3 FtB	7-3 FtB	9-3 FtB
CCFTA2-VP1-10	ND	260	ND	ND	ND	ND	ND	ND	ND	ND	61	ND	ND
CCFTA2-VP1-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP3-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CCFTA2-VP4-60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Limit of Quantitation (LOQ) Limit of Detection (LOD)	5.6	50	50	50	50	41	41	9.6	20	5.3	2.7	5	10
QC Results													
Solvent Spike 10 ng/L	16	72	N/A	N/A	N/A	85	N/A	110	120	100	120	67*	48*
Solvent Spike 30 ng/L	33	150*	N/A	N/A	N/A	98*	N/A	82	82	61*	68*	48*	32*
Extraction Blank	23*	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Solvent Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Linearity (R^2)^	0.96*	0.99	N/A	N/A	N/A	0.99	N/A	0.95	0.96	0.97	0.99	0.99	0.99

Notes
All units are in nanograms per liter, ng/L

Solvent spike 10 ng/L QC based on n = 2, acceptance limits 11-20 ng/L for PFCs except Fluorotelomer Sulfonamido Betaines (Acceptance limits 70 - 130 ng/L), 6:2 FtSaAm and 8:2 FtSaAm (Acceptance limits 57-110 ng/L) and 6:2 FtSaAm and 8:2 FtSaAm (Acceptance limits 70-100%)
Solvent spike 30 ng/L QC is based on n = 2, acceptance limit 21-39 ng/L for PFCs except 6:2 FtTHN (acceptance limit 32-59 ng/L), Fluorotelomer Sulfonamido Betaines (Acceptance limits 210 - 390 ng/L), 6:2 FtSaAm and 8:2 FtSaAm (Acceptance limits 170-310 ng/L), and 6:2 FtSaAm and 8:2 FtSaAm (Acceptance limits 70-100%)
Extraction blank QC is based on n = 1, < LOD
Solvent blank QC is based on n = 2, < LOD
Linearity (R^2) is based on 6 points, R2 > 0.97
Non-bolded = data taken from undiluted
Bold = Taken from diluted data
<LOD -- no signal or signal below cal bration curve calculation range
< LOQ -- below lowest cal bration curve point
*Did not pass
^Ranged from 20-6000 ng/L. 1/x weighted. Reporting limit of 10 for LOQ is due to concentration of sample through the extraction process
Reporting limit of 10 for LOQ is due to concentration of sample through the extraction process and correspond to the lowest cal bration standard of 20 ng/L

Table 6
CCAFS Analytical Results - PFCs in Soil and Sediments
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample Location	Sample Date	Perfluorooctane Sulfonate (PFOS) µg/kg	Perfluorooctanoic Acid (PFOA) µg/kg	Perfluorobutane Sulfonate (PFBS) µg/kg	Perfluorobutanoic Acid (PFBA) µg/kg	Perfluoropentanoic Acid (PFPA) µg/kg	Perfluorohexane Sulfonate (PFHxS) µg/kg	Perfluorohexanoic Acid (PFHxA) µg/kg	Perfluoroheptanoic Acid (PFHpA) µg/kg	Perfluorooctane Sulfonamide (FOSA) µg/kg	Perfluorononanoic Acid (PFNA) µg/kg	Perfluorodecane Sulfonate (PFDS) µg/kg	Perfluorodecanoic Acid (PFDA) µg/kg
		C8S	C8A	C4S	C4A	C5A	C6S	C6A	C7A	C8FOSA	C9A	C10S	C10A
CCFTA2-BKG1-1	11/13/2012	**0.32 J**	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U
CCFTA2-BKG1-7	11/13/2012	**0.91 J**	0.71 U	0.71 U	**0.22 J**	0.71 U	**0.21 J**	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-TW1-1	11/13/2012	**240**	**22**	**0.31 J**	**0.72 J**	**1.4**	**290**	**19**	**1**	**45**	**1.4**	**4**	**3**
CCFTA2-TW1-5	11/13/2012	**120**	**3.8**	**0.5 J**	**0.69 J**	**0.75 J**	**62**	**12**	0.76 U	**0.47 J**	**1.1**	0.76 U	0.76 U M
CCFTA2-TW2-1	11/13/2012	**10**	0.79 U	0.79 U	0.79 U	0.79 U	**3.1**	**0.37 J**	0.79 U	**2.2**	0.79 U	**33 M**	0.79 U
CCFTA2-TW2-6	11/13/2012	**220**	**3.5**	**1.1**	**0.94 J**	**2.1**	**46**	**9.1**	**1.7**	**3**	**1**	**2.9**	**1.8**
CCFTA2-TW3-5	11/13/2012	**2.6**	0.61 U	0.61 U	**0.12 J**	0.61 U	0.61 U	0.61 U M	**0.14 J**	0.61 U	0.61 U	0.61 U	0.61 U
CCFTA2-TW4-2.5	11/13/2012	**30**	**1**	0.68 U	0.68 U	0.68 U	0.68 U	0.68 U	0.68 U	0.68 U	**0.32 J**	0.68 U	0.68 U
CCFTA2-VP1-0.5	11/7/2012	**18**	**0.88**	**0.36 J M**	**2.9**	**3.7**	**13**	**7.1**	**0.16 J**	**3.9**	**0.26 J**	**5 M**	0.59 U
CCFTA2-VP1-3	11/7/2012	**1200**	**7.3**	**0.36 J**	**0.92**	**1.8**	**63**	**14**	**1.1**	**120**	0.64 U	**5.8 M**	**1.7**
CCFTA2-VP1-6	11/7/2012	**9300 M**	**22**	**3.7**	**4.2**	**2.9 M**	**130**	**17**	**3.3**	**82**	**6.3**	**6.1 M**	**1.7**
CCFTA2-VP1-10	11/7/2012	**1500**	**12**	**2.5**	**1.5**	**1.9**	**68**	**10**	**2**	**16**	**2.1**	0.67 U	**0.58 J**
CCFTA2-VP1-20	11/7/2012	0.74 U M	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP1-30	11/7/2012	**0.19 J**	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP1-40	11/7/2012	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP1-50	11/8/2012	**2.9**	0.74 U	0.74 U	0.74 U	0.74 U	**0.55 J**	0.74 U	0.74 U	0.74 U M	0.74 U	0.74 U	0.74 U
CCFTA2-VP1-60	11/8/2012	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-VP2-7	11/8/2012	**0.54 J**	0.67 U	0.67 U	0.67 U	0.67 U	**0.3 J**	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP2-10	11/8/2012	**0.27 J**	0.66 U	0.66 U	**0.24 J M**	0.66 U	**1.7**	**0.2 J**	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
CCFTA2-VP2-20	11/8/2012	**0.33 J**	0.67 U	0.67 U	0.67 U	0.67 U	**0.76 J**	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP2-30	11/8/2012	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP2-40	11/9/2012	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP2-50	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP2-60	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP4-7	11/9/2012	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-VP4-10	11/9/2012	**0.28 J**	0.7 U	0.7 U	0.7 U	0.7 U	**0.21 J**	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP4-20	11/9/2012	**13**	**1**	0.74 U	0.74 U	0.74 U	**5.6**	**1.2**	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP4-30	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP4-40	11/9/2012	0.78 U	0.78 U	0.78 U	**0.2 J**	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U M
CCFTA2-VP4-50	11/12/2012	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U
CCFTA2-VP4-60	11/12/2012	0.67 U M	0.67 U	0.67 U	**0.14 J**	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP6-5	11/12/2012	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	**0.72 J**	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP6-20	11/12/2012	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	**0.2 J**	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U
CCFTA2-VP6-30	11/12/2012	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U
CCFTA2-VP6-40	11/12/2012	0.74 U	0.74 U	0.74 U	**0.17 J**	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP6-50	11/12/2012	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP6-60	11/13/2012	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-BANR1	11/6/2012	**1.8 H**	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U	0.73 U
CCFTA2-BANR2	11/6/2012	**2.2 H**	0.8 U	0.8 U	0.78 U H	0.8 U	0.78 U H	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U
CCFTA2-BANR3	11/7/2012	**4**	0.55 U	0.55 U	**0.27 J**	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U
CCFTA2-BANR4	11/7/2012	**3.8**	**0.24 J**	0.59 U	0.59 U	0.59 U	**0.37 J**	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U
CCFTA2-BANR5	11/7/2012	**4.1**	**0.35 J**	**0.21 J**	0.57 U	0.57 U	**0.42 J**	**0.24 J**	0.57 U	0.57 U	0.57 U	0.57 U	0.57 U
CCFTA2-BANR6	11/8/2012	**4.7**	**0.24 J**	0.56 U	**0.46 J**	0.56 U	**0.74 J**	**0.2 J**	0.56 U	0.56 U	0.56 U	0.56 U	0.56 U
CCFTA2-BANR7	11/8/2012	**4.6**	**0.21 J**	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U	0.55 U
CCFTA2-BANR8	11/8/2012	**4.1**	**0.36 J**	0.58 U	0.58 U	0.58 U	**0.65 J**	0.58 U	0.58 U	0.58 U	0.58 U	0.58 U	0.58 U
CCFTA2-BANR9	11/9/2012	**4.2**	0.59 U	0.59 U	0.59 U	0.59 U	**0.6 J**	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U	0.59 U

Table 6
CCAFS Analytical Results - PFCs in Soil and Sediments
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample Location	Sample Date	Perfluoroundecanoic Acid (PFUnA) µg/kg	Perfluorododecanoic Acid (PFDoA) µg/kg	Perfluorotridecanoic Acid (PFTriA) µg/kg	Perfluorotetradecanoic Acid (PFTeA) µg/kg
		C11A	C12A	C13A	C14A
CCFTA2-BKG1-1	11/13/2012	0.59 U	0.59 U	0.59 U	0.59 U
CCFTA2-BKG1-7	11/13/2012	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-TW1-1	11/13/2012	0.62 U	0.62 U	0.62 U	0.62 U
CCFTA2-TW1-5	11/13/2012	0.76 U	0.76 U	0.76 U	0.76 U
CCFTA2-TW2-1	11/13/2012	0.79 U	0.79 U	0.79 U	0.79 U
CCFTA2-TW2-6	11/13/2012	0.76 U	0.76 U	0.76 U	0.76 U
CCFTA2-TW3-5	11/13/2012	0.61 U M	0.61 U	0.61 U	0.61 U
CCFTA2-TW4-2.5	11/13/2012	0.68 U	0.68 U	0.68 U	0.68 U
CCFTA2-VP1-0.5	11/7/2012	**0.48 J**	**0.84 J M**	0.59 U J	0.59 U
CCFTA2-VP1-3	11/7/2012	**0.64 J M**	**0.64 J M**	0.64 U	0.64 U
CCFTA2-VP1-6	11/7/2012	0.69 U	0.69 U	0.69 U	0.69 U
CCFTA2-VP1-10	11/7/2012	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP1-20	11/7/2012	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP1-30	11/7/2012	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP1-40	11/7/2012	0.74 U	**0.97 J**	0.74 U	0.74 U
CCFTA2-VP1-50	11/8/2012	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP1-60	11/8/2012	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-VP2-7	11/8/2012	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP2-10	11/8/2012	0.66 U	0.66 U	0.66 U	0.66 U
CCFTA2-VP2-20	11/8/2012	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP2-30	11/8/2012	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP2-40	11/9/2012	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP2-50	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP2-60	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP4-7	11/9/2012	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-VP4-10	11/9/2012	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP4-20	11/9/2012	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP4-30	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP4-40	11/9/2012	0.78 U	0.78 U	0.78 U	0.78 U
CCFTA2-VP4-50	11/12/2012	0.69 U	0.69 U	0.69 U	0.69 U
CCFTA2-VP4-60	11/12/2012	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP6-5	11/12/2012	0.67 U	0.67 U	0.67 U	0.67 U
CCFTA2-VP6-20	11/12/2012	0.65 U	0.65 U	0.65 U	0.65 U
CCFTA2-VP6-30	11/12/2012	0.76 U	0.76 U	0.76 U	0.76 U
CCFTA2-VP6-40	11/12/2012	0.74 U	0.74 U	0.74 U	0.74 U
CCFTA2-VP6-50	11/12/2012	0.7 U	0.7 U	0.7 U	0.7 U
CCFTA2-VP6-60	11/13/2012	0.71 U	0.71 U	0.71 U	0.71 U
CCFTA2-BANR1	11/6/2012	0.73 U	0.73 U	0.73 U	0.73 U
CCFTA2-BANR2	11/6/2012	0.8 U	0.8 U	0.8 U	0.8 U
CCFTA2-BANR3	11/7/2012	0.55 U	0.55 U	0.55 U	0.55 U
CCFTA2-BANR4	11/7/2012	0.59 U	0.59 U	0.59 U	0.59 U
CCFTA2-BANR5	11/7/2012	0.57 U	0.57 U	0.57 U	0.57 U
CCFTA2-BANR6	11/8/2012	0.56 U	0.56 U	0.56 U	0.56 U
CCFTA2-BANR7	11/8/2012	0.55 U	0.55 U	0.55 U	0.55 U
CCFTA2-BANR8	11/8/2012	0.58 U	0.58 U	0.58 U	0.58 U
CCFTA2-BANR9	11/9/2012	0.59 U	0.59 U	0.59 U	0.59 U

Notes:
J - Estimated: The analyte was positively identified; the quantitation is an estimation
M - Manual integrated compound
D - Sample results are obtained from a dilution; the surrogate or matrix sp ke recoveries reported are calculated from diluted samples
U - Undetected at the Limit of Detection
C#S - Indicates that the perfluorinated compound has # carbons and a sulfonyl group
C#A - Indicates that the perfluorinated compound has # carbons and a sulfonic acid group

Table 15
BAFB Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Perfluoroalkyl Carboxylates											Sum PFAAs	Perfluoroalkyl Sulfonates							Sum PFAS	Ratio A/S	Ratio S/A
	C4 PFBA	C5 PFPeA	C6 PFHxA	C7 PFHpA	C8 PFOA	C9 PFNA	C10 PFDA	C11 PFUdA	C12 PFDoA	C13 PFTrDA	C14 PFTeDA		C4 PFBS	C5 PFPeS	C6 PFHxS	C7 PFHpS	C8 PFOS	C9 PFNS	C10 PFDS			
6215-TW-03	2000	**>3000**	**>3000**	2000	45	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	4045	15	7.7	71	<LOQ	35	<LOD	<LOD	129	31.43	0.0
6626-TW-01	3600	**15000**	**22000**	2400	**3500**	190	5.0	<LOD	<LOD	<LOD	<LOD	46695	**5800**	**4000**	**42000**	2200	**92000**	580	30	146,610	0.32	3.1
6626-TW-02	190	420	430	110	62	6.3	<LOD	<LOD	<LOD	<LOD	<LOD	1218	45	47	540	25	560	<LOD	<LOD	1,217	1.00	1.0
6626-TW-03	300	980	930	330	83	12	<LOD	<LOD	<LOD	<LOD	<LOD	2635	22	28.6	550	21	870	<LOD	<LOQ	1,492	1.77	0.6
6626-TW-04	110	330	300	140	23	6.5	<LOD	<LOD	<LOD	<LOD	<LOD	910	9.6	10	180	5.9	180	<LOD	<LOD	386	2.36	0.4
6626-VAP-01-50	650	2200	2600	1200	1400	300	17	<LOD	<LOD	<LOD	<LOD	8367	1100	1000	**11000**	600	**35000**	140	11	48,851	0.17	5.8
BKCM02	<LOD	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0	<LOD	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	-	-	-
FT02-TW-06	370	860	1900	520	630	100	<LOQ	<LOD	<LOD	<LOD	<LOD	4380	1600	1500	**9300**	320	**6600**	13.4	<LOQ	19,333	0.23	4.4
FT02-TW-07	260	480	640	270	830	100	<LOD	<LOD	<LOD	<LOD	<LOD	2580	300	320	**7400**	680	**11000**	9.8	<LOD	19,710	0.13	7.6
FT02-TW-08	41	78	100	46	28	8.7	<LOD	<LOD	<LOD	<LOD	<LOD	302	11	8.9	180	12	350	<LOD	<LOD	562	0.54	1.9
FT02-TW-09	13	27	52	17	19	5.4	<LOQ	<LOD	<LOD	<LOD	<LOD	133	10	7.9	140	<LOQ	420	<LOD	<LOD	578	0.23	4.3
FT02-TW-10	<LOQ	<LOQ	<LOQ	<LOQ	5.2	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	5	9	<LOD	63	<LOQ	60	<LOD	<LOD	132	0.04	25.4
FT02-TW-11	<LOD	<LOQ	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0	5.1	<LOD	19	<LOQ	<LOQ	<LOD	<LOD	24	-	-
FT02-TW-13	**>3000**	**>3000**	**>3000**	**>3000**	**>3000**	2500	<LOD	<LOD	<LOD	<LOD	<LOD	2500	**9400**	**6900**	**6700**	**4300**	**6000**	35.5	<LOD	33,336	0.07	13.3
FT02-TW-14	99	82	160	23	95	5.6	<LOD	<LOD	<LOD	<LOD	<LOD	465	140	120	2200	110	2200	<LOD	<LOD	4,770	0.10	10.3
FT02-TW-15	89	120	280	71	150	18	<LOD	<LOD	<LOD	<LOD	<LOD	728	210	190	**55000**	120	1800	<LOQ	<LOD	57,320	0.01	78.7
FT02-VAP-01-40	200	520	760	360	240	42	<LOQ	<LOD	<LOD	<LOD	<LOD	2122	240	200	2700	140	**6500**	42.4	<LOQ	9,822	0.22	4.6
FT02-VAP-01-55	300	640	2000	250	870	11	<LOQ	<LOD	<LOD	<LOD	<LOD	4071	2800	2800	**15000**	1500	**10000**	<LOQ	<LOD	32,100	0.13	7.9
FT02-VAP-02-40	290	780	660	310	190	30	<LOQ	<LOD	<LOD	<LOD	<LOD	2260	340	220	2800	140	**6100**	16.5	<LOD	9,617	0.24	4.3
FT02-VAP-02-50	750	2500	2900	1100	1800	410	22	<LOD	<LOD	<LOD	<LOD	9482	1100	1000	**10000**	740	**35000**	260	32	48,132	0.20	5.1
FT02-VAP-03-40	840	**4000**	2200	1400	1600	280	<LOD	<LOD	<LOD	<LOD	<LOD	10320	660	640	**6000**	500	**7500**	6.3	<LOD	15,306	0.67	1.5
FT02-VAP-03-50	520	2000	1500	1200	1200	390	<LOD	<LOD	<LOD	<LOD	<LOD	6810	230	230	2600	240	**14000**	45.3	<LOD	17,345	0.39	2.5
FT02-VAP-04-40	190	480	930	190	260	32	<LOD	<LOD	<LOD	<LOD	<LOD	2082	650	500	2500	190	2400	<LOD	<LOD	6,240	0.33	3.0
FT02-VAP-04-50	240	510	850	180	360	25	<LOD	<LOD	<LOD	<LOD	<LOD	2165	640	460	**9900**	160	1900	<LOD	<LOD	13,060	0.17	6.0
FT02-VAP-05-50	86	170	240	120	91	5.6	<LOD	<LOD	<LOD	<LOD	<LOD	713	120	93	900	17	200	<LOD	<LOD	1,330	0.54	1.9
FT02-VAP-06-40	<LOQ	<LOD	<LOQ	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0	<LOD	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	-	-	-
FT02-VAP-06-50	14	23	34	7.5	13	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	92	16	13	150	<LOD	130	<LOD	<LOD	309	0.30	3.4
FT02-VAP-07-42	<LOQ	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0	<LOD	<LOD	<LOQ	<LOD	<LOQ	<LOD	<LOD	-	-	-
FT02-VAP-07-52	<LOQ	17	24	<LOQ	6.6	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	48	15	10	96	<LOQ	42	<LOD	<LOD	163	0.29	3.4
FT02-VAP-08-45	<LOQ	14	11	<LOQ	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	25	<LOQ	<LOQ	53	<LOD	14	<LOD	<LOD	67	0.37	2.7
FT02-VAP-08-55	29	48	80	24	29	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	210	43	35	300	6.9	130	<LOD	<LOD	515	0.41	2.5
FT02-VAP-09-45	74	200	340	98	110	12	<LOD	<LOD	<LOD	<LOD	<LOD	834	160	120	1100	58	620	<LOD	<LOD	2,058	0.41	2.5
FT02-VAP-09-55	1700	**4000**	**10000**	1600	**3500**	150	<LOD	<LOD	<LOD	<LOD	<LOD	20950	**7300**	**5300**	**27000**	1700	**23000**	38	<LOD	64,338	0.33	3.1
Limit of Quantitation (LOQ)	10	10	10	5	5	5	5	5	5	5	10		5	5	5	10	5	5	5			
Limit of Detection (LOD)	4.1	1.1	1.4	1.8	1.5	1.0	0.94	0.93	1.0	1.2	1.7		1.2	1.7	1.7	0.88	0.81	0.81	0.71			
QC Results																						
Solvent Spike 30 ng/L	28	30	29	30	25	29	27	30	26	30	29		30	N/A	29	30	28	N/A	25			
Solvent Spike 100 ng/L	95	87	95	104	89	92	96	88	97	98	89		91	N/A	94	91	93	N/A	88			
Extraction Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD		<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD			
Solvent Blank	<LOD	<LOD	<LOD	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD		<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD			
Linearity (R^2)^	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		0.99	N/A	0.99	0.99	0.99	N/A	0.99			

Table 15
BAFB Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Fluorotelomer Sulfonates			Perfluoroalkyl Sulfonamido Amines					Perfluoroalkyl Sulfonamide Amino Carboxylates					Fluorotelomer Thioamido Sulfonates		
	4:2 FtS	6:2 FtS	8:2 FtS	C4 PFBSaAm	C5 PFPeSaAm	C6 PFHxSaAm	C7 PFHpSaAm	C8 PFOSaAm	C4 PFBSaAmA	C5 PFPeSaAmA	C6 PFHxSaAmA	C7 PFHpSaAmA	C8 PFOSaAmA	4-2 FtTAoS	6-2 FtTAoS	8-2 FtTAoS
6215-TW-03	<LOD	1400	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-01	71	**130000**	410	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-02	<LOD	60	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-03	<LOD	620	23	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-04	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-VAP-01-50	120	1950	1400	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BKCM02	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-06	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-07	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-08	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-09	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-10	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-11	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-13	52	**3900**	107	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-14	<LOD	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-15	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-01-40	11	450	410	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-01-55	7.6	480	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-02-40	<LOD	560	220	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-02-50	140	2700	1300	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-03-40	81	2300	100	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-03-50	55	1900	580	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-04-40	52	1400	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-04-50	58	1300	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-05-50	<LOD	76	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-06-40	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-06-50	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-07-42	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-07-52	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-08-45	<LOD	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-08-55	<LOD	21	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-09-45	14.7	460	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-09-55	78	2766	364	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Limit of Quantitation (LOQ)	5	10	10	5	5	5	5	5	5	5	5	5	5	5	5	5
Limit of Detection (LOD)	1.6	0.84	1.9													
QC Results																
Solvent Spike 30 ng/L	37	32	32	N/A, uses PFOS cal curve					N/A, uses PFOS cal curve					N/A	30	N/A
Solvent Sp ke 100 ng/L	99	103	84											N/A	100	N/A
Extraction Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Solvent Blank	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Linearity (R^2)^	0.99	0.99	0.99	N/A, uses PFOS cal curve					N/A, uses PFOS cal curve					N/A	0.99	N/A

*Did not pass
^Ranged from 5-3000 ng/L. 1/x weighted.

