Final

Site Inspection Report
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Per- and Polyfluoroalkyl Substances Impacted Sites
ARNG Installations, Nationwide

March 2022

Prepared for

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

UNCLASSIFIED

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%	Percent
µg/kg	Microgram(s) per kilogram
µg/L	Microgram(s) per liter
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous Film Forming Foam
amsl	Above mean sea level
ANG	Air National Guard
AOI	Area of Interest
ARNG	Army National Guard
bgs	Below ground surface
bmsl	Below mean sea level
btoc	Below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Conceptual site model
DA	Department of the Army
DANG	Delaware Air National Guard
DNREC	Delaware Department of Natural Resources and Environmental Control
DEARNG	Delaware Army National Guard
DoD	Department of Defense
DPT	Direct-push technology
DQI	Data Quality Indicator
DQO	Data Quality Objectives
EA	EA Engineering, Science, and Technology, Inc., PBC
EIS	Extraction internal standards
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EB	Equipment Blank
FB	Field blank
ft	Foot (feet)
HA	Health Advisory
HDPE	High-density polyethylene
HQ	Hazard Quotient
IDW	Investigation-derived waste
ITRC	Interstate Technology Regulatory Council

LC/MS/MS	Liquid Chromatography Tandem Mass Spectrometry
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LOQ	Limit of quantification
MS	Matrix spike
MSD	Matrix spike duplicate
NCANGB	New Castle Air National Guard Base
NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	N-ethylperfluorooctane sulfonamidoacetic acid
ng/L	Nanogram(s) per liter
NMeFOSAA	N-methylperfluorooctane sulfonamidoacetic acid
No.	Number
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPD	Relative percent difference
SI	Site Inspection
SL	Screening level
TCRA	Time Critical Removal Action
TOC	Total organic carbon
TPP	Technical Project Planning
UCMR3	Unregulated Contaminant Monitoring Rule 3
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

The Army National Guard (ARNG) G9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at per- and polyfluoroalkyl substances (PFAS)-impacted sites at ARNG facilities nationwide. The objective of the SI at each facility is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS) at or above screening levels (SLs). An SI was completed at the Duncan Readiness Center (RC) and Army Aviation Support Facility (AASF). The Duncan RC and AASF is also referred to as the "facility" throughout this document.

The facility, operated by the Delaware ARNG (DEARNG), encompasses approximately 17.3 acres in New Castle, Delaware. The facility is located adjacent to the New Castle Airport, approximately 5.6 miles southwest of the City of Wilmington. Delaware's Air National Guard base is located across airport taxiways to the northeast. The Duncan RC and AASF lies within the Coastal Plain region of Delaware, which is composed of variegated silts and clays. DEARNG leased the property from the New Castle Airport in 1973 for a 50-year term and has been used as an active military facility since. The Duncan RC and AASF is currently, and has been historically, used for aircraft maintenance and administrative purposes. The facility includes an aircraft hangar, administrative offices, and helicopter landing pads.

The PA Report (AECOM Technical Services, Inc. 2020) identified one potential PFAS release area at the facility, the 1970s Helicopter Crash Site. Additionally, during SI scoping meetings with the ARNG, the Hangar was determined to be a potential PFAS release area. The release areas were grouped into two AOIs: AOI 1, which includes the Helicopter Crash Site, and AOI 2, which includes the Hangar. The SI field activities were conducted from 2 to 3 June 2021 and included the collection of soil and groundwater samples.

To fulfill the project Data Quality Objectives set forth in the approved installation-specific Uniform Federal Policy – Quality Assurance Project Plan Addendum (EA 2021b), samples were collected and analyzed for a subset of 24 PFAS via liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual Version 5.3 Table B-15. The 24 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.8** of this SI Report.

The Department of Defense (DoD) has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense dated 15 September 2021 (Deputy Assistant Secretary of Defense 2021). The ARNG PFAS SIs follow this DoD policy and, should the maximum site concentration for sampled media exceeds the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table ES-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil and groundwater within the boundaries of the facility may be impacted with other PFAS analytes.

Chemical concentrations from samples were compared against the project SLs as described in **Table ES-1**. A summary of the results of the SI data relative to the SLs is as follows:

- AOI 1 – PFOS or PFOA were detected in groundwater at concentrations exceeding the individual SLs of 40 nanograms per liter (ng/L) in all temporary well locations associated with AOI 1, with maximum concentrations of PFOS at 150 ng/L and PFOA at 120 ng/L at locations AOI01-02 and AOI01-01, respectively. PFBS was detected in groundwater at AOI 1, but did not exceed the SL.

- AOI 2 – PFOA, PFOS, and PFBS were detected in groundwater at AOI 2. PFOA exceeded the SL in groundwater with a concentration of 230 ng/L at AOI02-01. PFOS and PFBS did not exceed the SLs.

- AOI 1 and 2 – PFOA and PFOS were detected in soil at both AOI 1 and 2 at low concentrations, several orders of magnitude below the SLs. There were no detections of PFBS at either AOI.

- Upgradient Boundary Samples – PFOA, PFOS, and PFBS were detected in groundwater upgradient of AOI 1 and AOI 2 in samples taken from locations DAASF-01 and DAASF-02. The sample taken from location DAASF-02 exceeded the PFOA SL with a concentration of 150 ng/L, but there were no exceedances in the sample taken from location DAASF-01. The sample taken from location DAASF-03, located along the northeastern facility boundary, also exceeded the SL for PFOA with a concentration of 280 ng/L.

- Downgradient Boundary Samples - PFOA was detected in groundwater at downgradient location MW-15 with a concentration of 100 ng/L, exceeding the SL. PFBS and PFOS were detected at this location below their respective SLs.

- Recommendations – Based on the results of the SI, further evaluation of AOIs 1 and 2 are warranted in a Remedial Investigation.

Table ES-2 summarizes the SI results for soil and groundwater. Based on the conceptual site models which were updated with the SI findings, there is potential for exposure to residential drinking water receptors caused by potential DoD activities at the facility as well as potential and known off-facility adjacent sources.

Table ES-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOI 1: Helicopter Crash Site and AOI 2: Hangar.

Table ES-1 Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg) [1]	Industrial / Commercial Composite Worker (Soil) (µg/kg) [1]	Tap Water (Groundwater) (ng/L) [1]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:
1. Deputy Assistant Secretary of Defense. 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. 15 September 2021.

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

Table ES-2 Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Helicopter Crash Site	◐	●	●
2	Hangar	◐	●	●

Legend:
● = Detected; exceedance of screening levels.
◐ = Detected; no exceedance of screening levels.
○ = Not detected.

Table ES-3. Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Helicopter Crash Site	Exceedances of the SLs in groundwater at source area. No exceedances of SLs in soil.	Proceed to RI
2	Hangar	Exceedances of SLs in groundwater at source area. No exceedances of SLs in soil.	Proceed to RI

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1. INTRODUCTION

1.1 PROJECT AUTHORIZATION

The Army National Guard (ARNG) G9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) for Per- and Polyfluoroalkyl Substances (PFAS)-impacted sites at ARNG facilities nationwide. This work is supported by the U.S. Army Corps of Engineers (USACE) Baltimore District and their contractor, EA Engineering, Science, and Technology, Inc., PBC, (EA) under Contract Number (No.) W912DR-19-D-0005, Task Order No. W912DR20F0383. The ARNG performed this SI at the Duncan Readiness Center (RC) and Army Aviation Support Facility (AASF) (also referred to as the "facility") in Delaware.

The SI project elements were performed by EA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. Environmental Protection Agency [USEPA] 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA 1994), and in compliance with Army requirements and guidance for field investigations, including specific requirements for sampling for perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as PFAS. The term PFAS will be used throughout this plan to encompass all PFAS chemicals being evaluated, including PFOS, PFOA, and PFBS, which are the key components of the suspected releases being evaluated, along with the other 21 related compounds listed in the task order.

1.2 SI PURPOSE

A PA was performed at the facility (AECOM Technical Services, Inc. [AECOM] 2020) that identified a single potential PFAS release area, which was grouped into one Area of Interest (AOI). The SI was performed as the next step in the CERCLA process. During the SI scoping process a second AOI was identified. The objective of the SI was to identify whether there has been a release to the environment from the AOIs and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs).

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA 2005), an SI has five goals:

1) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

2) Determine the potential need for a removal action (i.e., Time Critical Removal Action [TCRA]; applies to drinking water only).

3) Collect or develop data to evaluate the release.

4) Collect additional data to develop the conceptual site model (CSM) in preparation for an effective remedial investigation (RI).

5) Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD).

In addition to the USEPA identified goals of an SI, the ARNG SI effort also identifies whether there are any impacts from potential off-facility PFAS sources.