Table 15
BAFB Analytical Results - AFFF Constituents in Groundwater
Field Investigation to Characterize PFCs at Air Force Sites
Cape Canaveral Air Force Station and Barksdale Air Force Base

Sample ID	Fluorotelomer Thio Hydroxy Ammonium	Fluorotelomer Sulfonamido Betaines				Fluorotelomer Sulfamido Amines		Fluorotelomer Betaines					
	6-2 FtTHN	6-2 FtSaB	8-2 FtSaB	10-2 FtSaB	12-2 FtSaB	6-2 FtSaAm	8-2 FtSaAm	5-1-2 FtB	7-1-2 FtB	9-1-2 FtB	5-3 FtB	7-3 FtB	9-3 FtB
6215-TW-03	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-01	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-02	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-03	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-TW-04	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
6626-VAP-01-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
BKCM02	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-06	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-07	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-08	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-09	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-10	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-11	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-13	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-14	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-TW-15	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-01-40	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-01-55	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-02-40	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-02-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-03-40	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-03-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-04-40	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-04-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-05-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-06-40	<LOQ	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-06-50	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-07-42	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-07-52	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-08-45	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-08-55	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-09-45	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
FT02-VAP-09-55	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Limit of Quantitation (LOQ)	21.0	50	50	50	50	41	41	9.6	20	5.3	2.7	5	10
Limit of Detection (LOD)													
QC Results													
Solvent Spike 30 ng/L	31*	330	N/A	N/A	N/A	200	N/A	96	97	84	57*	79	59*
Solvent Spike 100 ng/L	120	690*	N/A	N/A	N/A	510*	N/A	65*	65*	70	52*	61*	69*
Extraction Blank	21*	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Solvent Blank	6.8*	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD
Linearity (R^2)^	0.99	0.99	N/A	N/A	N/A	0.99	N/A	0.98	0.97	0.99	0.99	0.99	0.99

* = not within acceptance range
50-30000 ng/L

Notes
All units are in nanograms per liter, ng/L
Solvent spike 30 ng/L QC based on n = 3, acceptance limit 21-39 ng/L
Solvent spike 100 ng/L QC is based on n = 3, acceptance limit 70-130 ng/L
Extraction blank QC is based on n = 1, < LOD
Solvent blank QC is based on n = 3, < LOD
Linearity (R^2) is based on 6 points, R2 > 0.97
non-bolded = data taken from undiluted
Bold = Taken from diluted data
<LOD -- no signal, signal below calibration curve calculation range
<LOQ -- below lowest cal bration curve point
Calibration curves from 5-3000 ng/L for all compounds except 6:2 FtTHN (calibration curve from 7.5- 4500 ng/L) and 6-2 FtSaAm and 8-2 FtSaAm (calibration curve from 40 - 24,300 ng/L)
>3,000 indicates data from undiluted was beyond calibration, second run diluted failed so discrete value not reported

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Figures

Former
Fire Training 17
(FT-17) Area

Former Fire Station
(Building 1608)

Banana River

Atlantic Ocean

LEGEND

- Base Boundary
- Surface Water
- Building
- Pavement

N

0 3,000 6,000
Feet

Cape Canaveral Air Force Base
Florida

Cape Canaveral Air Force Station (CCAFS)
Sitewide Map

UCLA ARCADIS | FIGURE 1

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LEGEND

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Well Location
- Vertical Profile Sample Location
- Former Burn Pit
- Base Boundary
- Surface Water
- Building
- Pavement

Cape Canaveral Air Force Base
Florida

Cape Canaveral Air Force Station (CCAFS)
FT-17 Area Sample Location Map

UCLA ARCADIS | FIGURE 2

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LEGEND

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Well Location
- Vertical Profile Sample Location
- PFOS Contour
- Dashed where inferred
- Base Boundary
- Surface Water
- Building
- Pavement

VP6 Sample Location
19' Depth in ft bgs of Maximum PFOS Concentration
0.4 PFOS Concentration (µg/l)

Notes:
Only maximum concentration detected at vertical profile points are shown.
ft bgs - feet below ground surface
ND - not detected
NS - not sampled
PFOS - perfluorooctane sulfonate
µg/l - micrograms per liter

N

0 100 200
Feet

Cape Canaveral Air Force Base
Florida

Cape Canaveral Air Force Station (CCAFS) FT-17 Area PFOS Concentrations

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FIGURE 4

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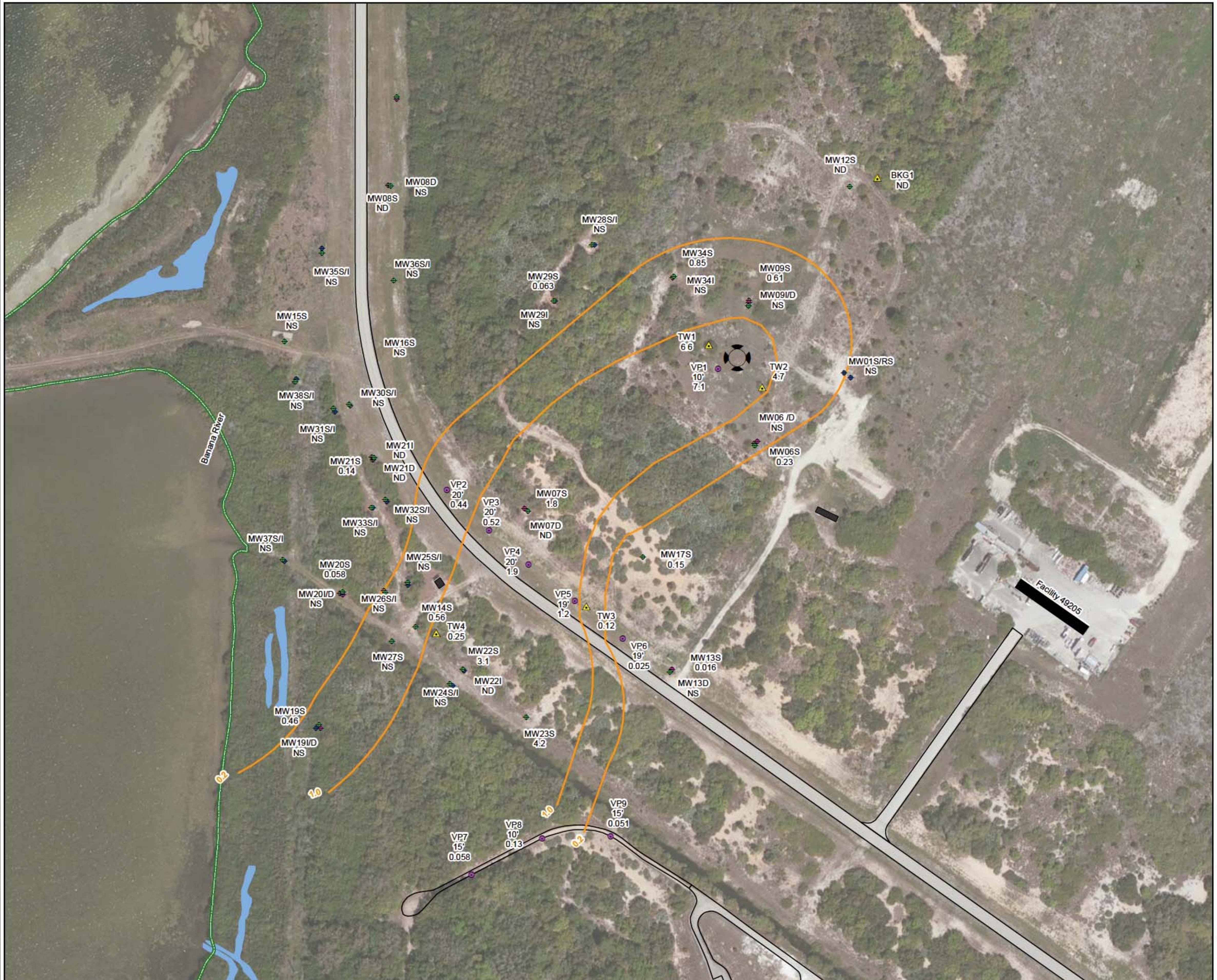

LEGEND

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Well Location
- Vertical Profile Sample Location
- PFOA Contour
- Base Boundary
- Surface Water
- Building
- Pavement

VP6 Sample Location
19' Depth in ft bgs of Maximum PFOA Concentration
0.25 PFOA Concentration (µg/l)

Notes:
Only maximum concentration detected at vertical profile points are shown.
ft bgs - feet below ground surface
ND - not detected
NS - not sampled
PFOA - perfluorooctanic acid
µg/l - micrograms per liter

N

0 100 200
Feet

Cape Canaveral Air Force Base
Florida

Cape Canaveral Air Force Station (CCAFS)
FT-17 Area PFOA Concentrations

UCLA ARCADIS

FIGURE
5

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LEGEND

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Temporary Well Location
- Vertical Profile Sample Location
- Base Boundary
- Surface Water
- Building
- Pavement

MWS08 Sample Location
11 / 10 PFOS / PFOA Concentration (µg/L)

Notes:
Only maximum concentration detected at vertical profile points are shown.
ft bgs - feet below ground surface
ND - not detected
NS - not sampled
PFOA - perfluorooctanic acid
PFOS - perfluorooctane sulfonate
µg/l - micrograms per liter

N

0 50 100
Feet

Cape Canaveral Air Force Base
Florida

Cape Canaveral Air Force Station (CCAFS)
Fire Station PFOS and PFOA Concentrations

UCLA ARCADIS | FIGURE 6

Path: C:\Users\SesitkoffDocuments\SusanSitkoff\PFOA\PFC_Report_201403\Figure_6_FSPFOA_OAResults_BAFBFormat.mxd Date Saved: 3/17/2014 11:34:35 AM Author: S.Sitkoff

UCLA ARCADIS

Appendix E

Field Sampling Plans

ARCADIS MALCOLM PIRNIE
Infrastructure · Water · Environment · Buildings

Imagine the result

Field Sampling Plan for the Assessment of Perfluorinated Compounds

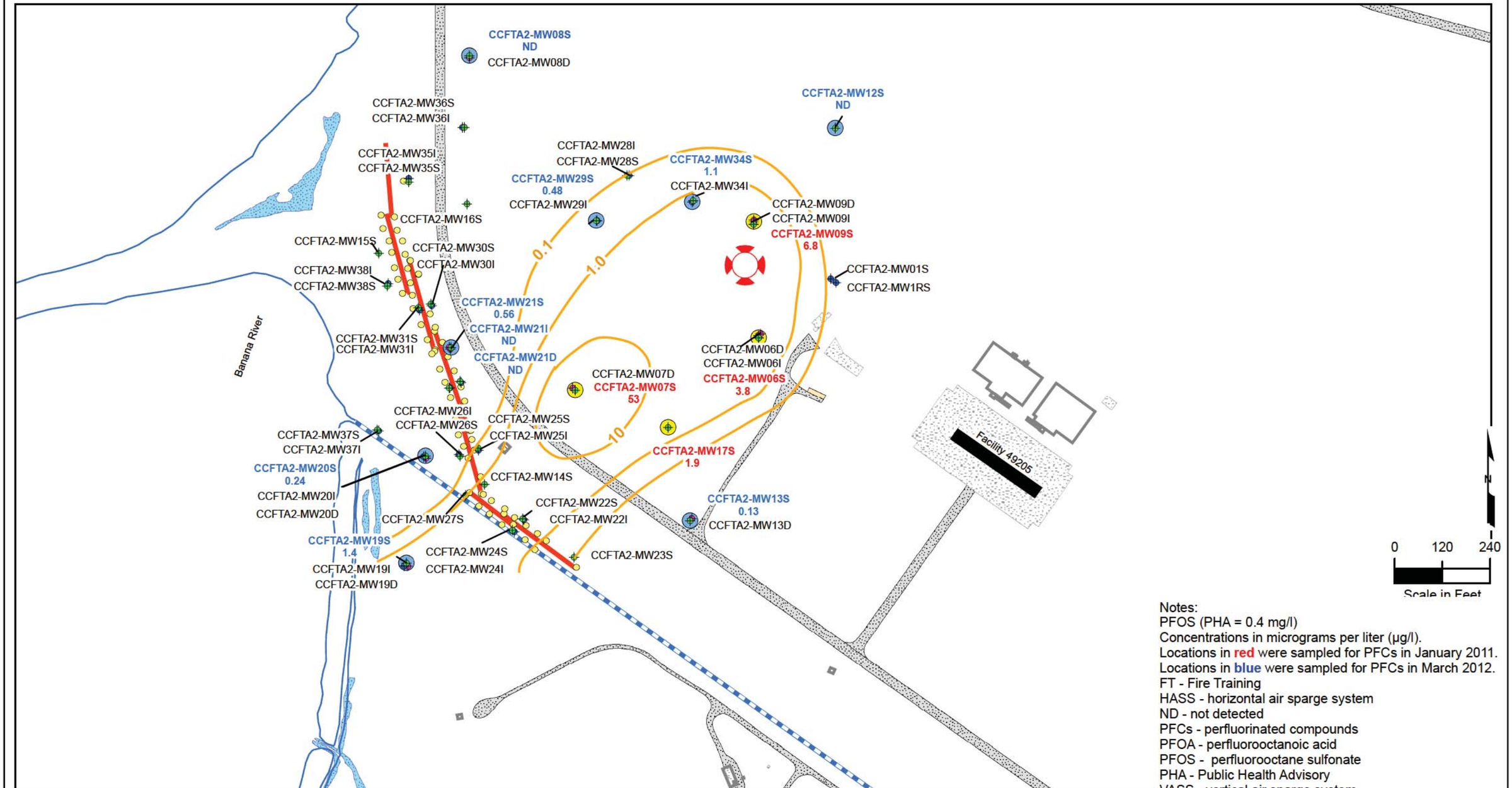
Addendum 1: Phase II Sampling Plan, Cape Canaveral Air Force Station, Florida

Cape Canaveral Air Force Station, Florida
Barksdale Air Force Base, Louisiana
Robins Air Force Base, Georgia
Beale Air Force Base, California

August 30, 2012

ARCADIS MALCOLM PIRNIE

Figures



Notes:
PFOS (PHA = 0.4 mg/l)
Concentrations in micrograms per liter (µg/l).
Locations in **red** were sampled for PFCs in January 2011.
Locations in **blue** were sampled for PFCs in March 2012.
FT - Fire Training
HASS - horizontal air sparge system
ND - not detected
PFCs - perfluorinated compounds
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
PHA - Public Health Advisory
VASS - vertical air sparge system

Legend

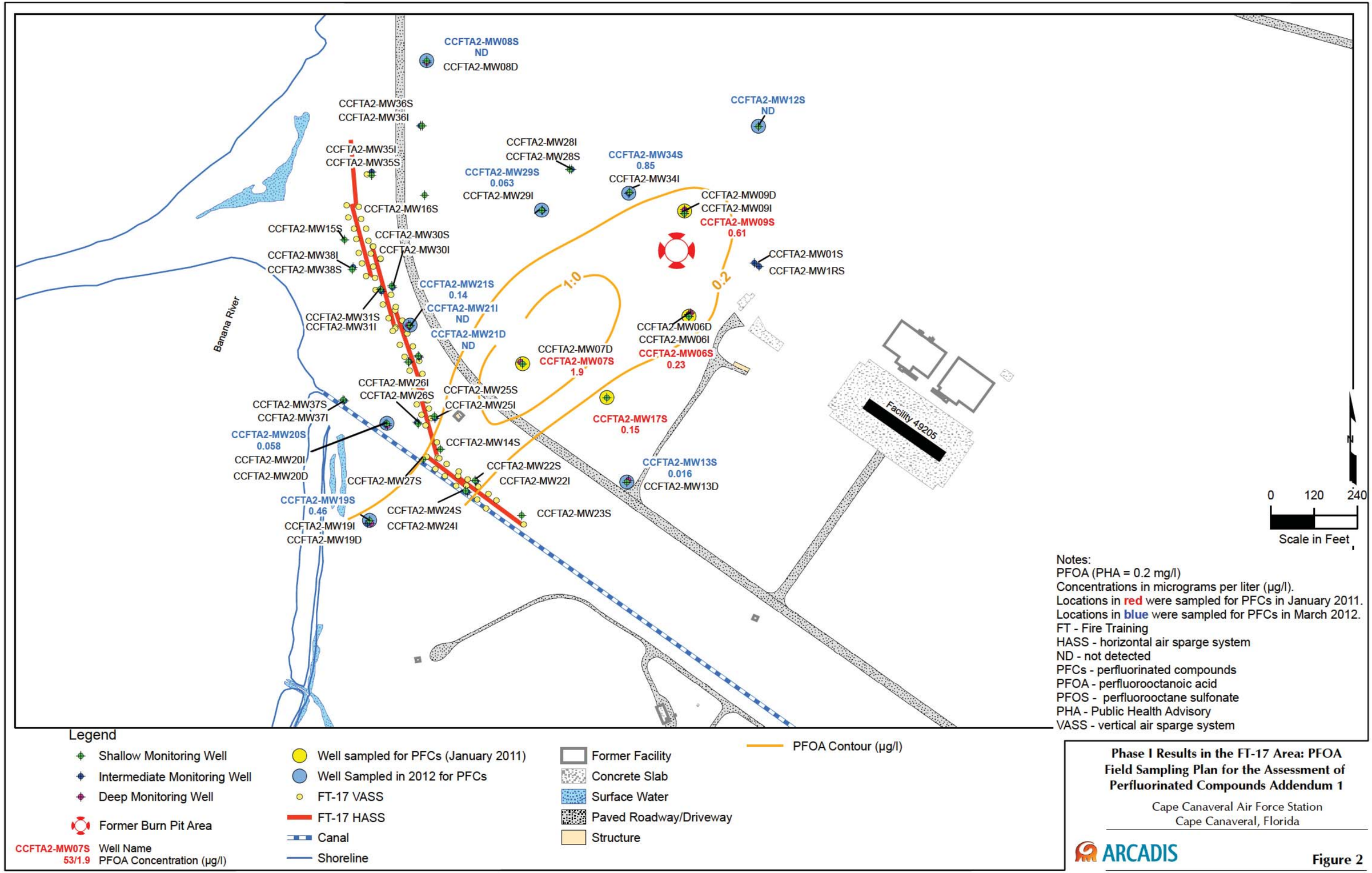
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Former Burn Pit Area
- CCFTA2-MW07S Well Name
- 53 PFOS Concentration (µg/l)
- Well sampled for PFCs (January 2011)
- Well Sampled in 2012 for PFCs
- FT-17 VASS
- FT-17 HASS
- Canal
- Shoreline
- PFOS Contour (µg/l)
- Former Facility
- Concrete Slab
- Surface Water
- Paved Roadway/Driveway
- Structure