2. SITE BACKGROUND

2.1 FACILITY LOCATION AND DESCRIPTION

The facility occupies 17.3 acres in New Castle, Delaware, adjacent to the New Castle Airport. Wilmington, Delaware, located 5.6 miles from the facility, is the nearest metropolitan area. Delaware's Air National Guard (DANG) base is located across the airport taxiways to the northeast. The surrounding properties are primarily zoned for single-family homes and businesses.

The facility property and the present day Wilmington Airport was an active duty Air Force Base in the 1940s. In 1949, the War Department started parceling the property. In 1973, the State of Delaware issued the DEARNG a certificate of title for the portion of the property containing the AASF and Duncan RC, and has since been used as an active military facility. The facility is comprised of an aircraft hangar to house machinery, several administrative offices, and helicopter landing pads. The AASF houses the maintenance hangar and the Duncan RC houses the administrative offices. Airport runways and taxiways are located directly adjacent to the facility, which is protected by a guarded gate (AECOM 2020). The facility location and layout are shown on **Figure 2-1**.

2.2 FACILITY ENVIRONMENTAL SETTING

Located in northern New Castle County, Delaware, southwest of Wilmington, Delaware, the facility is approximately 64 feet (ft) above mean sea level (amsl). The Christina River, located north of the facility, is part of the Christina River Basin reaching into Pennsylvania and Maryland and flows generally northeast into the Delaware River. The Delaware River, located east of the facility, flows south until it merges into the Delaware Bay. Ground surface within the facility is predominantly covered by buildings, asphalt, and concrete; however, green space exists around the parking lot and on the southwestern corner of the property, surrounding the stormwater detention basin. The facility lies within the Coastal Plain region of Delaware, which is composed of variegated silts and clays and is a predominantly low, flat area about 100 ft amsl (AECOM 2020).

The following sections include information on geology, hydrogeology, hydrology, climate, and current and future land use. The facility topography at Duncan RC and AASF are shown on **Figure 2-2**. The regional geology and groundwater features are shown on **Figure 2-3**. The regional surface water features and drainage basins are shown on **Figure 2-4**. Groundwater elevations and contours are presented on **Figure 2-5**.

2.2.1 Geology

The facility lies within the northern edge of the Atlantic Coastal Plain Province, which consists of semi- and unconsolidated fluvial deposited sediments. The Columbia Formation, middle Pliestocene in age, overlies the older Cretaceous Potomac Formation at the facility, dipping to the east. These formations were deposited in non-marine, fluvial environments (EA 2019).

The Columbia formation is characterized by fine to coarse, feldspathic quartz sand with varying amounts of gravel and scattered beds of tan to reddish-gray clayey silt. The Columbia Formation in New Castle County ranges in thickness from less than 10 ft to over 130 ft, where it occurs in channel deposits.

Eroded surfaces within the underlying Potomac Formation are filled by sediments of the Columbia Formation, forming paleo-channels that trend northeast to southwest with a thickness of approximately 70 ft. A paleo-channel is located adjacent to the New Castle Airport to the east. The Potomac Formation consists of interbedded dark-red, gray, pink, and white silty clay to clayey silt and fine to medium sand. Underlying the Potomac Formation is the Lower Paleozoic Wilmington Complex, consisting of felsic and mafic gneiss and minor schist, as well as the Brandywine Blue Gneiss, consisting of granulite facies felsic gneisses (EA 2019).

Soils encountered during the SI consisted mainly of silts, sands, some gravel, and minor clay lenses. Bedrock was not encountered during drilling.

2.2.2 Hydrogeology

New Castle County, Delaware, has two aquifers: the Columbia and Potomac. The Columbia is the surficial aquifer in this area and can either be perched or act as a hydrologic unit with the Potomac aquifer. A previous investigation was conducted by the ANG approximately 1 mile from the facility. At the time of the PA, it was inferred that the geologic information provided in this investigation was similar to that at the facility due to its proximity. The study indicated that the Columbia Formation in this area is predominantly dry, with perched water tables present. The Potomac aquifer consists of two independent (Upper and Middle), laterally continuous sand bodies within the water-bearing zones of the Potomac Formation. The water table under normal conditions sits at an elevation of approximately 20 to 30 ft amsl (AECOM 2020). During the SI, depth to water ranged from 25.88 to 32.89 ft (**Figure 2-5**).