Phase I Results in the FT-17 Area: PFOS Field Sampling Plan for the Assessment of Perfluorinated Compounds Addendum 1

Cape Canaveral Air Force Station
Cape Canaveral, Florida

ARCADIS

Figure 1



Notes:
PFOA (PHA = 0.2 mg/l)
Concentrations in micrograms per liter (µg/l).
Locations in **red** were sampled for PFCs in January 2011.
Locations in **blue** were sampled for PFCs in March 2012.
FT - Fire Training
HASS - horizontal air sparge system
ND - not detected
PFCs - perfluorinated compounds
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
PHA - Public Health Advisory
VASS - vertical air sparge system

Legend

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Former Burn Pit Area
- CCFTA2-MW07S — Well Name
- 53/1.9 — PFOA Concentration (µg/l)
- Well sampled for PFCs (January 2011)
- Well Sampled in 2012 for PFCs
- FT-17 VASS
- FT-17 HASS
- Canal
- Shoreline
- Former Facility
- Concrete Slab
- Surface Water
- Paved Roadway/Driveway
- Structure
- PFOA Contour (µg/l)

Phase I Results in the FT-17 Area: PFOA Field Sampling Plan for the Assessment of Perfluorinated Compounds Addendum 1

Cape Canaveral Air Force Station
Cape Canaveral, Florida

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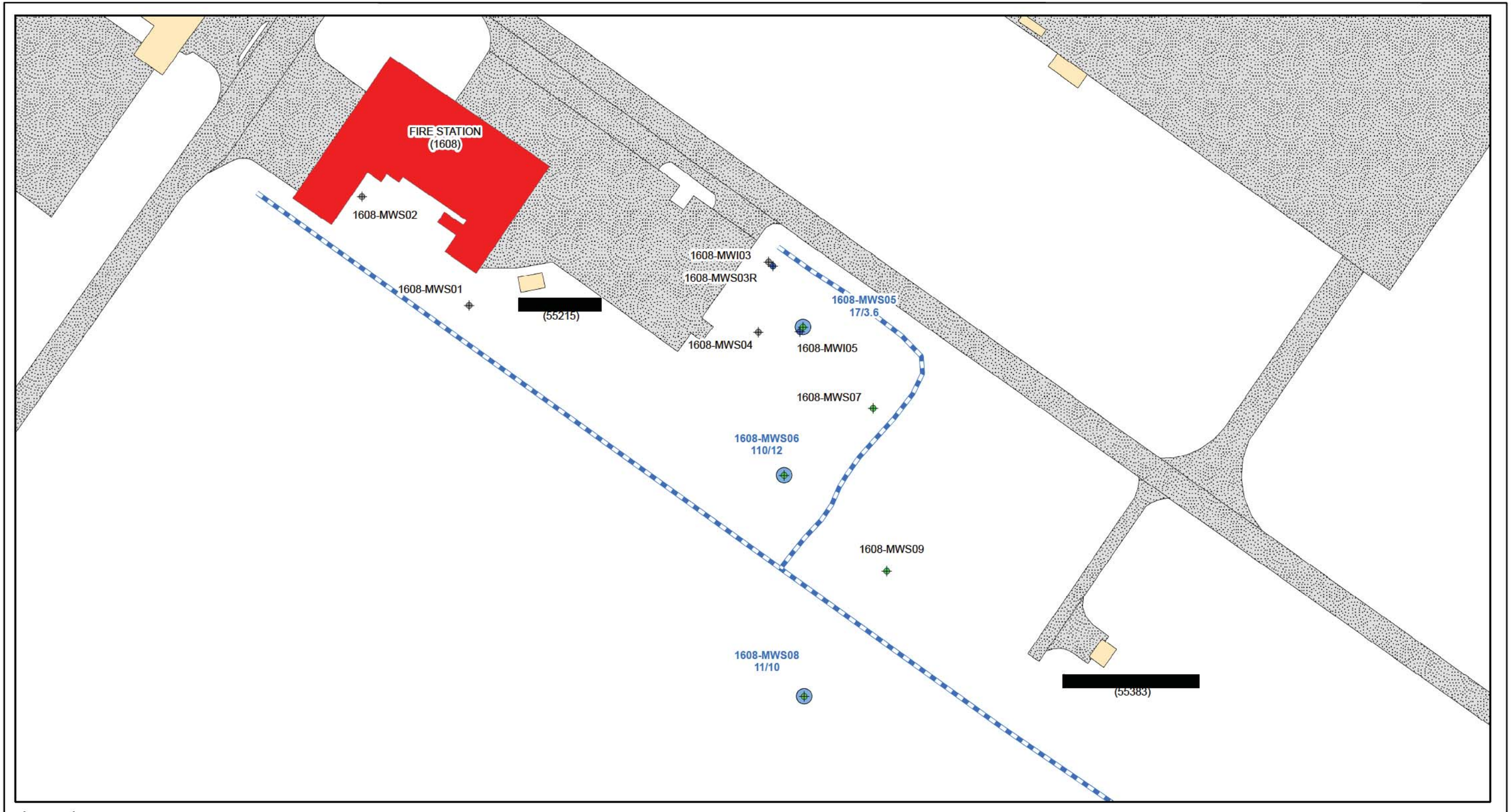
Figure 2



Legend

- Abandoned Monitoring Well
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Structure
- Fire Station
- Paved Roadway/Driveway
- Existing well targeted for sampling
- Canal
- 110/12 PFOS/PFOA Concentration (µg/l)

Notes:
Locations in **blue** were sampled in March 2012.
PFCs - perfluorinated compounds
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate

0 40 80
Scale in Feet

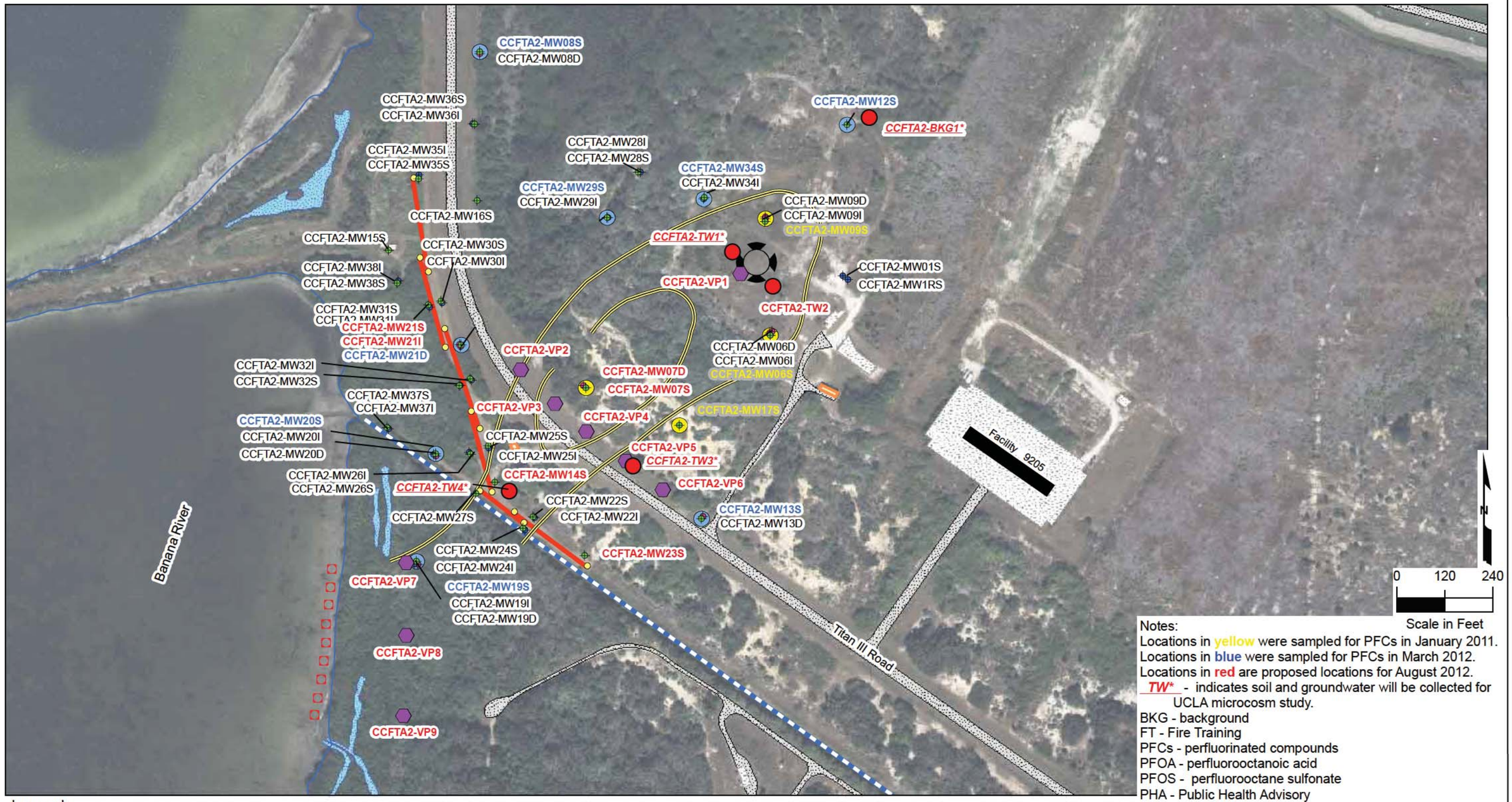
N

Phase I Results in CCAFS Former Fire Station: PFOS Detail Map Field Sampling Plan for the Assessment of Perfluorinated Compounds Addendum1

Cape Canaveral Air Force Station
Cape Canaveral, Florida

ARCADIS

Figure 3



Notes:
Locations in yellow were sampled for PFCs in January 2011.
Locations in blue were sampled for PFCs in March 2012.
Locations in red are proposed locations for August 2012.
TW* - indicates soil and groundwater will be collected for UCLA microcosm study.
BKG - background
FT - Fire Training
PFCs - perfluorinated compounds
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
PHA - Public Health Advisory

Legend

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Former Burn Pit Area
- CCFTA2-MW07S Well Name
- Vertical Aquifer Profile Boring
- Proposed Temporary Well Location
- Proposed Sediment Sample Location (Using Incremental Sampling Methodology)
- Well sampled in January 2011 for PFCs
- Well Sampled in March 2012 for PFCs
- FT-17 Vertical Air Sparge Sysytem
- Inferred Area of PFOA PHA exceedances
- FT-17 Horizontal Air Sparge System
- Canal
- Shoreline
- Former Facility
- Concrete Slab
- Surface Water
- Paved Roadway/Driveway
- Structure

Proposed Phase II Sampling Locations in the FT-17 Area
Field Sampling Plan for the Assessment of Perfluorinated Compounds Addendum 1

Cape Canaveral Air Force Station
Cape Canaveral, Florida

ARCADIS MALCOLM PIRNIE

Figure 4

Final
Site Investigation Report for Site Investigations of Fire Fighting Foam Usage at Various Air Force Bases in the United States for
Cape Canaveral Air Force Station, Brevard County, Florida

November 2014

Submitted to:

Air Force Civil Engineer Center
2261 Hughes Avenue, Suite 155
Lackland Air Force Base, Texas 78236-9583

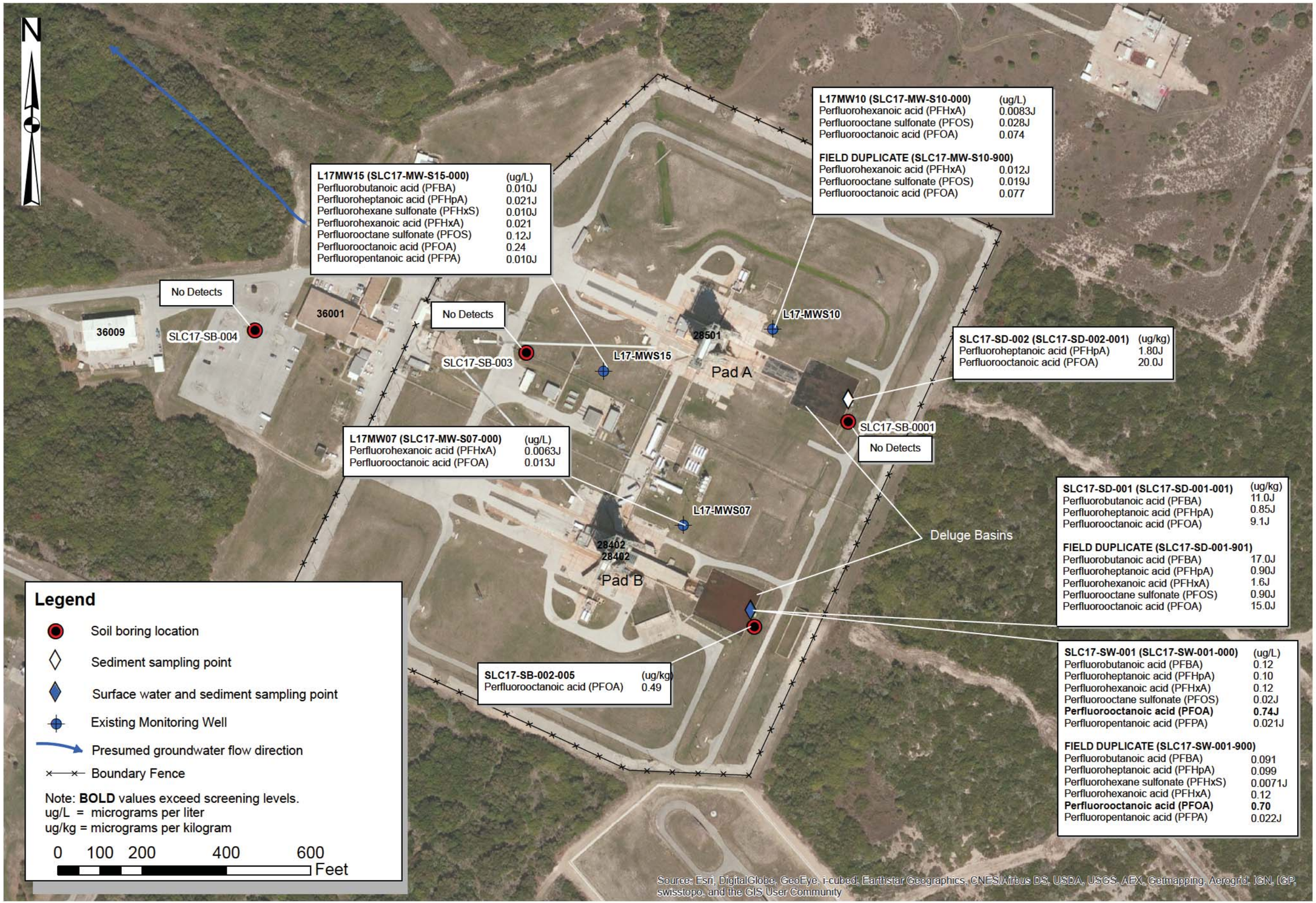
Submitted by:

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

Prepared by:

SES Construction and Fuel Services LLC
1006 Floyd Culler Court
Oak Ridge, Tennessee 37830-8022
under
Contract No. W912HN-12-D-0021
Delivery Order 0007

Appendix A
Figures



SES Construction and Fuel Services LLC
1006 Floyd Culler Court
Oak Ridge, Tennessee 37830

Job Title: Site Investigations of Fire Fighting Foam Usage at Various Air Force Bases in the States

Figure 3 Sample Locations and Detection Summary
Space Launch Complex 17
Cape Canaveral Air Force Station, Florida

R:\Projects\Q1062.0007\ Cape Canaveral AFS\Graphics\Fig 3 CCAFS Sample Locations LC-17.mxd (07/17/2014)

Appendix B

Tables

Table 1 Depth to Groundwater in Sampled Wells

Well Number	Northing	Easting	Depth to Water (feet/ BTOC)	Top of Casing Elevation (feet/AMSL)	Water Elevation (feet/AMSL)
L17MWS07	[redacted]	[redacted]	6.80	9.42	2.62
L17MWS10			6.41	8.97	2.56
L17MWS15			6.56	9.06	2.50

AMSL = above mean sea level BTOC = below top of casing

Table 2 Environmental Samples Collected at Space Launch Complex 17

Sample Identifier	Matrix	Sample Interval (feet/bgs)	Purpose/Location
SLC17-MW-S07-000	Groundwater	NA	Determine if PFCs are present in the shallow groundwater. Sample collected from monitoring well L17-MWS07, screened at shallow depth and situated between the launch pads, downgradient of the south deluge basin.
SLC17-MW-S10-000/ SLC17-MW-S10-900 (Field Duplicate)	Groundwater	NA	Determine if PFCs are present in the shallow groundwater. Sample collected from monitoring well LMWS10, screened at shallow depth and downgradient of the north deluge basin.
SLC17-MW-S15-000	Groundwater	NA	Determine if PFCs are in the shallow groundwater. Sample collected from monitoring well L17-MWS15, screened at shallow depth and situated between the launch pads, downgradient of the launch complex.
SLC17-SB-001-005/ SCL17-SB-001-905 (Field Duplicate)	Soil	4-5	Determine if PFCs remain in the subsurface soil above the vadose zone. Sample collected from just above the first water-saturated zone in the soil boring adjacent to the drainage point of the north deluge basin.
SLC17-SB-002-005	Soil	4-5	Determine if PFCs remain in the subsurface soil above the vadose zone. Sample collected from just above the first water-saturated zone in the soil boring adjacent to the drainage point of the south deluge basin.
SLC17-SB-003-005	Soil	4-5	Determine if PFCs remain in the subsurface soil above the vadose zone. Sample collected from just above the first water-saturated zone in a soil boring at the center of a reported area of foam release.
SLC17-SB-004-005	Soil	4-5	Determine if PFCs remain in the subsurface soil above the vadose zone. Sample collected from just above the first water-saturated zone in a soil boring at the center of a reported area of foam release.
SLC17-SD-001-001/ SLC17-SD-001-901 (Field Duplicate)	Sediment	0-1	Determine if PFCs remain in the sediments contained in the deluge basin. Sample collected at the drainage point of the south basin. Co-located with surface water sample.
SLC17-SD-002-001	Sediment	0-1	Determine if PFCs remain in the sediments contained in the deluge basin. Sample collected at the drainage point of the north basin.
SLC17-SW-001-000/ SLC17-SW-001-900 (Field Duplicate)	Surface Water	0-1	Determine if PFCs remain in the surface water standing in the deluge basins. Sample collected at the drainage point of the south basin. Co-located with sediment sample.

bgs = below ground surface NA = not applicable
PFC = perfluorinated chemical or compound

Table 3 Perfluorinated Chemicals or Compounds Detected in Groundwater Samples at SLC 17

Sample Number			SLC17-MW-S07-000		SLC17-MW-S10-000		SLC17-MW-S10-900 (Field Duplicate)		SLC17-MW-S15-000	
Analyte	CAS	EPA PHA (µg/L)	Result (µg/L)	Reporting Limit (µg/L)	Result (µg/L)	Reporting Limit (µg/L)	Result (µg/L)	Reporting Limit (µg/L)	Result (µg/L)	Reporting Limit (µg/L)
Perfluorobutanoic acid (PFBA)	375-22-4	NL	0.0098 U	0.0096	0.0098 U	0.0096	0.0097 U	0.0095	0.010 J	0.0094
Perfluoroheptanoic acid (PFHpA)	375-85-9	NL	0.020 U	0.013	0.020 U	0.013	0.019 U	0.013	0.021 J	0.013
Perfluorohexane sulfonate (PFHxS)	108427-53-8	NL	0.0098 U	0.0068	0.0098 U	0.0068	0.0097 U	0.0067	0.010 J	0.0067
Perfluorohexanoic acid (PFHxA)	307-24-4	NL	0.0063 J	0.0028	0.0083 J	0.0029	0.012 J	0.0028	0.021	0.0028
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.2	0.020 UJ	0.013	0.028 J	0.013	0.019 J	0.013	0.12 J	0.013
Perfluorooctanoic acid (PFOA)	335-67-1	0.4	0.013 J	0.0096	0.074	0.0096	0.077	0.0095	0.24	0.0094
Perfluoropentanoic acid (PFPA)	2706-90-3	NL	0.0098 U	0.011	0.0098 U	0.011	0.0097 U	0.011	0.010 J	0.01

Note: Shaded values indicate analyte not detected at the Method Detection Limit.
µg/L = micrograms per liter
CAS = Chemical Abstract Service
EPA = United States Environmental Protection Agency
J = estimated value
NL = not listed; an EPA PHA value has not been established for this analyte
PHA = Provisional Health Advisory. EPA Memorandum, October 2009.
U = analyte not detected
UJ = analyte not detected; associated with an estimated value

Table 4 Perfluorinated Chemicals or Compounds Detected in Sediment Samples at SLC 17

Sample Number			SLC17-SD-001-001		SLC17-SD-001-901 (Field Duplicate)		SLC17-SD-002-001	
Analyte	**CAS**	**EPA RSSL (µg/kg)**	**Result (µg/kg)**	**Reporting Limit (µg/kg)**	**Result (µg/kg)**	**Reporting Limit (µg/kg)**	**Result (µg/kg)**	**Reporting Limit (µg/kg)**
Perfluorobutanoic acid (PFBA)	375-22-4	NL	11.0 J	0.46	17 J	0.67	4.2 UJ	0.85
Perfluoroheptanoic acid (PFHpA)	375-85-9	NL	2.3 UJ	0.46	0.90 J	0.67	1.8 J	0.85
Perfluorohexanoic acid (PFHxA)	307-24-4	NL	0.85 J	0.57	1.6 J	0.84	4.2 UJ	1.1
Perfluorooctane sulfonate (PFOS)	1763-23-1	6,000	2.3 U	0.54	0.90 J	0.78	4.2 U	0.99
Perfluorooctanoic acid (PFOA)	335-67-1	16,000	9.1 J	0.88	15 J	1.3	20 J	1.6

Note: Shaded values indicate analyte not detected at the Method Detection Limit.
µg/kg = micrograms per kilogram
EPA = United States Environmental Protection Agency
NL = not listed; an EPA RSSL value has not been established for this analyte
U = Analyte not detected
CAS = Chemical Abstract Service
J = estimated value.
RSSL = Residential Soil Screening Level. EPA Memorandum, November 2009.
UJ = Analyte not detected. Associated with an estimated value.