The Upper Potomac aquifer lies in both the shallow and intermediate groundwater-bearing zones. The shallow zone extends from 0 to 30 ft amsl, and there is no clear distinction between the surficial Columbia aquifer and the Upper Potomac aquifer. Separated from the shallow zone by a semi-confining layer of clay, the intermediate groundwater-bearing zone ranges from 1 to 20 ft thick, extends approximately 50 ft below mean sea level (bmsl), and is considered to be part of the Upper Potomac aquifer. Results of groundwater elevation data from a previous investigation at the adjacent ANG facility suggest that the shallow and intermediate zones are interconnected, as they show similar trends in groundwater levels and flow directions (Amec Foster Wheeler 2019). Groundwater elevations calculated using depth to groundwater measurements and survey data collected during the SI indicated groundwater within the shallow and intermediate aquifer underlying the southern and western portions of the facility flows primarily to the north/northeast and to the northwest in the eastern portion of the facility.

The Middle Potomac aquifer is considered the deep groundwater-bearing zone and is separated from the Upper Potomac aquifer by a layer of clay 60 to 80 ft thick; it does not vertically transmit water. Below the clay layer, the aquifer's water-bearing sands extend from 120 to 130 ft bmsl. Groundwater levels are about 5 to 10 ft bmsl, suggesting that the groundwater is

confined, and there is little transmission of water vertically between the Upper and Middle Potomac aquifers. Groundwater in the Middle Potomac aquifer flows to the south-southeast (AECOM 2020).

In New Castle County, south of the Chesapeake and Delaware Canal, approximately 10 miles south of the facility, nearly all drinking water is from groundwater provided by public and private wells. However, north of the canal in northern New Castle County, where the facility is located, groundwater supplies only 30 percent (%) of drinking water (AECOM 2020).

Based on the USEPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, it was indicated during the PA that PFAS were detected in a public water system above the Health Advisory (HA) within 20 miles of the facility between 2013 and 2015. In May 2016, USEPA replaced provisional HAs with a more conservative HA of 70 parts per trillion for PFOS and PFOA, individually or combined. PFAS analyses performed prior to 2016 had method detection limits that were higher than currently achievable. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 but might be detected if analyzed today. The Delaware Department of Natural Resources and Environmental Control (DNREC) reported that Artesian Water Company, a primary drinking water provider in the area, and the City of New Castle Municipal Services Commission detected PFAS in public water supply wells within the area of the facility. The area of investigation is approximately 7 square miles and is bounded to the north by Interstate 295, the Delaware River to the east, Route 273 to the south, and Route 13 and New Castle Airport to the west. This area of PFAS contamination includes New Castle County Airport, the facility property, and surrounding residential areas. The public water supply is treated for PFAS contamination prior to distribution (AECOM 2020).

EDR™ conducted a well search for a 1-mile radius surrounding the facility and it was noted that there are eight private domestic groundwater supply wells within 1 mile of the facility. In November 2016, in response to the previously described lowering of the HA levels, USEPA collected samples from one of these private wells located approximately 1 mile northwest of Duncan RC and AASF. While PFOS was not detected in any collected samples, PFOA was detected in exceedance of the HA. Attempts were made by DNREC and USEPA to further investigate the well, however, the owner did not respond (USEPA 2018a).

Using additional online resources, such as state and local geographic information system databases, wells were researched to a 4-mile radius of the facility. According to data from the state of Delaware, the majority of wells to the southeast of the facility, deep groundwater's downgradient direction, are monitoring wells. A 2019 USEPA report figure shows four Artesian public water supply wells located 3 miles south of the facility. However, according to interviews with DNREC, there are additional Artesian and City of New Castle Municipal Service Commission public wells located within 3 miles of the facility to the northeast, east, and southeast. North of the facility, shallow groundwater's downgradient direction to the Christina River, there are a combination of monitoring and domestic groundwater wells (AECOM 2020).

2.2.3 Hydrology

North of the facility is the Christina River, a part of the Christina River Basin that extends from Pennsylvania through New Castle County, Delaware. The Christina River Basin is characterized

by dendritic interconnected rivers, streams, and wetlands, with outflow to the Delaware River. The Christina River is in the southernmost area of the basin and flows northeast, into the Delaware River. Surface water accounts for 70% of New Castle County's water supply, the majority of which comes from the Christina River Basin, which provides 60% of New Castle County's water overall. The majority of the Christina River is in New Castle County, with headwaters in Maryland. The Christina River is tidal from just south of the town of Christiana to its convergence with the Delaware River. This section of the Christina lies approximately 1 mile west of the facility and tidal freshwater wetlands occur throughout the area (AECOM 2020).