Table 5 Perfluorinated Chemicals or Compounds Detected in Surface Water Samples at SLC 17

Sample Number			SLC17-SW-001-000		SLC17-SW-001-900 (Field Duplicate)	
Analyte	**CAS**	**EPA PHA (µg/L)**	**Result (µg/L)**	**Reporting Limit (µg/L)**	**Result (µg/L)**	**Reporting Limit (µg/L)**
Perfluorobutanoic acid (PFBA)	375-22-4	NL	0.12	0.0095	0.091	0.0094
Perfluoroheptanoic acid (PFHpA)	375-85-9	NL	0.10	0.013	0.099	0.013
Perfluorohexane sulfonate (PFHxS)	108427-53-8	NL	0.0097 U	0.0068	0.0071 J	0.0067
Perfluorohexanoic acid (PFHxA)	307-24-4	NL	0.12	0.0028	0.12	0.0028
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.2	0.020 J	0.013	0.019 UJ	0.013
Perfluorooctanoic acid (PFOA)	335-67-1	0.4	**0.74 J**	0.0095	**0.70**	0.0094
Perfluoropentanoic acid (PFPA)	2706-90-3	NL	0.021 J	0.011	0.022 J	0.011

Note: Shaded values indicate analyte not detected at the Method Detection Limit. BOLD values exceed the corresponding screening value.

µg/L = micrograms per liter
CAS = Chemical Abstract Service
EPA = United States Environmental Protection Agency
J = Estimated value.
NL = not listed; an EPA PHA value has not been established for this analyte
PHA = Provisional Health Advisory. EPA Memorandum, October 2009.
U = analyte not detected

VZ Technologies LLC
14640 Hangar Rd, Suite 2306
Patrick AFB, FL 32925
Phone: 321-853-6951

14 Nov 16
SP16-130

ATTENTION: Patrick Giniewski, 45 CES/CEI
Patrick.Giniewski@us.af.mil

SUBJECT: **Cape Canaveral Air Force Station (CCAFS) Regional Wastewater Treatment Facility (WWTF) Percolation Pond Groundwater Monitoring for PFOS and PFOA**

1. Introduction: On 19 Oct 16 and 20 Oct 16, sampling of all ten groundwater monitoring wells at the percolation ponds for the subject facility was conducted by Robin Carter and Travis Young, VZ Technologies, LLC.

2. Methodology: Prior to groundwater samples being obtained, each of the monitoring wells were purged with a Geopump II Peristaltic Pump with Easy-Load head and dedicated well tubing with disposable pump head tubing for each monitoring well. Water levels were recorded from each of the monitoring wells using a Heron Water Level Meter. During purging activities, field parameter measurements were measured using a YSI Professional Plus pH/salinity/dissolved oxygen/conductivity/temperature meter, and a Hanna Model 93414 Turbidity meter. Monitoring well purge activities and field parameter measurements were conducted in accordance with FDEP Standard Operating Procedures, dated July 2014 (DEP-SOP-001/01). All field equipment was properly calibrated and/or verified prior to use in the field. Groundwater samples were collected, placed on wet ice, and submitted under chain-of-custody documentation to the subcontracted laboratory Accutest.

3. Results: The monitoring well numbers and analytical laboratory results are summarized in Table 1.

4. Documentation: Attached are copies of the laboratory analysis results and groundwater sampling logs for you information and files. Also included is a short customer feedback form. We appreciate your comments about our service, so please complete and return the survey to us. Should there be any questions concerning this report or the attachments, contact Travis Young at (321) 890-7532.

Richard B. Davis, PE
Program/Contract Manager
Environmental Support Contract III

Attachments: a/s

cc: J. Tarantine, John.Tarantine@us.af.mil, 45 CES/CEIE
D. May, Darren.May.ctr@us.af.mil, ESC
J. Barnes, Joan.Barnes@us.af.mil, 45 CES CEOE

Table 1 Analytical Laboratory Results

Parameter	Units	MW-1	MW-3	MW-5R	MW-6	MW-7	MW-9	MW-10	MW-11	MW-12	MW-13
Perfluoroalkylcarboxylic Acids											
Perfluoroheptanoic acid	µg/L	0.0077 U	0.0177 I	0.0503	0.0236	0.0300	0.0295	0.0245	0.0163 I	0.0077 U	0.0077 U
Perfluorooctanoic acid		0.0038 U	0.0164 I	0.0409	0.0245	0.0291	0.0254	0.0287	0.0148 I	0.0038 U	0.0038 U
Perfluorononanoic acid		0.0038 U	0.00769 I	0.0199 I	0.0040 U	0.0123 I	0.0130 I	0.0129 I	0.00616 I	0.0038 U	0.0038 U
Perfluoroalkylsulfonates											
Perfluorobutanesulfonic acid	µg/L	0.0077 U	0.0117 I	0.0083 U	0.0080 U	0.0156 I	0.0146 I	0.0145 I	0.0288	0.0077 U	0.0077 U
Perfluorohexanesulfonic acid		0.0178 I	0.185	0.208	0.0660	0.259	0.193	0.171	0.176	0.0077 U	0.00992 I
Perfluorooctanesulfonic acid		0.0477	0.612	0.250	0.285	0.250	0.511	0.472	0.201	0.0038 U	0.0038 U

NOTES

1. **I - Indicates the reported value is between the laboratory method detection limit (MDL) and the practical quantitation limit (PQL).**
2. **U - Indicates that the compound was analyzed for but not detected.**

APPENDIX B

PHOTOGRAPH LOGS

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	**22 May 2017** **11:14** **Photo 1:** AFFF Release Area 1 (Hangar F [redacted] hand augering and soil sample collection at MW01003
	Direction of Photo: **South**

	**22 May 2017** **11:15** **Photo 2:** AFFF Release Area 1 (Hangar F [redacted]); hand augering at MW01003
	Direction of Photo: **East**

	**22 May 2017** **11:15** **Photo 3:** AFFF Release Area 1 (Hangar F [redacted] Soil sample collection at MW01003
	Direction of Photo: **Southwest**

	**22 May 2017** **11:24** **Photo 4:** AFFF Release Area 1 (Hangar F [redacted] DPT drilling at MW01003
	Direction of Photo: **South**

	**22 May 2017** **11:24** **Photo 5:** AFFF Release Area 1 (Hangar F [redacted] DPT drilling, soil sampling via Macro-Core® at MW01003
	Direction of Photo: **West**

	**22 May 2017** **11:24** **Photo 6:** AFFF Release Area 1 (Hangar F [redacted] DPT drilling, soil sampling via Macro-Core® at MW01003
	Direction of Photo: **North**

	**22 May 2017** **12:03** **Photo 7:** AFFF Release Area 1 (Hangar F [redacted] Temporary monitoring well installation at MW01003
	Direction of Photo: **Northwest**

	**22 May 2017** **12:52** **Photo 8:** AFFF Release Area 1 (Hangar F [redacted] DPT drilling at MW01002
	Direction of Photo: **South**

	**22 May 2017** **13:00** **Photo 9:** AFFF Release Area 1 (Hangar F [redacted] Well development at MW01003
	Direction of Photo: **South**

	**22 May 2017** **13:25** **Photo 10:** AFFF Release Area 1 (Hangar F [redacted] DPT drilling at MW01002
	Direction of Photo: **Southeast**

	**22 May 2017** **13:32** **Photo 11:** AFFF Release Area 1 (Hangar F [redacted] Borehole after abandonment at MW01002
	Direction of Photo: **Northwest**

APPENDIX C

FIELD FORMS

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APPENDIX C-1

FIELD ACTIVITY DAILY LOGS

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FIELD ACTIVITY DAILY LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Investigation Area:**	AFFF Release Area 1
Weather:	Cloudy, 10-15 mph winds, upper 80s	**Date and Time:**	05/22/17 2249
Technician(s):	Jason Hayes, Jason Drizd		

Description of Daily Activities and Events:

0730-arrived at Cape Canaveral Visitor Center. Met personnel from AmDrill., 0915-all personnel were finally approved to get passes and proceeded to AFFF Area 1., 0920-John Langett arrived on-site., 0930-conducted tailgate safety meeting and completed pfc protocol checklist., 0950-AmDrill started decon of all tooling and the rig itself. AmecFW personnel calibrated both PID, turbidity, and YSI., 1000-John Langett left site., 1030-all equipment was calibrated within acceptable ranges, 1110-Started hand augering at MW01003, 1115-took sample CAPEC01-SO-005, 1120-took sample CAPEC01-SO-006, 1125-took sample CAPEC-FD-SO-001. FD was taken at MW01003, 3-4 foot interval., 1200-completed MW01003, set up to develop well. AmDrill set up to decon all tooling., 1215-started hand augering at MW01002, 1225-took sample CAPEC01-SO-003, 1230-took sample CAPEC01-SO-004, 1230-finished development of MW01003, 1335-completed MW01002, set up to develop well. AmDrill set up to decon all tooling., 1355-started hand augering at MW01001, 1405-took sample CAPEC01-SO-001, 1415-took sample CAPEC01-SO-002. An MS/MSD was taken at the 3-4 foot interval., 1415-finished development of MW01002, 1500-completed MW01001, set up to develop well. AmDrill set up to decon all tooling., 1530-took sample CAPEC01-SD-001. An MS/MSD and FD was taken at this location, 1540-finished development of MW01001, 1545-took sample CAPEC-EB-001 from shoe of DPT rod tooling., 1550-took sample CAPEC-FB-001, 1600-left Cape Canaveral to go to Patrick AFB.,

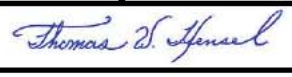
List Samples Collected:

CAPEC01-SO-005, CAPEC01-SO-006, CAPEC-FD-SO-001, CAPEC01-SO-003, CAPEC01-SO-004, CAPEC01-SO-001, CAPEC01-SO-002,, CAPEC01-SD-001, CAPEC-FD-SD-001, CAPEC-EB-001, CAPEC-FB-001

Deviation from Plans:

None

Visitors on Site:	**Important Telephone Calls / Photos Taken:**	**Signature:**
John Langett	None	
		Name (print): Jason Hayes

QA/QC'd by: **Thomas W. Hensel**  **QA/QC Date:** **6/14/2017**

FIELD ACTIVITY DAILY LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Investigation Area:**	AFFF Release Area 1
Weather:	Cloudy, windy, upper 80s	**Date and Time:**	05/24/17 1828
Technician(s):	Jason Hayes, Jason Drizd		

Description of Daily Activities and Events:

0630-arrived at Patrick AFB., 0641-began calibrating gw sampling equipment., 0656-complete calibration of gw sampling equipment., 0700-conducted tailgate safety meeting , 0705-Jason Drizd (JD) left for Cape Canaveral AFS to conduct groundwater sampling., 0830-arrive at Cape Canaveral AFS AFFF Area 1., 0930-begin purging MW01001., 1020-finish purging MW01001., 1026-finish sampling MW01001., 1028-begin purging MW01002., 1108-finish purging MW01002., 1110-finish sampling MW01002., 1116-begin purging MW01003., 1156-finish purging MW01003., 1158-finish sampling MW01003., 1125-AmecFW and AmDrill personnel arrived at Cape Canaveral AFS to start abandonment of MW01001 to MW01003., 1430-completed abandonment of all wells at Cape Canaveral AFS. All waste was mobilized to designated staging area as directed by John Langett. Mobilized back to Patrick AFB.

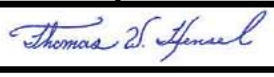
List Samples Collected:

CAPEC01-GW-001, CAPEC01-GW-002, CAPEC01-GW-003, CAPEC-FD-GW-001

Deviation from Plans:

None

Visitors on Site:	**Important Telephone Calls / Photos Taken:**	**Signature:**
None	None	 **Name** (print): Jason Hayes

QA/QC'd by: **Thomas W. Hensel**  **QA/QC Date:** **6/14/2017**

FIELD ACTIVITY DAILY LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Investigation Area:**	AFFF Release Area 1
Weather:	Clear calm, mid 80s	**Date and Time:**	05/25/17 1800
Technician(s):	Jason Hayes, Jason Drizd		

Description of Daily Activities and Events:

0800-conducted tailgate safety meeting and completed pfc protocol checklist., 0900-collected Solid IDW sample (CAPEC-Solid IDW)., 1000-left site., 1330-Gary Kihn and Jason Hayes arrived at Cape Canaveral AFS to get base specific labels for IDW., 1410-Gary Kihn and Jason Hayes left site., 1700-arrived at Cape Canaveral AFS and collected Liquid IDW sample (CAPEC-Liquid IDW)., 1715-verified all drums were labeled properly with base specific labels. A total of 4 drums of IDW were left at Cape Canaveral AFS; 1 was drill cuttings, 3 were liquid waste from purge water and decon water., 1720-Jason Drizd and Jason Hayes left site to travel home.

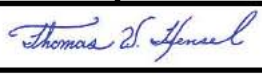
List Samples Collected:

CAPEC-Solid IDW, CAPEC-Liquid IDW

Deviation from Plans:

None

Visitors on Site:	**Important Telephone Calls / Photos Taken:**	**Signature:**
None	None	
		Name (print): Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/16/2017

APPENDIX C-2

DAILY PFAS PROTOCOL CHECKLISTS

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ATTACHMENT 1 TO SOP AFW-01
DAILY PFAS PROTOCOL CHECKLIST

amec foster wheeler

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101 0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Weather (temp./precipitation):**	Cloudy, 10-15 mph winds, upper 90s
Site/Area Name:	AFFF Release Area 1		
Field Manager:	Jason Hayes	**Date and Time:**	05/22/17 0931

Field Clothing and PPE (as applicable):

- [x] Field crew in compliance with Tables 1 and 2, SOP AFW-01
- [x] Field crew has not used fabric softener on clothing
- [ ] Field crew has not used cosmetics, moisturizers, hand cream, or other related products or exposed body parts this morning
- [x] Field crew has not applied unacceptable sunscreen or insect repellant

Field Equipment:

- [ ] No Teflon® containing materials on-site
- [x] All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene
- [x] No waterproof field books on-site other than Rite-in-the-Rain® Products
- [x] No plastic clipboards, binders, or spiral hard cover notebooks on-site
- [x] No adhesives (Post-it® Notes) on-site
- [x] Coolers filled with regular ice only. No chemical (blue) ice packs in possession

Sample Containers:

- [x] All sample containers made of HDPE or polypropylene. Samples are not stored in containers made of LDPE
- [x] Caps are lined or unlined and made of HDPE or polypropylene

Wet Weather (as applicable):

- [x] For personnel in direct contact with samples and/or sampling equipment, wet weather gear made of Vinyl, polyurethane, PVC, latex or rubber-coated materials only

Equipment Decontamination:

- [x] "PFAS-free" water on-site for decontamination of sample equipment
- [x] Alconox and Liquinox to be used as decontamination materials

Food Considerations:

- [x] No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the investigation area or removal of worker offsite until in compliance. Repeated failure to comply with PFAS sample protocols will result in the permanent removal of worker(s) from the investigation area.

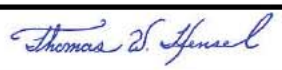
Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

None

Signature:

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

ATTACHMENT 1 TO SOP AFW-01
DAILY PFAS PROTOCOL CHECKLIST

amec foster wheeler

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101 0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Weather (temp./precipitation):**	Cloudy, windy, mid 80s, chance of rain in the afternoon
Site/Area Name:	AFFF Release Area 1		
Field Manager:	Jason Hayes	**Date and Time:**	05/24/17 0700

Field Clothing and PPE (as applicable):

- [x] Field crew in compliance with Tables 1 and 2, SOP AFW-01
- [x] Field crew has not used fabric softener on clothing
- [ ] Field crew has not used cosmetics, moisturizers, hand cream, or other related products or exposed body parts this morning
- [x] Field crew has not applied unacceptable sunscreen or insect repellant

Field Equipment:

- [ ] No Teflon® containing materials on-site
- [x] All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene
- [x] No waterproof field books on-site other than Rite-in-the-Rain® Products
- [x] No plastic clipboards, binders, or spiral hard cover notebooks on-site
- [x] No adhesives (Post-it® Notes) on-site
- [x] Coolers filled with regular ice only. No chemical (blue) ice packs in possession

Sample Containers:

- [x] All sample containers made of HDPE or polypropylene. Samples are not stored in containers made of LDPE
- [x] Caps are lined or unlined and made of HDPE or polypropylene

Wet Weather (as applicable):

- [x] For personnel in direct contact with samples and/or sampling equipment, wet weather gear made of Vinyl, polyurethane, PVC, latex or rubber-coated materials only

Equipment Decontamination:

- [x] "PFAS-free" water on-site for decontamination of sample equipment
- [x] Alconox and Liquinox to be used as decontamination materials

Food Considerations:

- [x] No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the investigation area or removal of worker offsite until in compliance. Repeated failure to comply with PFAS sample protocols will result in the permanent removal of worker(s) from the investigation area.

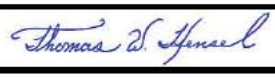
Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

None

Signature:

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

ATTACHMENT 1 TO SOP AFW-01
DAILY PFAS PROTOCOL CHECKLIST

amec foster wheeler

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101 0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Weather (temp./precipitation):**	Cloudy calm mid 80s
Site/Area Name:	AFFF Release Area 1		
Field Manager:	Jason Hayes	**Date and Time:**	05/25/17 0800

Field Clothing and PPE (as applicable):

- [x] Field crew in compliance with Tables 1 and 2, SOP AFW-01
- [x] Field crew has not used fabric softener on clothing
- [ ] Field crew has not used cosmetics, moisturizers, hand cream, or other related products or exposed body parts this morning
- [x] Field crew has not applied unacceptable sunscreen or insect repellant

Field Equipment:

- [ ] No Teflon® containing materials on-site
- [x] All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene
- [x] No waterproof field books on-site other than Rite-in-the-Rain® Products
- [x] No plastic clipboards, binders, or spiral hard cover notebooks on-site
- [x] No adhesives (Post-it® Notes) on-site
- [x] Coolers filled with regular ice only. No chemical (blue) ice packs in possession

Sample Containers:

- [x] All sample containers made of HDPE or polypropylene. Samples are not stored in containers made of LDPE
- [x] Caps are lined or unlined and made of HDPE or polypropylene

Wet Weather (as applicable):

- [x] For personnel in direct contact with samples and/or sampling equipment, wet weather gear made of Vinyl, polyurethane, PVC, latex or rubber-coated materials only

Equipment Decontamination:

- [x] "PFAS-free" water on-site for decontamination of sample equipment
- [x] Alconox and Liquinox to be used as decontamination materials

Food Considerations:

- [x] No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the investigation area or removal of worker offsite until in compliance. Repeated failure to comply with PFAS sample protocols will result in the permanent removal of worker(s) from the investigation area.