The facility sits on the Lower Christina River Watershed, at the edge of the Christina Basin, with wetlands lying north of the facility. On facility grounds, runoff flows away from the paved areas and structures into a detention basin on the southern end of the property, where runoff will infiltrate or evaporate. However, surrounding the facility, general surface water flow is north into the Christina River and Nonesuch Creek, which converge downstream and continue northeast to the Delaware River (AECOM 2020).

The facility is closest to the 68-mile marker of the Delaware River. A presentation from the Delaware River Basin Commission provides 2009 PFAS concentration data for media tested along the Delaware River. PFAS were detected in surface water in the section closest to the facility, between river miles 68 and 70. The 2009 PFOA concentration at river mile 68.1 was 0.0277 micrograms per liter (µg/L), and the PFOS concentration was 0.00575 µg/L (AECOM 2020).

2.2.4 Climate

The climate at the facility is humid continental. The Delaware Bay and Atlantic Ocean to the east and south, and the Chesapeake Bay to the west moderate temperature extremes in the winter and summer months. Although the extremes are lessened, the climate at the facility is still continental with hot summers, cold winters, and precipitation throughout the year. Mean annual temperature in New Castle is 54 degrees Fahrenheit (°F). Average annual high temperature for Wilmington, Delaware, in New Castle County, is 64.1 °F and average annual low temperature is 45.8 °F. Annual precipitation for Wilmington is approximately 43 inches of rain and 19 inches of snowfall (AECOM 2020).

2.2.5 Current and Future Land Use

The facility currently resides on a portion of land leased from the New Castle Airport under the terms of a 50-year lease. It has been an active military facility since the signing of the lease in December 1973. The facility is currently used for aircraft maintenance and administrative activities. Future land use is not anticipated to change (AECOM 2020).

2.2.6 Critical Habitat and Threatened/Endangered Species

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

- Birds: Eastern Black Rail, *Laterallus jamaicensis* ssp. *jamaicensis* (Threatened)

- Reptiles: Bog Turtle, *Clemmys muhlenbergii* (Threatened)
- Flowering Plants: Small Whorled Pogonia, *Isotria medeoloides* (Threatened); and Swamp Pink, *Helonias bullata* (Threatened)
- Mammals: Northern Long-eared Bat, *Myotis septentrionalis* (Threatened).

2.3 HISTORY OF AQUEOUS FILM FORMING FOAM USE

Aqueous film forming foam (AFFF), a firefighting agent, was commonly used by the U.S. military to extinguish petroleum fires, for firefighting training, and for the suppression of fires in uncontained areas. Military use of AFFF began in the 1970s and was most widely used at DoD installations with airfields. Two Potential PFAS release areas were identified at the Duncan RC and AASF. The first AOI was identified where AFFF-containing firefighting foam may have been released onsite at the Duncan RC and AASF by the municipal fire department when they responded to a helicopter crash that occurred at the site boundary in the 1970s. Interviews and records obtained during the PA indicate that the facility's hangar fire suppression system has contained JET-X since a 2011 retrofitting. This synthetic foam concentrate is intended for firefighting applications but it is unknown if it is PFAS-containing. There is also uncertainty as to what type of foam was contained in the fire suppression system prior to the 2011 retrofitting. As such, the SI included the hangar as a potential AOI for investigation. A more detailed description of each AOI is presented in **Chapter 3**.

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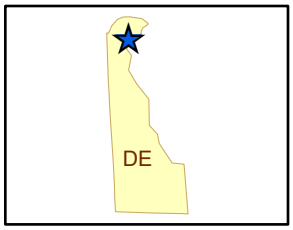
Army National Guard Site Inspections
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 2-1
Facility Location



Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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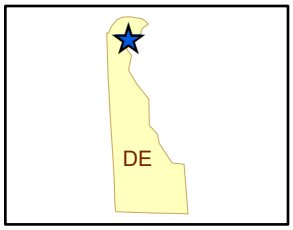
Army National Guard Site Inspections
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 2-2
Topography