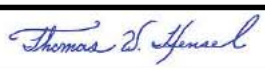
Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

None

Signature:

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/15/2017

APPENDIX C-3

TAILGATE SAFETY MEETING REPORTS

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TAILGATE SAFETY MEETING REPORT

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date and Time:**	05/22/17 0915
Field Manager Name:	Jason Hayes	**Site Health and Safety Officer (HSO):**	Jason Hayes
Safety Meeting Type:	Initial Kickoff Tailgate Safety Meeting		

Order of Business

Topics Discussed (check all that apply)

- ☑ Site History/Site Layout
- ☑ Scope of Work
- ☑ Personnel Responsibilities
- ☑ Medical Surveillance Requirements
- ☑ Training Requirements
- ☑ Safe Work Practices
- ☑ Logs, Reports, Recordkeeping
- ☑ Sanitation and Illumination
- ☑ Air Surveillance Type and Frequency
- ☑ Monitoring Instruments and Personal Monitoring
- ☑ Action Levels
- ☑ Accident Reporting Procedures
- ☑ Site Control (visitor access, buddy system, work zones, security, communications)
- ☑ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
- ☑ Engineering Controls
- ☑ PPE Required/PPE Used
- ☑ Define PPE Levels, Donning, Doffing Procedures
- ☑ Physical Hazards and Controls (e g., overhead utility lines)
- ☑ Decontamination Procedures for Personnel and Equipment
- ☑ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
- ☑ Site/Regional Emergency Procedures (e.g. earthquake response, typhoon response, etc.)
- ☑ Medical Emergency Response Procedures (e.g., exposure control precautions, location of first aid kit, etc.)
- ☑ Hazardous Materials Spill Procedures
- ☑ Applicable SOPs (e.g., Hearing Conservation Program, Safe Driving, etc.)
- ☑ Injury/Illness Reporting Procedures
- ☑ Route to Hospital and Medical Care Provider Visit Guidelines
- ☑ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)
- ☑ Review AHAs with all parties engaged in the activity (EM-385 1-1, para 01.A.13.b)

Safety suggestions by site workers:	Watch work around rig
Action taken on previous suggestions:	Communicate with drillers before approaching rig
Injuries/accidents/personnel changes since previous meeting:	NA
Observations of unsafe work practices/conditions that have developed since previous meeting:	None
Location of (or changes in the locations of) evacuation routes/safe refuge areas:	Equipment lay-down yard
Other Safety Topics Discussed:	None
Additional comments:	None

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Attendee Name (print)	Company	Signature	Attendee Name (print)	Company	Signature
Jason Hayes	Amec FW				
Jason Drizd	Amec FW				
Gary Kihn	Amec FW				
Todd Ives	AmDrill, Inc.				
Keith Anderson	AmDrill, Inc.				
John Langett	AFCEC/CZOE				

Meeting Conducted By (print)	**Company and Title**	**Signature**
Jason Hayes	Amec FW - Field Manager	

QA/QC'd by: Thomas W. Hensel **QA/QC Date:** 6/14/2017

TAILGATE SAFETY MEETING REPORT

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date and Time:**	05/24/17 0700
Field Manager Name:	Jason Hayes	**Site Health and Safety Officer (HSO):**	Jason Hayes
Safety Meeting Type:	Regular/Daily Tailgate Safety Meeting		

Order of Business

Topics Discussed (check all that apply)

- ☑ Site History/Site Layout
- ☑ Scope of Work
- ☑ Personnel Responsibilities
- ☑ Medical Surveillance Requirements
- ☑ Training Requirements
- ☑ Safe Work Practices
- ☑ Logs, Reports, Recordkeeping
- ☑ Sanitation and Illumination
- ☑ Air Surveillance Type and Frequency
- ☑ Monitoring Instruments and Personal Monitoring
- ☑ Action Levels
- ☑ Accident Reporting Procedures
- ☑ Site Control (visitor access, buddy system, work zones, security, communications)
- ☑ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
- ☑ Engineering Controls
- ☑ PPE Required/PPE Used
- ☑ Define PPE Levels, Donning, Doffing Procedures
- ☑ Physical Hazards and Controls (e g., overhead utility lines)
- ☑ Decontamination Procedures for Personnel and Equipment
- ☑ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
- ☑ Site/Regional Emergency Procedures (e.g. earthquake response, typhoon response, etc.)
- ☑ Medical Emergency Response Procedures (e.g., exposure control precautions, location of first aid kit, etc.)
- ☑ Hazardous Materials Spill Procedures
- ☑ Applicable SOPs (e.g., Hearing Conservation Program, Safe Driving, etc.)
- ☑ Injury/Illness Reporting Procedures
- ☑ Route to Hospital and Medical Care Provider Visit Guidelines
- ☑ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)
- ☑ Review AHAs with all parties engaged in the activity (EM-385 1-1, para 01.A.13.b)

Safety suggestions by site workers:	Weather may be in the area
Action taken on previous suggestions:	Listen for warning calls from the base
Injuries/accidents/personnel changes since previous meeting:	None
Observations of unsafe work practices/conditions that have developed since previous meeting:	None
Location of (or changes in the locations of) evacuation routes/safe refuge areas:	Equipment lay-down yard
Other Safety Topics Discussed:	None
Additional comments:	None

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Attendee Name (print)	Company	Signature	Attendee Name (print)	Company	Signature
Jason Hayes	Amec FW				
Jason Drizd	Amec FW				
Gary Kihn	Amec FW				
Todd Ives	AmDrill, Inc.				
Keith Anderson	AmDrill, Inc.				

Meeting Conducted By (print)	**Company and Title**	**Signature**
Jason Hayes	Amec FW - Field Manager	

QA/QC'd by: Thomas W. Hensel **QA/QC Date:** 6/14/2017

TAILGATE SAFETY MEETING REPORT

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date and Time:**	05/25/17 0800
Field Manager Name:	Jason Hayes	**Site Health and Safety Officer (HSO):**	Jason Hayes
Safety Meeting Type:	Regular/Daily Tailgate Safety Meeting		

Order of Business

Topics Discussed (check all that apply)

- ☑ Site History/Site Layout
- ☑ Scope of Work
- ☑ Personnel Responsibilities
- ☑ Medical Surveillance Requirements
- ☑ Training Requirements
- ☑ Safe Work Practices
- ☑ Logs, Reports, Recordkeeping
- ☑ Sanitation and Illumination
- ☑ Air Surveillance Type and Frequency
- ☑ Monitoring Instruments and Personal Monitoring
- ☑ Action Levels
- ☑ Accident Reporting Procedures
- ☑ Site Control (visitor access, buddy system, work zones, security, communications)
- ☑ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
- ☑ Engineering Controls
- ☑ PPE Required/PPE Used
- ☑ Define PPE Levels, Donning, Doffing Procedures
- ☑ Physical Hazards and Controls (e g., overhead utility lines)
- ☑ Decontamination Procedures for Personnel and Equipment
- ☑ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
- ☑ Site/Regional Emergency Procedures (e.g. earthquake response, typhoon response, etc.)
- ☑ Medical Emergency Response Procedures (e g., exposure control precautions, location of first aid kit, etc.)
- ☑ Hazardous Materials Spill Procedures
- ☑ Applicable SOPs (e g., Hearing Conservation Program, Safe Driving, etc.)
- ☑ Injury/Illness Reporting Procedures
- ☑ Route to Hospital and Medical Care Provider Visit Guidelines
- ☑ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)
- ☑ Review AHAs with all parties engaged in the activity (EM-385 1-1, para 01.A.13 b)

Safety suggestions by site workers:	Be aware of hazards
Action taken on previous suggestions:	Notify all personnel of potential hazards noticed onsite
Injuries/accidents/personnel changes since previous meeting:	None
Observations of unsafe work practices/conditions that have developed since previous meeting:	None
Location of (or changes in the locations of) evacuation routes/safe refuge areas:	Equipment lay-down yard
Other Safety Topics Discussed:	None
Additional comments:	None

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Attendee Name (print)	Company	Signature	Attendee Name (print)	Company	Signature
Jason Hayes	Amec FW				
Jason Drizd	Amec FW				
Gary Kihn	Amec FW				

Meeting Conducted By (print)	**Company and Title**	**Signature**
Jason Hayes	Amec FW - Field Manager	

QA/QC'd by: Thomas W. Hensel **QA/QC Date: 6/15/2017**

APPENDIX C-4

SOIL BORING/MONITORING WELL RECORDS

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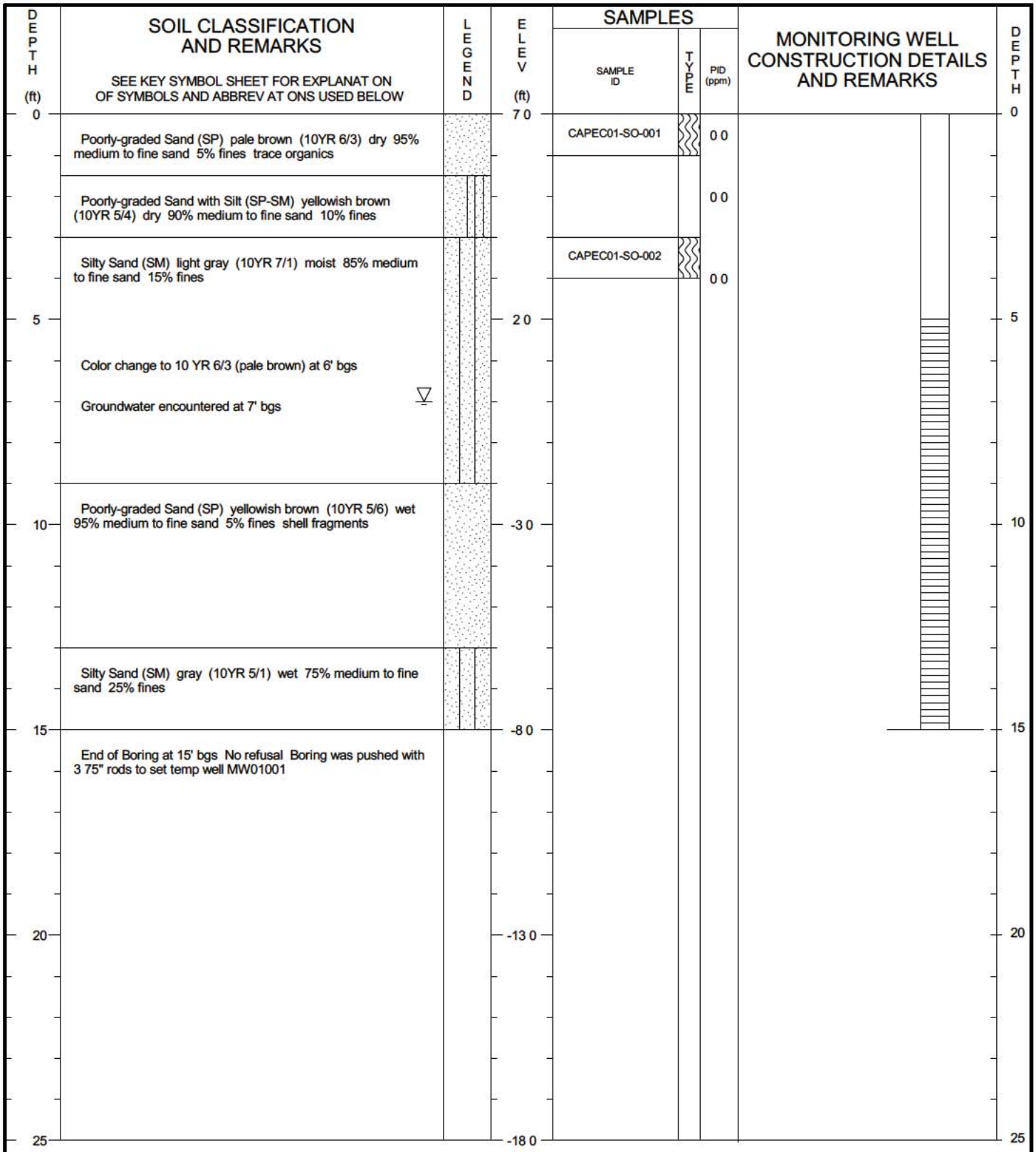


START DATE	5/22/2017	TOC ELEVAT ON	6 97 ft
END DATE	5/22/2017	GROUND ELEVAT ON	6 97 ft
DR LLER	AmDrill	VERT CAL DATUM	NAVD88
EQU PMENT	Geoprobe 6625CPT	NORTH NG	[redacted]
METHOD	Geoprobe Direct Push	EAST NG	[redacted]
HOLE D A	4-inch	HOR ZONTAL DATUM	FL State Plane
S TE	Cape Canaveral AFS Area 1		
LOGGED BY	J Hayes		

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: PFAS Release Area Site Investigation

Project No: 775303101.0007.0400

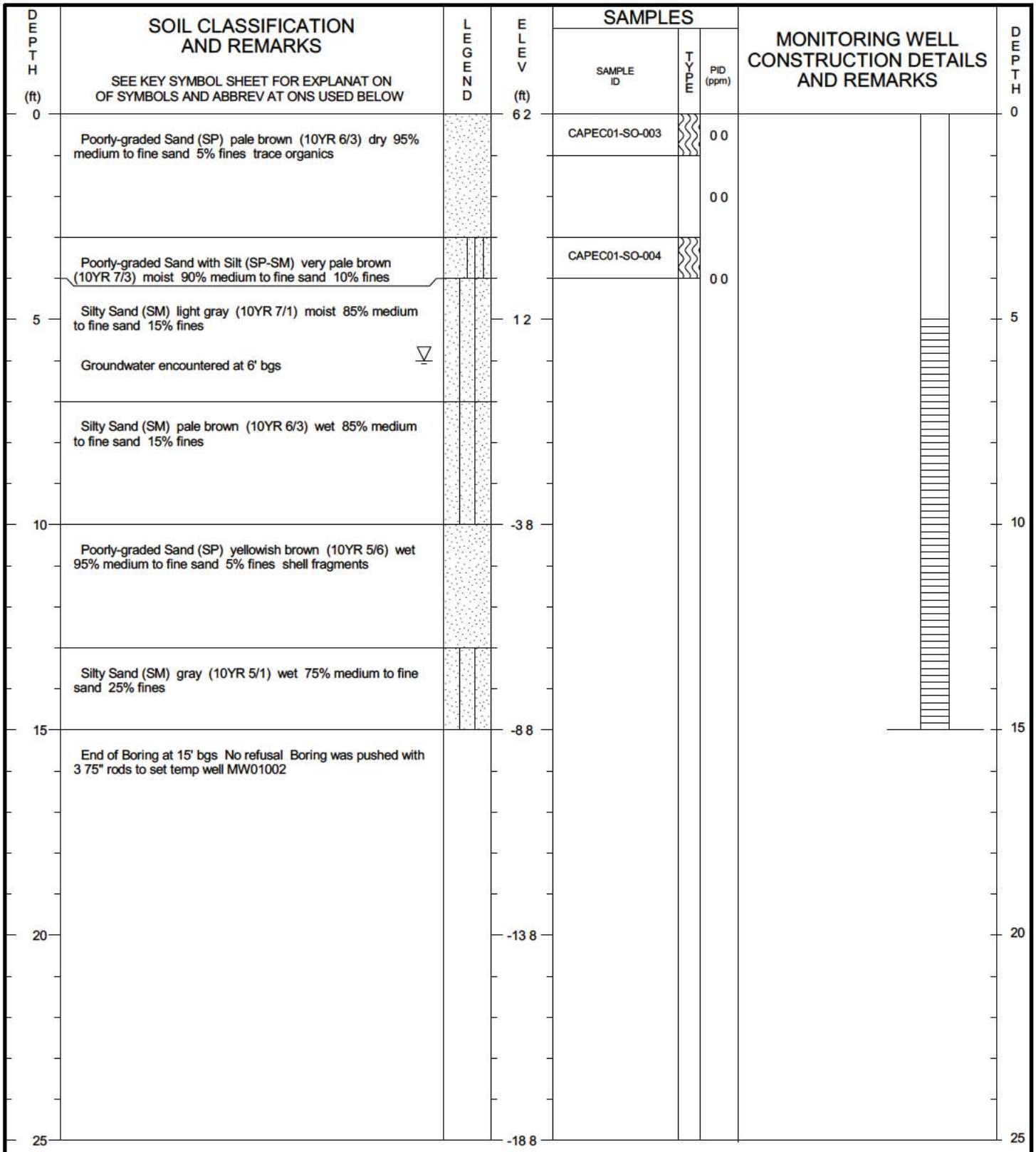
Checked By: T. Hensel

Well No. MW01001

amec foster wheeler

2030 Fa ng Waters Road
Su te 300
Knoxv e, TN 37922

AMEC SO L-ROCK-MWELL ENV 02 CAPE O 0004 GPJ AMECFW EMPLA E GD 7/18/17



START DATE	5/22/2017	TOC ELEVAT ON	6 19 ft
END DATE	5/22/2017	GROUND ELEVAT ON	6 19 ft
DR LLER	AmDrill	VERT CAL DATUM	NAVD88
EQU PMENT	Geoprobe 6625CPT	NORTH NG	[redacted]
METHOD	Geoprobe Direct Push	EAST NG	
HOLE D A	4-inch	HOR ZONTAL DATUM	FL State Plane
S TE	Cape Canaveral AFS Area 1		
LOGGED BY	J Hayes		

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: PFAS Release Area Site Investigation

Project No: 775303101.0007.0400

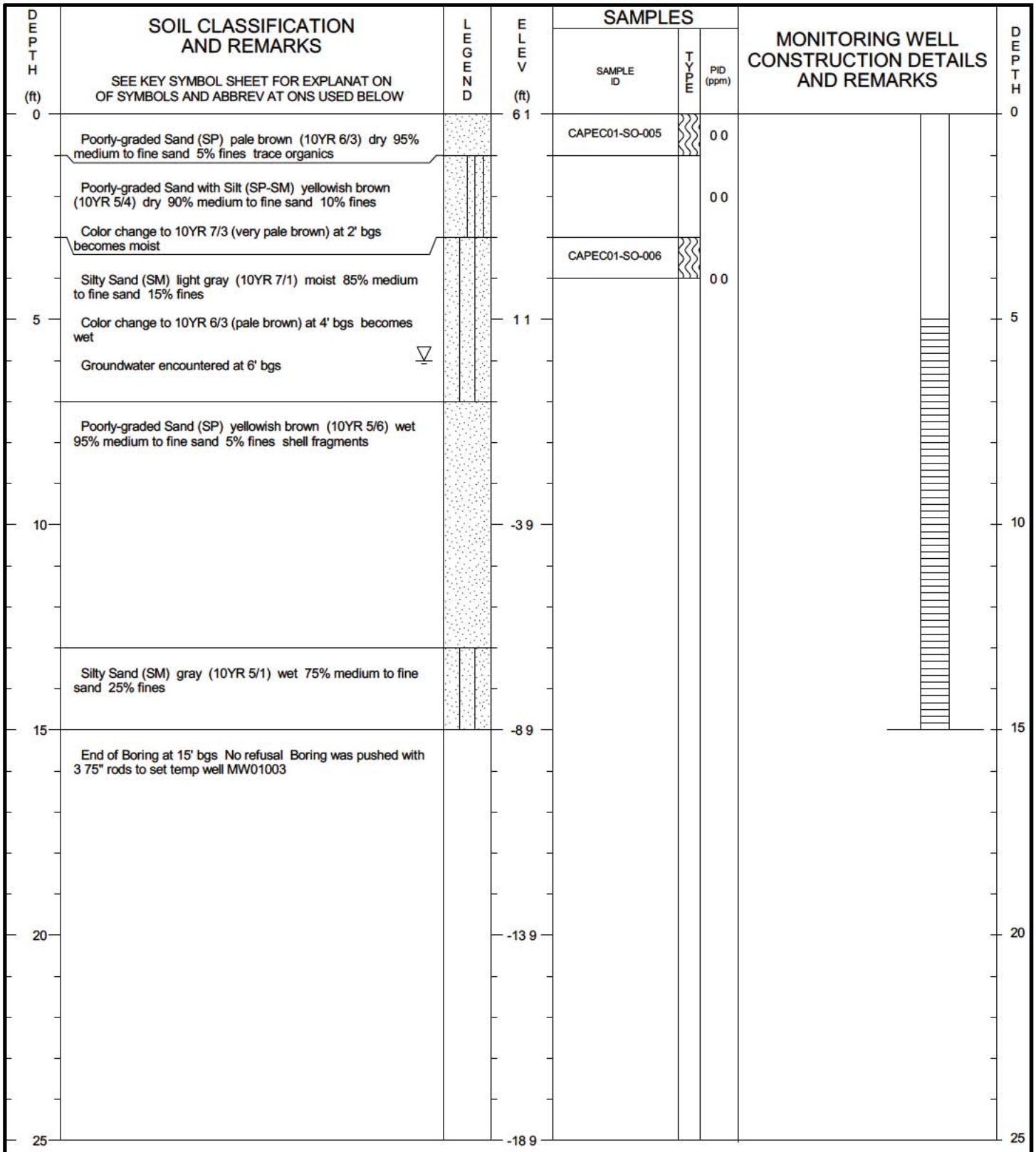
Checked By: T. Hensel

Well No. MW01002

amec foster wheeler

2030 Fa ng Waters Road
Su te 300
Knoxv e, TN 37922

AMEC SO L-ROCK-MWELL ENV 02 CAPE O 0004 GPJ AMECFW EMPLA E GD 7/18/17



START DATE	5/22/2017	TOC ELEVAT ON	6 11 ft
END DATE	5/22/2017	GROUND ELEVAT ON	6 11 ft
DR LLER	AmDrill	VERT CAL DATUM	NAVD88
EQU PMENT	Geoprobe 6625CPT	NORTH NG	[redacted]
METHOD	Geoprobe Direct Push	EAST NG	[redacted]
HOLE D A	4-inch	HOR ZONTAL DATUM	FL State Plane
S TE	Cape Canaveral AFS Area 1		
LOGGED BY	J Hayes		

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: PFAS Release Area Site Investigation

Project No: 775303101.0007.0400

Checked By: T. Hensel

Well No. MW01003

amec foster wheeler

2030 Fa ng Waters Road
Su te 300
Knoxv e, TN 37922

AMEC SO L-ROCK-MWELL ENV 02 CAPE O 0004 GPJ AMECFW EMPLA E GD 7/18/17

APPENDIX C-5

SOIL SAMPLE COLLECTION LOGS

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SOIL SAMPLE COLLECTION LOG

Project Name	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number**	775303101.0007
Contract	FA8903-16-D-0027	**Task Order**	0004
Installation	Cape Canaveral AFS (CAPEC)	**Start Date**	05/22/17
Location ID	MW01001	**End Date**	05/22/17
Technician(s)	Jason Hayes, Jason Drizd		

Sample ID	Sample Date/Time	Sample Depth (ft)	USCS Symbol	Comments/Observations
CAPEC01-SO-001	05/22/17 1405	0 - 0.5	SP	None
CAPEC01-SO-002	05/22/17 1415	3 - 4	SM	None

Sample Collection Method	Grab	**Analysis/Method(s)**	PFAS (Modified USEPA 537)
Sample Container Type(s)	4 oz HDPE	**Preservative(s)**	Ice (4 C)

Associated Blank Samples:

MS/MSD taken with sample

Signature

Notes:

A soil sample was also collected from the surface interval (0-0.5') and subsurface interval (3-4') and composited with surface and subsurface soil samples from the remaining borings at AFFF Release Area 1 (MW01002 and MW01003) for laboratory analysis of TOC (Lloyd-Kahn/USEPA Method 9060A), pH (USEPA Method 9045C), and particle size analysis (ASTM D422). The resulting sample IDs for the surface and subsurface soil samples were CAPEC01-(0-1) and CAPEC01-(3-4), respectively.