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Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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Army National Guard Site Inspections
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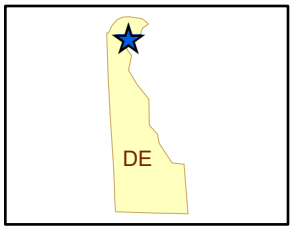
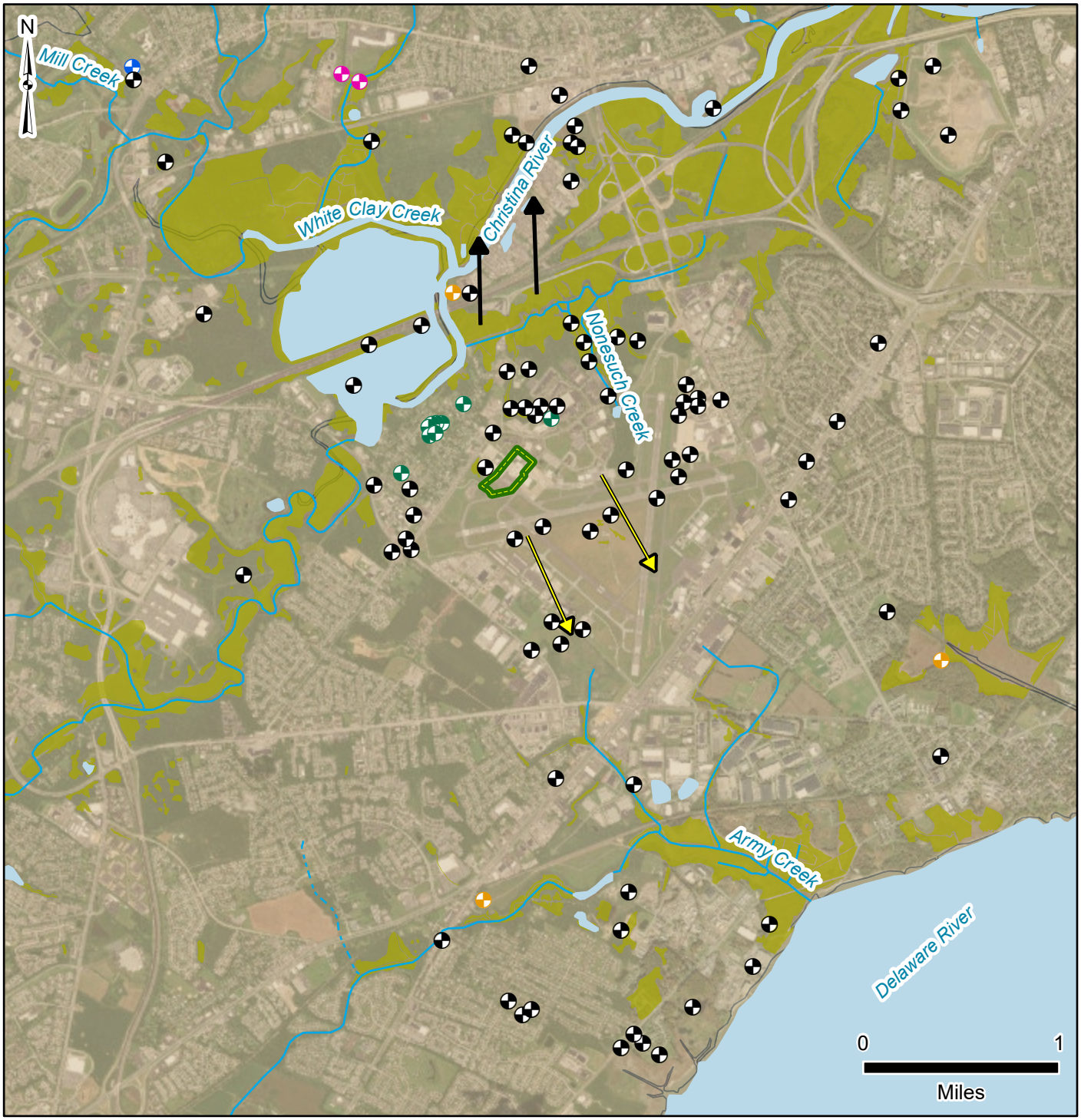
Duncan RC and AASF, Delaware

Figure 2-3
Groundwater Features





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Facility Data
- Facility Boundary

Well Type
- Agriculture
- Domestic
- Irrigation
- Monitoring
- Other

Hydrogeology
- Inferred Shallow Groundwater Flow Direction
- Inferred Deep Groundwater Flow Direction

Geology
- Potomac Formation

Hydrology
- Perennial Stream/Creek
- Intermittent Stream/Creek
- Waterbody
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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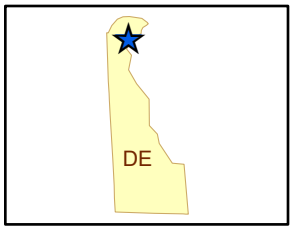
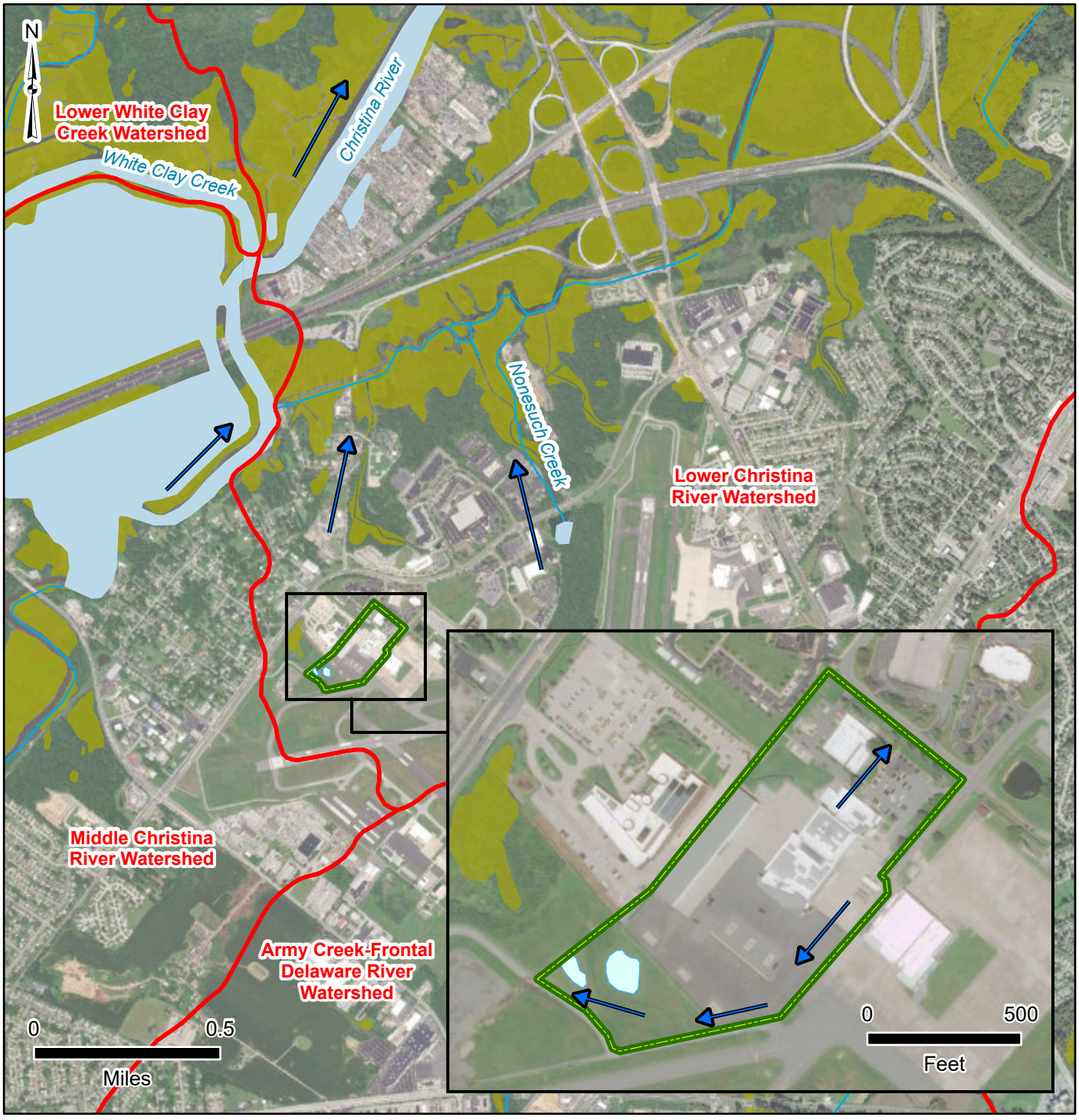
Army National Guard Site Inspections
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 2-4
Surface Water Features