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

SOIL SAMPLE COLLECTION LOG

Project Name	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number**	775303101.0007
Contract	FA8903-16-D-0027	**Task Order**	0004
Installation	Cape Canaveral AFS (CAPEC)	**Start Date**	05/22/17
Location ID	MW01002	**End Date**	05/22/17
Technician(s)	Jason Hayes, Jason Drizd		

Sample ID	Sample Date/Time	Sample Depth (ft)	USCS Symbol	Comments/Observations
CAPEC01-SO-003	05/22/17 1225	0 - 0.5	SP	None
CAPEC01-SO-004	05/22/17 1230	3 - 4	SM	None

Sample Collection Method	Grab	**Analysis/Method(s)**	PFAS (Modified USEPA 537)
Sample Container Type(s)	4 oz HDPE	**Preservative(s)**	Ice (4 C)

Associated Blank Samples:

None

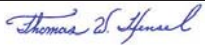
Signature

Notes:

A soil sample was also collected from the surface interval (0-0.5') and subsurface interval (3-4') and composited with surface and subsurface soil samples from the remaining borings at AFFF Release Area 1 (MW01001 and MW01003) for laboratory analysis of TOC (Lloyd-Kahn/USEPA Method 9060A), pH (USEPA Method 9045C), and particle size analysis (ASTM D422). The resulting sample IDs for the surface and subsurface soil samples were CAPEC01-(0-1) and CAPEC01-(3-4), respectively.

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

SOIL SAMPLE COLLECTION LOG

Project Name	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number**	775303101.0007
Contract	FA8903-16-D-0027	**Task Order**	0004
Installation	Cape Canaveral AFS (CAPEC)	**Start Date**	05/22/17
Location ID	MW01003	**End Date**	05/22/17
Technician(s)	Jason Hayes, Jason Drizd		

Sample ID	Sample Date/Time	Sample Depth (ft)	USCS Symbol	Comments/Observations
CAPEC01-SO-005	05/22/17 1015	0 - 0.5	SP	None
CAPEC01-SO-005	05/22/17 1020	3 - 4	SM	None

Sample Collection Method	Grab	**Analysis/Method(s)**	PFAS (Modified USEPA 537)
Sample Container Type(s)	4 oz HDPE	**Preservative(s)**	Ice (4 C)

Associated Blank Samples:

CAPEC-FD-SO-001

Signature

Notes:

A soil sample was also collected from the surface interval (0-0.5') and subsurface interval (3-4') and composited with surface and subsurface soil samples from the remaining borings at AFFF Release Area 1 (MW01001 and MW01002) for laboratory analysis of TOC (Lloyd-Kahn/USEPA Method 9060A), pH (USEPA Method 9045C), and particle size analysis (ASTM D422). The resulting sample IDs for the surface and subsurface soil samples were CAPEC01-(0-1) and CAPEC01-(3-4), respectively.

Name (print):

Jason Hayes

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

APPENDIX C-6

WELL CONSTRUCTION FORMS

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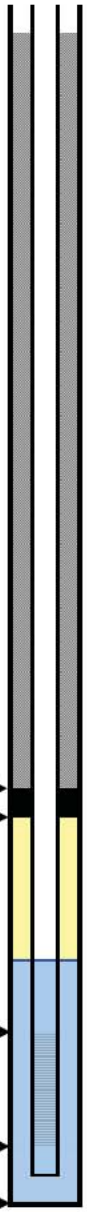
WELL CONSTRUCTION FORM

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract Number:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Location ID:**	AFFF Release Area 1
Drilling Subcontractor:	AmDrill, Inc.	**We**	MW01001
Drilling Personnel:	Todd Ives, Keith Anderson	**Start Date:**	05/22/17
Drilling Method:	DPT	**End Date:**	05/22/17
Technician(s)	Jason Hayes, Jason Drizd		

Type of Well:	Flush Mount
Measuring Point:	Top of Riser (TOR)
TOC/TOR Difference (in):	See survey data
Approximate Diameter of Borehole (in):	4
Depth to Water (ft):	7
During Drilling:	7
Date:	05/22/17
Post Development:	See development log
Date:	05/22/17
Hydrologic Unit:	W
Water added during drilling (gal):	None
Water removed during development (gal):	None
Top of Bentonite Seal (ft):	NA
Top of Filter Pack (ft):	4 8
Top of Screen Interval (ft):	4 8
Bottom of Screened Interval (ft):	14.8
Bottom of Filter Pack (ft):	14.8
Bottom of Borehole (ft):	15.0



Protective Casing:

Type:	SLS
Dimensions (in):	NA
Stickup (ft):	NA
Length (ft):	NA
Guard Post:	NA

Surface Pad:

Type:	None
Length (ft):	NA
Width (ft):	NA
Thickness (in):	NA

Annular Seal (grout above well seal):

Material:	NA
Installation Method:	NA

Bentonite Seal:

Manufacturer:	NA
Material:	NA
Type:	NA
Installation Method:	NA
Hydration time (hrs):	NA

Filter Pack Material:

Manufacturer:	Prepack
Material:	1S
Size (Sieve Size):	20/40
Installation Method:	Gravity
Surging time:	None

Well Casing (Solid Riser Above Screen):

Manufacturer:	Silver-Line Enviro-Pure
Type/Material:	PVC
Length (ft):	5.0
Diameter (in):	2.0

Well Screen:

Manufacturer:	Silver-Line Enviro-Pure
Type/Material:	PVS
Diameter (in):	2.0
Length (ft):	10 0
Slot Size (in):	0 01
Slot Type:	Factory Slot
Sump/End Cap:	End cap

Notes:

Pre-packed temporary well, no sand or bentonite added.
PVS = PVC Upper/Stainless Steel Lower

Signature:

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Name (print): Jason Hayes

QA/QC'd by: Thomas W. Hensel

QA/QC Date: 6/14/2017

WELL CONSTRUCTION FORM

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract Number:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Location ID:**	AFFF Release Area 1
Drilling Subcontractor:	AmDrill, Inc.	**Well ID:**	MW01002
Drilling Personnel:	Todd Ives, Keith Anderson	**Start Date:**	05/22/17
Drilling Method:	DPT	**End Date:**	05/22/17
Technician(s)	Jason Hayes, Jason Drizd		

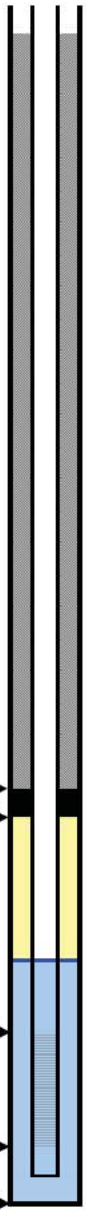
Type of Well: Flush Mount
Measuring Point: Top of Riser (TOR)
TOC/TOR Difference (in): See survey data

Approximate Diameter of Borehole (in): 4

Depth to Water (ft):
- **During Drilling:** 6
- **Date:** 05/22/17
- **Post Development:** See development log
- **Date:** 05/22/17

Hydrologic Unit: W

Water added during drilling (gal): None
Water removed during development (gal): None



Top of Bentonite Seal (ft): NA
Top of Filter Pack (ft): 4 8
Top of Screen Interval (ft): 4 8
Bottom of Screened Interval (ft): 14.8
Bottom of Filter Pack (ft): 14.8
Bottom of Borehole (ft): 15.0

Protective Casing:
- **Type:** SLS
- **Dimensions (in):** NA
- **Stickup (ft):** NA
- **Length (ft):** NA
- **Guard Post:** NA

Surface Pad:
- **Type:** None
- **Length (ft):** NA
- **Width (ft):** NA
- **Thickness (in):** NA

Annular Seal (grout above well seal):
- **Material:** NA
- **Installation Method:** NA

Bentonite Seal:
- **Manufacturer:** NA
- **Material:** NA
- **Type:** NA
- **Installation Method:** NA
- **Hydration time (hrs):** NA

Filter Pack Material:
- **Manufacturer:** Prepack
- **Material:** 1S
- **Size (Sieve Size):** 20/40
- **Installation Method:** Gravity
- **Surging time:** None

Well Casing (Solid Riser Above Screen):
- **Manufacturer:** Silver-Line Enviro-Pure
- **Type/Material:** PVC
- **Length (ft):** 5.0
- **Diameter (in):** 2.0

Well Screen:
- **Manufacturer:** Silver-Line Enviro-Pure
- **Type/Material:** PVS
- **Diameter (in):** 2.0
- **Length (ft):** 10 0
- **Slot Size (in):** 0 01
- **Slot Type:** Factory Slot

Sump/End Cap: End cap

Notes:
Pre-packed temporary well, no sand or bentonite added.
PVS = PVC Upper/Stainless Steel Lower

Signature:

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

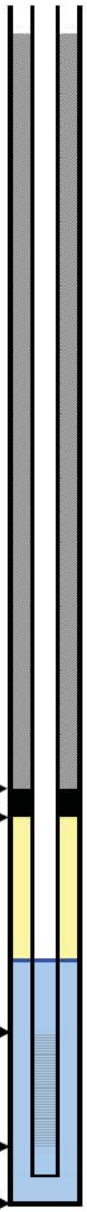
Name (print): Jason Hayes

QA/QC'd by: Thomas W. Hensel **QA/QC Date:** 6/14/2017

WELL CONSTRUCTION FORM

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract Number:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Location ID:**	AFFF Release Area 1
Drilling Subcontractor:	AmDrill, Inc.	**Well ID:**	MW01003
Drilling Personnel:	Todd Ives, Keith Anderson	**Start Date:**	05/22/17
Drilling Method:	DPT	**End Date:**	05/22/17
Technician(s)	Jason Hayes		

Type of Well:	Flush Mount
Measuring Point:	Top of Riser (TOR)
TOC/TOR Difference (in):	See survey data
Approximate Diameter of Borehole (in):	4
Depth to Water (ft):	6
During Drilling:	6
Date:	05/22/17
Post Development:	See development log
Date:	05/22/17
Hydrologic Unit:	W
Water added during drilling (gal):	None
Water removed during development (gal):	None



Top of Bentonite Seal (ft):	NA
Top of Filter Pack (ft):	4 8
Top of Screen Interval (ft):	4 8
Bottom of Screened Interval (ft):	14.8
Bottom of Filter Pack (ft):	14.8
Bottom of Borehole (ft):	15.0

Protective Casing:

Type:	NAO
Dimensions (in):	NA
Stickup (ft):	NA
Length (ft):	NA
Guard Post:	NA

Surface Pad:

Type:	NA
Length (ft):	NA
Width (ft):	NA
Thickness (in):	NA

Annular Seal (grout above well seal):

Material:	NA
Installation Method:	NA

Bentonite Seal:

Manufacturer:	NA
Material:	NA
Type:	NA
Installation Method:	NA
Hydration time (hrs):	NA

Filter Pack Material:

Manufacturer:	Prepack
Material:	1S
Size (Sieve Size):	20/40
Installation Method:	Gravity
Surging time:	None

Well Casing (Solid Riser Above Screen):

Manufacturer:	Silver-Line Enviro-Pure
Type/Material:	PVC
Length (ft):	5.0
Diameter (in):	2.0

Well Screen:

Manufacturer:	Silver-Line Enviro-Pure
Type/Material:	PVS
Diameter (in):	2.0
Length (ft):	10 0
Slot Size (in):	0 01
Slot Type:	Factory Slot

Sump/End Cap: End cap

Notes:

Pre-packed temporary well, no sand or bentonite added.
PVS = PVC Upper/Stainless Steel Lower

Signature:

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Name (print): Jason Hayes

QA/QC'd by: Thomas W. Hensel **QA/QC Date:** 6/14/2017

APPENDIX C-7

WELL DEVELOPMENT LOGS

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WELL DEVELOPMENT LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date Started/Date Completed:**	5/22/2017
Well ID:	MW01001	**Initial Depth to Water (ft):**	6 36
Measuring Point:	Top of Riser	**Total Depth of Well (ft):**	15.0
Development Method:	PUMPED	**Depth to Water After Purging (ft):**	6.4
Total Volume Purged (gal):	50	**1 Casing Volume (gal):**	1.4
Technician(s):	Jason Drizd	**3 Casing Volumes (gal):**	4.3

Date/Time	Intake Depth (feet)	Water Level (feet)	Rate (GPM)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Cum. Volume (gal.)	Comments/Observations During Purging (color, sediment, etc.)
05/22/17 1405			2.5								Pumping Started
05/22/17 1426	15	6.57	2.5	28.76	7.33	6 20	1.32	-62.8	9.63	25	Clear
05/22/17 1432	15	6.51	2.5	28 69	7.35	6 31	1.44	-67.7	8.12	37.5	Clear
05/22/17 1437	15	6.47	2.5	28.71	7.29	6 33	1.34	-64.9	8.01	50.0	Clear

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes

Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter
Hach 2100Q 15060C041690,
YSI 556 MPS 06K1082AL

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V = Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
=Π * (2 0 (in)/12 (in/ft))/2)^2 * 8.64 * 7.48 gal/ft^3
= 1.4 gal.

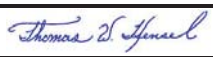
Signature:

Notes:

None

Name (print)

Jason Drizd

QA/QC'd by: **Thomas W. Hensel**  **QA/QC Date:** **6/14/2017**

WELL DEVELOPMENT LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date Started/Date Completed:**	5/22/2017
Well ID:	MW01002	**Initial Depth to Water (ft):**	5 58
Measuring Point:	Top of Riser	**Total Depth of Well (ft):**	15.0
Development Method:	PUMP	**Depth to Water After Purging (ft):**	5 58
Total Volume Purged (gal):	50	**1 Casing Volume (gal):**	1.5
Technician(s):	Jason Drizd	**3 Casing Volumes (gal):**	4.6

Date/Time	Intake Depth (feet)	Water Level (feet)	Rate (GPM)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Cum. Volume (gal.)	Comments/Observations During Purging (color, sediment, etc.)
05/22/17 1251			2.5								Pumping Started
05/22/17 1306	15	5.80	2.5	27 54	7.82	2 98	3.62	101 0	17.1	25	Clear
05/22/17 1311	15	5.78	2.5	27 23	7.64	2 96	2.56	105 5	3.99	37.5	Clear
05/22/17 1316	15	5.74	2.5	27 25	7.47	2 94	3.21	109 0	1.89	50	Clear

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes — Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Geosubmersible Pump
Hach 2100Q 15060C041690,
YSI 556 MPS 06K1082AL

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V = Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
=Π * (2 0 (in)/12 (in/ft))/2)^2 * 9.42 * 7.48 gal/ft^3
= 1.5 gal.

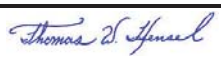
Signature:

Notes:

None

Name (print)

Jason Drizd

QA/QC'd by: **Thomas W. Hensel**  **QA/QC Date:** **6/14/2017**

WELL DEVELOPMENT LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date Started/Date Completed:**	5/22/2017
Well ID:	MW01003	**Initial Depth to Water (ft):**	5.47
Measuring Point:	Top of Casing	**Total Depth of Well (ft):**	15.0
Development Method:	PUMP	**Depth to Water After Purging (ft):**	5.45
Total Volume Purged (gal):	56	**1 Casing Volume (gal):**	1.6
Technician(s):	Jason Drizd	**3 Casing Volumes (gal):**	4.7

Date/Time	Intake Depth (feet)	Water Level (feet)	Rate (GPM)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Cum. Volume (gal.)	Comments/Observations During Purging (color, sediment, etc.)
05/22/17 1141			2.5								Pumping Started
05/22/17 1149	15	5.64	2.5	29 29	8.01	3 88	2.47	115 0	37.6	12.5	Clear
05/22/17 1154	15	5.67	2.5	27 99	7.86	3 07	2.16	103.7	8.70	25	Clear
05/22/17 1203	15	5.70	2.5	27.47	7.76	3 05	2.52	95.3	42.0	40	Clear, surged
05/22/17 1210	15	5.70	2.5	26 89	7.62	3 00	1.85	93.2	2.48	56	Clear

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Geosubmersible Pump
Hach 2100Q 15060C041690,
YSI 556 MPS 06K1082AL

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V = Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
=Π * (2 0 (in)/12 (in/ft))/2)^2 * 9.53 * 7.48 gal/ft^3
= 1.6 gal.

Signature:

Notes:

None

Name (print)

Jason Drizd

QA/QC'd by: **Thomas W. Hensel** Thomas W. Hensel **QA/QC Date:** **6/14/2017**

APPENDIX C-8

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORMS

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WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number**	775303101.0007
Contract	FA8903-16-D-0027 **Task Order** 0004	**Date**	05/22/17
Installation	Cape Canaveral AFS (CAPEC)	**Calibration Start Time**	10:15
Sample Technician(s)	Jason Drizd	**Calibration End Time**	10:54

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (mg/L)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
05/22/17	1015	N/A	4 00	N/A	1.12	N/A	N/A	185 8	N/A	None
			6 80	N/A						
			9 62	N/A						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (mg/L)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
05/22/17	1054	N/A	4 00	9.58	1.00	8.21	N/A	200 0	N/A	None
			7 01	20.2						
			9 93	99.4						
				792						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GB162	02/28/19
pH (7)	7GB164	02/28/19
pH (10)	7GB166	02/28/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GB161	02/28/18
Salinity	N/A	05/22/17
D.O.	N/A	05/22/17
ORP	7GC226	12/31/17

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	N/A	09/30/17
20	N/A	09/30/17
100	N/A	08/31/17
800	N/A	09/30/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter	YSI 556 MPS	06K1082AL
Turbidity Meter	Hach 2100Q	14070C033883

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: N/A

Signature:

Name (print): Jason Drizd

QA/QC'd by: **Thomas W. Hensel** Thomas W. Hensel **QA/QC Date:** **6/14/2017**

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number**	775303101.0007
Contract	FA8903-16-D-0027 **Task Order** 0004	**Date**	05/24/17
Installation	Cape Canaveral AFS (CAPEC)	**Calibration Start Time**	0641
Sample Technician(s)	Jason Drizd	**Calibration End Time**	0656

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (mg/L)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
05/24/17	0641	N/A	4.18	N/A	0.992	N/A	N/A	190.1	N/A	None
			6.78	N/A						
			10.35	N/A						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (mg/L)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
05/24/17	0655	N/A	4 00	9.98	1.000	8.22	N/A	200 0	N/A	None
			7 00	20.2						
			10.06	101						
				799						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GB162	02/28/19
pH (7)	7GB164	02/28/19
pH (10)	7GB166	02/28/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GB161	02/28/18
Salinity	N/A	05/24/17
D.O.	N/A	05/24/17
ORP	7GC226	12/31/17

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	NA	09/30/17
20	NA	09/30/17
100	NA	08/31/17
800	NA	09/30/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter	YSI 556 MPS	06K1082AL
Turbidity Meter	Hach 2100Q	15060C041690

Calibrated Within Acceptance Criteria (Y/N): Yes

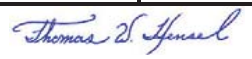
If No, Provide Explanation: NA

Notes:

None

Signature:

Name (print): Jason Drizd

QA/QC'd by: Thomas W. Hensel  **QA/QC Date:** 6/14/2017

APPENDIX C-9

GROUNDWATER SAMPLING LOGS

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DEP Form FD 9000-24: GROUNDWATER SAMPLING LOG

SITE NAME:	Cape Canaveral AFS (CAPEC)	SITE LOCATION:	AFFF Release Area 1
WELL NO:	MW01001	SAMPLE ID:	CAPEC01-GW-001
DATE:	05/24/17		

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH:	STATIC WATER DEPTH (feet):	PURGE PUMP TYPE OR BAILER:
2	1/4	5 to 15	6.34	PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (15.0 feet – 6.34 feet) X 0.082 gallons/foot X 3.785 liters/gallon = 5.4 liters

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot X feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING NITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (liters):
8	8	0930	1020	25

TIME	VOLUME PURGED ({Purging-Volume})	CUMUL. VOLUME PURGED (liters)	PURGE RATE (mL/min)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (C)	COND. (mS/cm)	DISSOLVED OXYGEN (mg/L)	ORP (mV)	TURBIDITY (NTUs)	COLOR	ODOR
0938	4	4	500	6.34	7.60	28.13	0.649	0.16	-116.6	18.8	Clear	NA
0946	8	12	500	6.34	7.38	28.35	0.651	0.17	-121.2	18.0	Clear	NA
0954	12	24	500	6.34	7.22	28.39	0.660	0.18	-125.3	7.84	Clear	NA
1002	16	40	500	6.34	7.13	28.37	0.660	0.37	-129.0	5.39	Clear	NA
1010	20	60	500	6.34	7.10	28.35	0.657	0.45	-133.5	4.37	Clear	NA
1018	24	84	500	6.34	7.09	28.44	0.659	0.44	-137.3	3.27	Clear	NA
				Final Values	7.09	28.44	0.659	0.44	-137.3	3.27		

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT:	SAMPLING ENDED AT:
Jason Drizd Amec Foster Wheeler		1020	1026

PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED:	FILTER SIZE (µm):
8	HDPE	No	NA
		Filtration Equipment Type:	NA

FIELD DECONTAMINATION: PUMP: No TUBING: No DUPLICATE: CAPEC-FD-GW-001

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MAT. CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
MW01001	2	HDPE	125	Ice (4 C)	NA	Not Recorded	PFAS (Mod. EPA 537)	APP	250

REMARKS:
None

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; HDPE = High Density Polyethylene; LDPE = Low Density Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After (Through) Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: + 0.2 units **Temperature:** + 0.2 oC **Specific Conductance:** + 5% **Dissolved Oxygen:** all readings < 20% saturation (see Table FS 2200-2); optionally, + 0.2 mg/L or + 10% (whichever is greater) **Turbidity:** all readings < 20 NTU; optionally + 5 NTU or + 10% (whichever is greater)

QA/QC'd by Thomas W. Hensel **QA/QC Date 6/14/2017**

DEP Form FD 9000-24: GROUNDWATER SAMPLING LOG

SITE NAME:	Cape Canaveral AFS (CAPEC)	SITE LOCATION:	AFFF Release Area 1
WELL NO:	MW01002	SAMPLE ID:	CAPEC01-GW-002
DATE:	05/24/17		

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH:	STATIC WATER DEPTH (feet):	PURGE PUMP TYPE OR BAILER:
2	1/4	5 to 15	5.52	PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (15.0 feet – 5.52 feet) X 0.082 gallons/foot X 3.785 liters/gallon = 5.9 liters

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot X feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING NITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (liters):
7	7	1028	1108	21

TIME	VOLUME PURGED ({Purging-Volume})	CUMUL. VOLUME PURGED (liters)	PURGE RATE (mL/min)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (C)	COND. (mS/cm)	DISSOLVED OXYGEN (mg/L)	ORP (mV)	TURBIDITY (NTUs)	COLOR	ODOR
1036	4	4	500	5.52	7.60	26.62	0.324	0.16	-43.5	49.8	Clear	NA
1042	8	12	500	5.52	7.57	26.95	0.320	0.87	-4.9	56.2	Clear	NA
1050	12	24	500	5.52	7.58	26.88	0.317	0.97	-9.9	8.49	Clear	NA
1058	16	40	500	5.52	7.60	26.99	0.317	1.01	-13.8	3.88	Clear	NA
1106	20	60	500	5.52	7.60	27.02	0.315	1.06	-15.0	3.08	Clear	NA
				Final Values	7.60	27.02	0.315	1.06	-15.0	3.08		

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT:	SAMPLING ENDED AT:
Jason Drizd Amec Foster Wheeler		1108	1110

PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED:	FILTER SIZE (µm):
7	HDPE	No Filtration Equipment Type:	NA NA

FIELD DECONTAMINATION: PUMP: No TUBING: No DUPLICATE: None Collected

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
SAMPLE ID CODE	# CONTAINERS	MAT. CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
MW01002	2	HDPE	125	Ice (4 C)	NA	Not Recorded	PFAS (Mod. EPA 537)	APP	500

REMARKS:
None

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; HDPE = High Density Polyethylene; LDPE = Low Density Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After (Through) Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: + 0.2 units **Temperature:** + 0.2 oC **Specific Conductance:** + 5% **Dissolved Oxygen:** all readings < 20% saturation (see Table FS 2200-2); optionally, + 0.2 mg/L or + 10% (whichever is greater) **Turbidity:** all readings < 20 NTU; optionally + 5 NTU or + 10% (whichever is greater)

QA/QC'd by Thomas W. Hensel Thomas W. Hensel **QA/QC Date 6/14/2017**

DEP Form FD 9000-24: GROUNDWATER SAMPLING LOG

SITE NAME:	Cape Canaveral AFS (CAPEC)	SITE LOCATION:	AFFF Release Area 1
WELL NO:	MW01003	SAMPLE ID:	CAPEC01-GW-003
DATE:	05/24/17		

PURGING DATA

WELL DIAMETER (inches):	TUBING DIAMETER (inches):	WELL SCREEN INTERVAL DEPTH:	STATIC WATER DEPTH (feet):	PURGE PUMP TYPE OR BAILER:
2	1/4	5 to 15	5.42	PP

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY
(only fill out if applicable)
= (15.0 feet – 5.42 feet) X 0.082 gallons/foot X 3.785 liters/gallon = 5.9 liters

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
(only fill out if applicable)
= gallons + (gallons/foot X feet) + gallons = gallons

INITIAL PUMP OR TUBING DEPTH IN WELL (feet):	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT:	PURGING ENDED AT:	TOTAL VOLUME PURGED (liters):
7	7	1116	1156	21

TIME	VOLUME PURGED ({Purging-Volume})	CUMUL. VOLUME PURGED (liters)	PURGE RATE (mL/min)	DEPTH TO WATER (feet)	pH (standard units)	TEMP. (C)	COND. (mS/cm)	DISSOLVED OXYGEN (mg/L)	ORP (mV)	TURBIDITY (NTUs)	COLOR	ODOR
1124	4	4	500	5.42	7.50	26.93	0.327	0.35	-42.1	53.3	Clear	NA
1132	8	12	500	5.42	7.30	27.14	0.317	0.71	-50.0	56.2	Clear	NA
1140	12	24	500	5.42	7.44	27.21	0.321	0.76	-65.1	39.2	Clear	NA
1148	16	40	500	5.42	7.56	27.32	0.321	0.79	-59.2	9.24	Clear	NA
1156	20	60	500	5.42	7.57	27.35	0.320	0.74	-66.2	6.69	Clear	NA
				Final Values	7.57	27.35	0.320	0.74	-66.2	6.69		

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION:	SAMPLER(S) SIGNATURE(S):	SAMPLING INITIATED AT:	SAMPLING ENDED AT:
Jason Drizd Amec Foster Wheeler		1156	1158

PUMP OR TUBING DEPTH IN WELL (feet):	TUBING MATERIAL CODE:	FIELD-FILTERED:	FILTER SIZE (µm):
7	HDPE	No Filtration Equipment Type: NA	NA

FIELD DECONTAMINATION: PUMP: No TUBING: No DUPLICATE: None Collected

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION					
SAMPLE ID CODE	# CONTAINERS	MAT. CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH	INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	SAMPLE PUMP FLOW RATE (mL per minute)
MW01003	2	HDPE	125	Ice (4 C)	NA	Not Recorded	PFAS (Mod. EPA 537)	APP	500

REMARKS:
None

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; HDPE = High Density Polyethylene; LDPE = Low Density Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After (Through) Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: **1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.**

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: + 0.2 units **Temperature:** + 0.2 oC **Specific Conductance:** + 5% **Dissolved Oxygen:** all readings < 20% saturation (see Table FS 2200-2); optionally, + 0.2 mg/L or + 10% (whichever is greater) **Turbidity:** all readings < 20 NTU; optionally + 5 NTU or + 10% (whichever is greater)

QA/QC'd by Thomas W. Hensel **QA/QC Date 6/14/2017**

APPENDIX C-10

SEDIMENT SAMPLE COLLECTION LOG

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SEDIMENT SAMPLE COLLECTION LOG

Project Name:	Site Inspection of AFFF Release Areas Environmental Programs Worldwide	**Project Number:**	775303101.0007
Contract:	FA8903-16-D-0027	**Task Order:**	0004
Installation:	Cape Canaveral AFS (CAPEC)	**Date:**	05/22/17
Location ID:	SD01001	**Northing/Easting:**	1508722.12/791942 59
Technician(s):	Jason Hayes		

SEDIMENT SAMPLE

Description

NAME (USCS Symbol): color, moisture, % by wt, plasticity, dilatancy, toughness, dry strength,consistency

Organic Soils

Sample Depth (ft):	NA	**Sample ID:**	CAPEC01-SD-001
MS/MSD Collected:	Yes	**Sample Date:**	05/22/17
Duplicate ID:	CAPEC-FD-SD-001	**Sample Collection Time:**	1530
Sample Container Type(s):	4 oz HDPE	**Sample Collection Methods:**	Grab
Preservative(s):	Ice (4 °C)	**Analysis/Method(s):**	PFAS (Modified USEPA 537)

SURFACE WATER SAMPLE

Time	Intake Depth (in)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, etc.)
NA	NA	NA	NA	NA	NA	NA	NA	NA

Sample Depth (ft):	NA	**Sample Date:**	NA
Sample ID:	NA	**Sample Collection Time:**	NA
MS/MSD Collected:	NA	**Sample Collection Methods:**	NA
Duplicate ID:	NA	**Surface Water Depth (ft):**	NA
Sample Container Type(s):	NA	**Water Body and Water Quality Characteristics:**	
Preservative(s):	NA	NA	
Analysis/Method(s):	NA		

Location Image:

Caption: SD01001 facing north

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): NA

Calibrated Within Criteria (Y/N): NA

Stainless Steel Scoop

Notes:

None

Signature:

Name (print)

Jason Hayes

QA/QC'd by: Thomas W. Hensel Thomas W. Hensel **QA/QC Date:** 6/14/2017

APPENDIX D

LABORATORY ANALYTICAL REPORTS (DVD)

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APPENDIX E

DATA VALIDATION REPORT

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DATA VALIDATION REPORT

SITE INSPECTION OF AQUEOUS FILM FORMING FOAM (AFFF) RELEASE AREAS

ENVIRONMENTAL PROGRAMS WORLDWIDE

CAPE CANAVERAL AIR FORCE STATION

Samples Collected Between 22 and 24 May 2017

Prepared for:

Air Force Civil Engineer Center

Joint Base San Antonio – Lackland, Texas

Prepared by:

amec foster wheeler

Contract FA8903-16-D-0027

Task Order 0004

July 2017

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TABLE OF CONTENTS

LIST OF TABLES

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ACRONYMS AND ABBREVIATIONS

%	percent
µg/L	micrograms per liter
6:2 FTS	6:2 Fluorotelomer sulfonate
8:2 FTS	8:2 Fluorotelomer sulfonate
Amec Foster Wheeler	Amec Foster Wheeler Environment & Infrastructure, Inc.
AFFF	Aqueous Film Forming Foam
CCV	Continuing Calibration Verification
CLP	Contract Laboratory Program
COC	Chain of Custody
DoD	Department of Defense
DL	detection limit
EPA	United States Environmental Protection Agency
EtFOSAA	Ethylperfluorooctane sulfonamidoacetic acid
ICAL	initial calibration
ICV	Initial Calibration Verification
ID	Identification
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantification
MeFOSAA	Methylperfluorooctane sulfonamidoacetic acid
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PFASs	Per- and polyfluoroalkyl substances
PFDA	Perfluorodecanoic acid
PFDoA	Perfluorododecanoic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid

PFTeDA	Perfluorotetradecanoic acid
PFTrDA	Perfluorotridecanoic acid
PFUnA	Perfluoroundecanoic acid
QC	Quality Control
QPP	Quality Program Plan
QSM	Quality Systems Manual
RPD	Relative Percent Difference
SGS	SGS Accutest

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) collected six water samples, including one field duplicate, one equipment blank, and one field blank, and nine soil or sediment samples, including two field duplicates, between 22 and 24 May 2017, from Cape Canaveral Air Force Station, located in Cape Canaveral, Florida. Amec Foster Wheeler submitted the samples to SGS Accutest (SGS), located in Orlando, Florida on 26 May 2017. SGS assigned the samples to sample delivery group FA44406. SGS analyzed the samples for per- and polyfluoroalkyl substances (PFASs) by United States Environmental Protection Agency (EPA) Method 537. A list of these samples by field sample identification (ID), sample collection date, sample matrix, and laboratory sample ID is presented in Table 1.

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2.0 DATA VALIDATION METHODOLOGY

Amec Foster Wheeler performed EPA Stage 4 validation on 10 percent (%) of the samples and EPA Stage 2B validation on the remaining samples associated with this sampling event as indicated on Table 1. The Stage 4 validation includes review of the quality control (QC) results in the laboratory's analytical report and reported on QC summary forms as well as recalculation checks and review of the instrument raw data outputs. The Stage 2B validation includes review of the QC results in the laboratory's analytical report and reported on QC summary forms with no review of the associated raw data. Data from equipment and field blanks did not undergo validation because results from these samples are only used to assess data usability for field samples. This data validation has been performed in general accordance with:

- Amec Foster Wheeler, 2016. Draft, Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas, Environmental Programs Worldwide, Quality Program Plan (QPP), Contract FA8903-16-D-0027, Task Order 0004, December 2016.
- Department of Defense (DoD), 2013. DoD Quality Systems Manual for Environmental Laboratories, Version 5.0. July 2013.
- EPA, 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry, Version 1.1, September 2009. EPA Document #: EPA/600/R-08/092.
- EPA, 2014. EPA Contract Laboratory Program (CLP) National Functional Guidelines for Superfund Organic Methods Data Review, EPA/540-R-014-002.

The CLP guideline was written specifically for the CLP, and has been modified for the purposes of this data review where it differs from method-specific, QPP-specified, and laboratory-specified QC requirements.

The laboratory's certified analytical report and supporting documentation were reviewed to assess the following:

- Data package and electronic data deliverable completeness;
- Laboratory case narrative review;
- Chain of custody (COC) compliance;
- Holding time compliance;
- QC sample frequency;
- Initial calibration, initial calibration verification (ICV), and continuing calibration verification (CCV) compliance with method-specified criteria;
- Presence or absence of laboratory contamination as demonstrated by laboratory blanks;

- Accuracy and bias as demonstrated by recovery of surrogate spikes, laboratory control sample (LCS), and matrix spike (MS) samples;
- Internal standard recoveries;
- Analytical precision as relative percent difference (RPD) of analyte concentration between laboratory duplicates or MS/MS duplicate (MSD);
- Sampling and analytical precision as RPD of analyte concentration between field duplicates;
- Assessment of field contamination as demonstrated by field and equipment blanks;
- Insofar as possible, the degree of conformance to method requirements and good laboratory practices.

In general, it is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but any reported value may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

LCSs and LCS duplicates (LCSDs) are aliquots of analyte-free matrices that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked matrix is then processed through the same analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

MSs and MSDs are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Equipment blanks are prepared by passing analyte-free water through or over sample collection equipment and collecting the water in sample containers. Equipment blanks are analyzed for the analytical suite required for the project. Equipment blanks are used to monitor for possible sample contamination during the sample collection process and serve as a check on the effectiveness of field decontamination procedures.

Field blanks are prepared by pouring an aliquot of analyte-free water into a sample container in the field. Field blanks are analyzed for the analytical suite required for the project. Field blanks are used to monitor for possible sample contamination originating from the water used for equipment decontamination.

Laboratory, equipment, and field blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

When target analytes are detected in blanks, analyte concentrations in the associated samples less than ten times the concentration detected in the blank will be B qualified.

3.5 LABORATORY AND FIELD DUPLICATES

Laboratory and field duplicate analysis verifies acceptable method precision by the laboratory at the time of preparation and analysis and/or sampling precision at the time of collection.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE USED DURING DATA VALIDATION

B The analyte was detected in the sample and an associated blank and the concentration detected in the sample was less than ten times the concentration detected in the blank.

U The analyte was analyzed for, but was not detected.

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

Q The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

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5.0 QUALIFICATION REASON CODES

Amec Foster Wheeler applied the following reason code to the data during validation:

FDD Field duplicate imprecision

LCL Low LCS recovery. Analytical result may be biased low.

MSL Low MS/MSD recovery. Analytical result may be biased low.

SGH High surrogate recovery. Analytical result may be biased high.

SGL Low surrogate recovery. Analytical result may be biased low.

TR Detected concentration is less than the limit of quantification (LOQ).

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6.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

The samples were received at the laboratory under proper COC, intact, properly preserved, and at temperatures less than the QPP-specified maximum of 10 degrees Celsius.

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7.0 SPECIFIC DATA VALIDATION FINDINGS

Results from these samples may be considered usable with the limitations and exceptions described Sections 7.1 through 8.0.

7.1 PER- AND POLYFLUOROALKYL SUBSTANCES BY EPA METHOD 537

PFAS results generated by SGS are usable with the limitations described in Sections 7.1.1 through 7.1.10.

7.1.1 Holding Times

The aqueous samples were extracted for PFASs within the QPP-specified maximum holding time of 14 days from sample collection and the extracts were analyzed within the QPP-specified maximum hold time of 28 days from extraction. The solid samples were extracted for PFASs within the method-recommended maximum holding time of 60 days from sample collection and the extracts were analyzed within the method-recommended 30 days from extraction.

7.1.2 Initial Calibrations

The ICALs associated with the analysis of these samples met the Quality Systems Manual (QSM)-specified criteria of correlation coefficients greater than 0.99 and the calibration standards calculating to 70 to 130% of its true concentrations.

7.1.3 Initial Calibration Verification

ICV recoveries were within the QPP-specified 75% to 125% limits, with the following exception:

- Ethylperfluorooctane sulfonamidoacetic acid (EtFOSAA) recovery was high at 129% in the ICV associated with samples CAPEC01-GW-001, CAPEC01-GW-002, CAPEC01-GW-003, and CAPEC-FD-GW-001. EtFOSAA was not detected in these samples and data usability is not adversely affected by the potential high analytical bias.

7.1.4 Continuing Calibration Verification

CCV recoveries were within the QPP specified 75% to 125% limits.

7.1.5 Laboratory Blanks

PFASs were not detected in the laboratory blanks associated with these samples.

7.1.6 Field and Equipment Blanks

PFASs were not detected in the field and equipment blanks associated with these samples.

7.1.7 Laboratory Control Sample Accuracy

Laboratory Control Sample (LCS) recoveries were within QPP-specified 70 to 130% limits, with the following exception:

- Perfluorododecanoic acid (PFDoA) (64%), perfluorotridecanoic acid (PFTrDA) (62%), perfluorotetradecanoic aicd (PFTeDA) (67%), 6:2 fluorotelomer sulfonate (6:2 FTS) (140%), and

8:2 fluorotelomer sulfonate (8:2 FTS) (136%) recoveries were outside specified limits in the LCS associated with samples CAPEC01-GW-001, CAPEC01-GW-002, CAPEC01-GW-003, and CAPEC-FD-GW-001. Data limitations are summarized below.

- Amec Foster Wheeler UJ qualified the non-detected PFDoA, PFTrDA, and PFTeDA results from these samples because of the potential low analytical bias. (Qualifier and reason code: UJ-LCL)
- 6:2 FTS and 8:2 FTS were not detected in these samples and data usability is not adversely affected by the potential high analytical bias.

7.1.8 Matrix Spikes/ Matrix Spike Duplicates

SGS performed MS and MSD analyses on samples CAPEC01-SD-001, CAPEC01-SO-002, and CAPEC01-GW-002. Recoveries were within the QPP-specified 70 to 130% limits and RPDs between MS and MSD results were less than the QPP-specified maximum of 30%, with the following exceptions.

- Perfluorooctanesulfonic acid (PFOS) recovery was low at 69% in the MSD and 6:2 FTS recovery was high at 133% in the MS performed on sample CAPEC01-GW-002. Data limitations are summarized below.
  - Amec Foster Wheeler J qualified the detected PFOS result from this sample because of the potential low analytical bias. (Qualifier and reason code: J-MSL)
  - 6:2 FTS was not detected in this sample and data usability is not adversely affected by the potential high analytical bias.
- PFDoA (68%-MS), PFTrDA (55%, 55%), PFTeDA (43%, 41%), PFOS (68%-MS), and methylperfluorooctane sulfonamidoacetic acid (MeFOSAA) (68%-MS) recoveries were low in the MS and/or MSD performed on sample CAPEC01-SD-001. Amec Foster Wheeler J qualified the detected PFOS results and UJ qualified the non-detected PFDoA, PFTrDA, PFTeDA, and MeFOSAA results from this sample and its field duplicate CAPEC-FD-SD-001 because of the potential low analytical bias. (Qualifier and reason code: J/UJ-MSL)

7.1.9 Surrogate Recoveries

Surrogate recoveries were within the QPP-specified 70 to 130% limits, with the following exceptions:

- Recovery of the surrogate compound d5-EtFOSAA was low at 69% in the analysis of sample CAPEC01-SD-001. This recovery was within laboratory-specified limits and SGS did not re-extract or reanalyze this sample. Amec Foster Wheeler UJ qualified the non-detected EtFOSAA and MeFOSAA results from this sample because of the potential low analytical bias. (Qualifier and reason code: UJ-SGL)
- Recovery of the surrogate compound $^{13}C_2$-perfluorodecanoic acid (PFDA) was high at 138% in the analysis of sample CAPEC01-GW-002. Data limitations are summarized below.

- Amec Foster Wheeler J qualified the detected perfluorononanoic acid (PFNA) and PFDA results from this sample because of the potential high analytical bias. (Qualifier and reason code: J-SGH)
- Perfluoroundecanoic acid (PFUnA), PFDoA, PFTeDA, PFTrDA, and 8:2 FTS were not detected in this sample and data usability is not adversely affected by the potential high analytical bias.

7.1.10 Internal Standard Recoveries

Internal standard recoveries were within the QPP-specified limits of 50 to 150% of the average area counts measured during the initial calibration.

7.1.11 Data Reporting and Analytical Procedures

SGS J qualified analytes with concentrations between the detection limit (DL) and the LOQ. Amec Foster Wheeler agrees that these results are quantitatively uncertain and has J qualified these results. (Qualifier and reason code: J-TR)

SGS calibrates their instrument using linear and branched isomers, but the solution used for calibration verification and spiking contains linear isomers only. The analytical software is unable to correctly auto-integrate analytes when peaks for both linear and branched isomers are present, so the initial calibrations, CCVs, and samples containing both linear and branched isomers require manual integration. Other software limitations include not being able to print more than one chromatogram for each analyte and having the printed baselines appear high due to poor printing resolution. Since the manual integrations are performed to ensure that both linear and branched isomers are included in the analytical results, Amec Foster Wheeler's review of the manual integrations is a check to make sure both linear and branched isomer peaks are fully integrated.

A proficiency testing sample, PTRCK-GW-001, was submitted to SGS on 23 May 2017 containing 0.100 micrograms per liter (µg/L) of perfluorooctanoic acid (PFOA) and 0.200 µg/L of PFOS. SGS analyzed the sample and detected 0.0977 µg/L for PFOA and 0.153 µg/L for PFOS, results which are within the established acceptance range of 60 to 140% of the spike value

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8.0 FIELD DUPLICATE RESULTS

Amec Foster Wheeler collected field duplicates with samples CAPEC01-GW-001 (CAPEC-FD-GW-001), CAPEC01-SD-001 (CAPEC-FD-SD-001), and CAPEC01-SO-005 (CAPEC-FD-SO-001). Detected results and RPDs for the field duplicate are summarized in Table 2. Precision values were within the QPP-specified limits of less than 30% RPD or the difference between analytical results less than the LOQ, with the following exception.

- The RPD between PFOS results from sample CAPEC01-SO-005 and its field duplicate CAPEC-FD-SO-001 was high at 114%. Amec Foster Wheeler J qualified the detected PFOS results from these samples because of potential sampling or analytical imprecision. (Qualifier and reason code: J-FDD)

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9.0 SUMMARY AND CONCLUSIONS

Amec Foster Wheeler evaluated a total of 208 data records from field samples during the validation. Amec Foster Wheeler J or UJ qualified 72 records (35%) as estimated values because of field duplicate imprecision, low LCS recoveries, low MS/MSD recoveries, high or low surrogate recoveries, and/or analyte concentrations between the DL and the LOQ. Qualified data are summarized in Table 3.

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REFERENCES

Amec Foster Wheeler, 2016. Draft, Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas, Environmental Programs Worldwide, Quality Program Plan (QPP), Contract FA8903-16-D-0027, Task Order 0004, December 2016.

Department of Defense (DoD), 2017. DoD Quality Systems Manual for Environmental Laboratories, Version 5.1. January 2017.

EPA, 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), Version 1.1, September 2009. EPA Document #: EPA/600/R-08/092.

EPA, 2014. EPA Contract Laboratory Program (CLP) National Functional Guidelines for Superfund Organic Methods Data Review, EPA/540-R-014-002.

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TABLES

Table 1
Field Samples Submitted to SGS Accutest
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Cape Canaveral Air Force Station Florida

Sample Identification	Collection Date	Sample Matrix	Laboratory SDG	Laboratory Sample Identification	Notes
CAPEC01-GW-001	24-May-17	Groundwater	FA44406	FA44406-1	Stage IV
CAPEC01-SD-001	22-May-17	Sediment	FA44406	FA44406-2	MS/MSD, Stage IV
CAPEC01-SO-001	22-May-17	Soil	FA44406	FA44406-3	Stage IV
CAPEC01-SO-002	22-May-17	Soil	FA44406	FA44406-4	MS/MSD
CAPEC01-SO-003	22-May-17	Soil	FA44406	FA44406-5	
CAPEC01-SO-004	22-May-17	Soil	FA44406	FA44406-6	
CAPEC01-SO-005	22-May-17	Soil	FA44406	FA44406-7	
CAPEC01-SO-006	22-May-17	Soil	FA44406	FA44406-8	
CAPEC-EB-001	22-May-17	QC Water	FA44406	FA44406-9	Equipment Blank
CAPEC-FB-001	22-May-17	QC Water	FA44406	FA44406-10	Field Blank
CAPEC-FD-SD-001	22-May-17	Sediment	FA44406	FA44406-11	Field Duplicate of Sample CAPEC01-SD-001
CAPEC-FD-SO-001	22-May-17	Soil	FA44406	FA44406-12	Field Duplicate of Sample CAPEC01-SO-005
CAPEC01-GW-002	24-May-17	Groundwater	FA44406	FA44406-13	MS/MSD
CAPEC01-GW-003	24-May-17	Groundwater	FA44406	FA44406-14	
CAPEC-FD-GW-001	24-May-17	Groundwater	FA44406	FA44406-15	Field Duplicate of Sample CAPEC01-GW-001

Notes:
MS/MSD = Matrix Spike / Matrix Spike Duplicate
SDG = Sample Delivery Group

Table 2
Field Duplicate Detections
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Cape Canaveral Air Force Station, Florida

Analyte	LOQ	Primary Sample	Field Duplicate	Units	RPD	Notes
Samples CAPEC01-GW-001 and CAPEC-FD-GW-001						
PFHxA	0.015	0.0300	0.0297	µg/L	1.0%	
PFHpA	0.015	0.0141 J	0.0136 J	µg/L	3.6%	
PFOA	0.015	0.0262	0.0281	µg/L	7.0%	
PFBS	0.015	0.0203	0.0211	µg/L	3.9%	
PFHxS	0.015	0.0507	0.0539	µg/L	6.1%	
PFOS	0.015	0.0409	0.042	µg/L	2.9%	
Samples CAPEC01-SD-001 and CAPEC-FD-SD-001						
PFHxA	0.0020	0.00234 J	0.00117 J	mg/kg	67%	± LOQ
PFHpA	0.0020	0.00217 J	0.00127 J	mg/kg	52%	± LOQ
PFOA	0.0020	0.00227 J	0.00134 J	mg/kg	52%	± LOQ
PFNA	0.0020	0.00133 J	0.0019 U	mg/kg	NC	± LOQ
PFDA	0.0020	0.00191 J	0.00147 J	mg/kg	26%	
PFUnA	0.0020	0.00109 J	0.000979 J	mg/kg	11%	
PFHxS	0.0020	0.00136 J	0.000969 J	mg/kg	34%	± LOQ
PFOS	0.0020	0.0303	0.0259	mg/kg	16%	
Samples CAPEC01-SO-005 and CAPEC-FD-SO-001						
PFHxA	0.0020	0.00127 J	0.000373 J	mg/kg	109%	± LOQ
PFHpA	0.0020	0.00120 J	0.0010 U	mg/kg	NC	± LOQ
PFOA	0.0020	0.000727 J	0.0010 U	mg/kg	NC	± LOQ
PFNA	0.0020	0.000738 J	0.0010 U	mg/kg	NC	± LOQ
PFDA	0.0020	0.00186 J	0.0010 U	mg/kg	NC	± LOQ
PFUnA	0.0020	0.00108 J	0.0010 U	mg/kg	NC	± LOQ
PFDoA	0.0020	0.00118 J	0.000778 J	mg/kg	41%	± LOQ
PFTrDA	0.0020	0.000530 J	0.0010 U	mg/kg	NC	± LOQ
PFTeDA	0.0020	0.000663 J	0.0010 U	mg/kg	NC	± LOQ
PFOS	0.0020	0.00327	0.000897 J	mg/kg	114%	J-FDD

Notes:
µg/L = micrograms per liter
LOQ = limit of quantification
mg/kg = milligrams per kilogram
NC = not calculable
PFBS = perfluorobutanesulfonic acid
PFDA = perfluorodecanoic acid
PFDoA = perfluorododecanoic acid
PFHpA = perfluoroheptanoic acid
PFHxA = perfluorohexanoic acid
PFHxS = perfluorohexanesulfonic acid
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
PFTeDA = perfluorotetradecanoic acid
PFTrDA = perfluorotridecanoic acid
PFUnA = perfluoroundecanoic acid
RPD = relative percent difference

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported limit of detection.

Reason Codes:
FDD = Field duplicate imprecision
± LOQ = The difference ebtween analyte concentrations is less than the LOQ, indicating acceptable sampling and analytical precision.

Table 3
Qualifiers Added During Validation
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Cape Canaveral Air Force Station, Florida

Sample Identification	Analyte	Results	Validation Qualifiers and Reason Codes
CAPEC01-GW-001	PFDoA	0.012 µg/L	UJ LCL
CAPEC01-GW-001	PFHpA	0.0141 µg/L	J TR
CAPEC01-GW-001	PFTeDA	0.012 µg/L	UJ LCL
CAPEC01-GW-001	PFTrDA	0.012 µg/L	UJ LCL
CAPEC01-GW-002	PFDA	0.00836 µg/L	J SGH, TR
CAPEC01-GW-002	PFDoA	0.012 µg/L	UJ LCL
CAPEC01-GW-002	PFNA	0.0136 µg/L	J SGH, TR
CAPEC01-GW-002	PFOS	0.0942 µg/L	J MSL
CAPEC01-GW-002	PFTeDA	0.012 µg/L	UJ LCL
CAPEC01-GW-002	PFTrDA	0.012 µg/L	UJ LCL
CAPEC01-GW-003	PFDoA	0.012 µg/L	UJ LCL
CAPEC01-GW-003	PFNA	0.00796 µg/L	J TR
CAPEC01-GW-003	PFTeDA	0.012 µg/L	UJ LCL
CAPEC01-GW-003	PFTrDA	0.012 µg/L	UJ LCL
CAPEC01-SD-001	EtFOSAA	0.0077 mg/kg	UJ SGL
CAPEC01-SD-001	MeFOSAA	0.0077 mg/kg	UJ MSL, SGL
CAPEC01-SD-001	PFDA	0.00191 mg/kg	J TR
CAPEC01-SD-001	PFDoA	0.0019 mg/kg	UJ MSL
CAPEC01-SD-001	PFHpA	0.00217 mg/kg	J TR
CAPEC01-SD-001	PFHxA	0.00234 mg/kg	J TR
CAPEC01-SD-001	PFHxS	0.00136 mg/kg	J TR
CAPEC01-SD-001	PFNA	0.00133 mg/kg	J TR
CAPEC01-SD-001	PFOA	0.00227 mg/kg	J TR
CAPEC01-SD-001	PFOS	0.0303 mg/kg	J MSL
CAPEC01-SD-001	PFTeDA	0.0019 mg/kg	UJ MSL
CAPEC01-SD-001	PFTrDA	0.0019 mg/kg	UJ MSL
CAPEC01-SD-001	PFUnA	0.00109 mg/kg	J TR
CAPEC01-SO-001	PFHpA	0.000826 mg/kg	J TR
CAPEC01-SO-001	PFHxA	0.00162 mg/kg	J TR
CAPEC01-SO-001	PFHxS	0.00113 mg/kg	J TR
CAPEC01-SO-002	PFHxA	0.000414 mg/kg	J TR
CAPEC01-SO-002	PFHxS	0.000746 mg/kg	J TR
CAPEC01-SO-002	PFOS	0.0017 mg/kg	J TR
CAPEC01-SO-003	EtFOSAA	0.00192 mg/kg	J TR
CAPEC01-SO-003	MeFOSAA	0.00192 mg/kg	J TR
CAPEC01-SO-003	PFDA	0.000864 mg/kg	J TR
CAPEC01-SO-003	PFHxA	0.000502 mg/kg	J TR
CAPEC01-SO-003	PFOS	0.00127 mg/kg	J TR
CAPEC01-SO-003	PFUnA	0.00157 mg/kg	J TR
CAPEC01-SO-004	PFDoA	0.00102 mg/kg	J TR
CAPEC01-SO-004	PFHxA	0.000227 mg/kg	J TR
CAPEC01-SO-005	PFDA	0.00186 mg/kg	J TR
CAPEC01-SO-005	PFDoA	0.00118 mg/kg	J TR
CAPEC01-SO-005	PFHpA	0.0012 mg/kg	J TR
CAPEC01-SO-005	PFHxA	0.00127 mg/kg	J TR
CAPEC01-SO-005	PFNA	0.000738 mg/kg	J TR
CAPEC01-SO-005	PFOA	0.000727 mg/kg	J TR
CAPEC01-SO-005	PFOS	0.00327 mg/kg	J FDD
CAPEC01-SO-005	PFTeDA	0.000663 mg/kg	J TR

Table 3
Qualifiers Added During Validation
Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Cape Canaveral Air Force Station, Florida

Sample Identification	Analyte	Results	Validation Qualifiers and Reason Codes
CAPEC01-SO-005	PFTrDA	0.00053 mg/kg	J TR
CAPEC01-SO-005	PFUnA	0.00108 mg/kg	J TR
CAPEC01-SO-006	PFDoA	0.000864 mg/kg	J TR
CAPEC01-SO-006	PFHxA	0.000307 mg/kg	J TR
CAPEC01-SO-006	PFOS	0.000562 mg/kg	J TR
CAPEC-FD-GW-001	PFDoA	0.012 µg/L	UJ LCL
CAPEC-FD-GW-001	PFHpA	0.0136 µg/L	J TR
CAPEC-FD-GW-001	PFTeDA	0.012 µg/L	UJ LCL
CAPEC-FD-GW-001	PFTrDA	0.012 µg/L	UJ LCL
CAPEC-FD-SD-001	MeFOSAA	0.0074 mg/kg	UJ MSL
CAPEC-FD-SD-001	PFDA	0.00147 mg/kg	J TR
CAPEC-FD-SD-001	PFDoA	0.0019 mg/kg	UJ MSL
CAPEC-FD-SD-001	PFHpA	0.00127 mg/kg	J TR
CAPEC-FD-SD-001	PFHxA	0.00117 mg/kg	J TR
CAPEC-FD-SD-001	PFHxS	0.000969 mg/kg	J TR
CAPEC-FD-SD-001	PFOA	0.00134 mg/kg	J TR
CAPEC-FD-SD-001	PFOS	0.0259 mg/kg	J MSL
CAPEC-FD-SD-001	PFTeDA	0.0019 mg/kg	UJ MSL
CAPEC-FD-SD-001	PFTrDA	0.0019 mg/kg	UJ MSL
CAPEC-FD-SD-001	PFUnA	0.000979 mg/kg	J TR
CAPEC-FD-SO-001	PFDoA	0.000778 mg/kg	J TR
CAPEC-FD-SO-001	PFHxA	0.000373 mg/kg	J TR
CAPEC-FD-SO-001	PFOS	0.000897 mg/kg	J FDD, TR

Notes:
µg/L = micrograms per liter
EtFOSAA = ethylperfluorooctane sulfonamidoacetic acid
MeFOSAA = methylperfluorooctane sulfonamidoacetic acid
mg/kg = milligrams per kilogram
PFDA = perfluorodecanoic acid
PFDoA = perfluorododecanoic acid
PFHpA = perfluoroheptanoic acid
PFHxA = perfluorohexanoic acid
PFHxS = perfluorohexanesulfonic acid
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
PFTeDA = perfluorotetradecanoic acid
PFTrDA = perfluorotridecanoic acid
PFUnA = perfluoroundecanoic acid

Validation Qualifiers
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Reason Codes
FDD = Field duplicate imprecision.
LCL = Low laboratory control sample recovery. Analytical result may be biased low.
MSL = Low matrix spike recovery. Analytical result may be biased low.
SGH = High surrogate recovery. Analytical result may be biased high.
SGL = Low surrogate recovery. Analytical result may be biased low.
TR = Detected concentration is less than the limit of quantification.

APPENDIX F

IDW NON-HAZARDOUS WASTE MANIFEST

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NON-HAZARDOUS WASTE MANIFEST

NON-HAZARDOUS MANIFEST	1. Generator's US EPA ID No.	Manifest Doc No. 10191	2. Page 1 of 1	

GENERATOR

3. Generator's Name and Mailing Address: Cape Canaveral Air Force Station 1224 Jupiter Street, PAFB FL 32925 4. Generator's Phone: Michael K Bowers 321-853-4289		A. Manifest Number B. State Generator's ID
5. Transporter 1 Company Name EVERGREEN WASTE LLC	6. US EPA ID Number GAR 000 034 710	C. State Transporter's ID D. Transporter's Phone 7707395600
7. Transporter 2 Company Name	8. US EPA ID Number	E. State Transporter's ID F. Transporter's Phone
9. Designated Facility Name and Site Address Covanta 3920 Goshen Industrial Blvd Augusta GA 30906	10. US EPA ID Number	G. State Facility ID H. State Facility Phone 706-771-9100

11. Description of Waste Materials	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt./Vol.	I. Misc. Comments
A NONREGULATED MATERIAL, NONHAZARDOUS	3	DM	165	G	
B NONREGULATED MATERIAL, NONHAZARDOUS	1	DM	350	P	
C					
D					

J. Additional Descriptions for Materials Listed Above	K. Disposal Location			
11A: IDW Water 11 B: IDW Soils	Cell		Level	
	Grid			

15. Special Handling Instructions and Additional Information
MATERIALS FOR INCINERATION ONLY
CCAFS Tracking # 17-209

Purchase Order # EMERGENCY CONTACT / PHONE NO.: 256-759-3922 DANIELLE WASKE

16. GENERATOR'S CERTIFICATE:
I hereby certify that the above-described materials are not hazardous wastes as defined by CFR Part 261 or any applicable state law, have been fully and accurately described, classified and packaged and are in proper condition for transportation according to applicable regulations.

Printed Name	Signature	Month	Day	Year
MICHAEL K. BOWERS	[redacted]	10	20	17

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed Name	Signature	Month	Day	Year
David Muldrow	[redacted]	10	20	17

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed Name	Signature	Month	Day	Year

FACILITY

19. Certificate of Final Treatment/Disposal
I certify, on behalf of the above listed treatment facility, that to the best of my knowledge, the above-described waste was managed in compliance with all applicable laws, regulations, permits and licenses on the dates listed above.

20. Facility Owner or Operator: Certification of receipt of non-hazardous materials covered by this manifest.

Printed Name	Signature	Month	Day	Year

White- TREATMENT, STORAGE, DISPOSAL FACILITY COPY Blue- GENERATOR #2 COPY Yellow- GENERATOR #1 COPY

Pink- FACILITY USE ONLY Gold- TRANSPORTER #1 COPY