Facility Data
- Facility Boundary

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

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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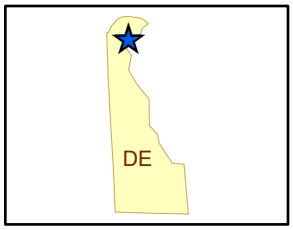
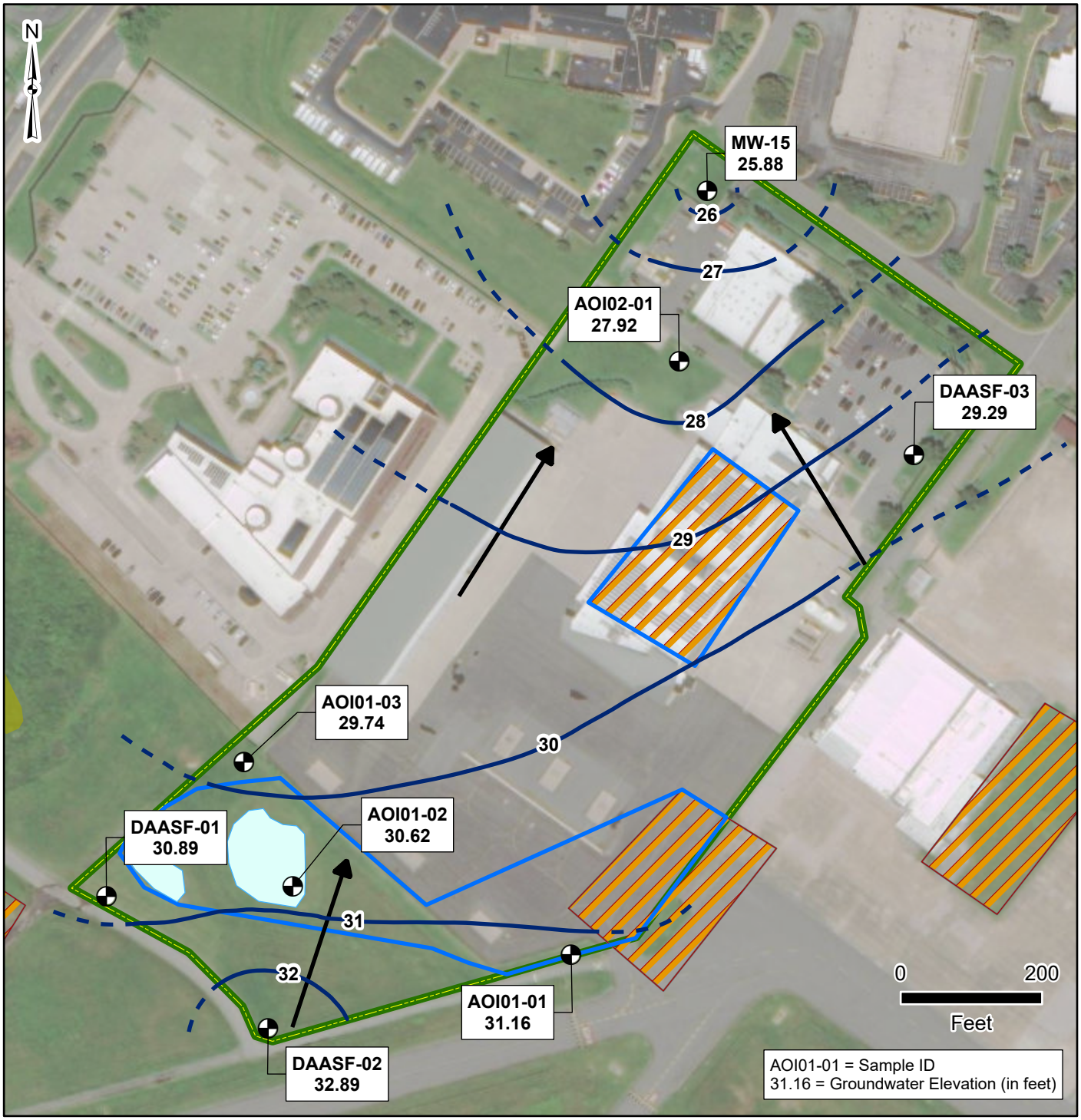
Duncan RC and AASF, Delaware

Figure 2-5
Groundwater Contours and Elevation in Feet Above Mean Sea Level





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Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Hydrogeology
- Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour Interval (1 foot)
- Dashed where Inferred

Hydrology
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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3. SUMMARY OF AREAS OF INTEREST

Based on the PA findings, one AOI was identified at the Duncan RC and AASF: AOI 1 Helicopter Crash Site. A second AOI was identified at the facility during scoping for the SI: AOI 2 Hangar. Additionally, several adjacent potential sources of PFAS have been identified (**Figure 3-1**). A summary of the AOIs and the adjacent potential sources is presented below.

3.1 AOI 1

3.1.1 Helicopter Crash Site

The ARNG Helicopter Crash Site is located on the southeastern boundary between the facility and the New Castle Airport properties. The crash occurred sometime in the 1970s. Historical knowledge suggests the municipal fire department responded to the scene using a foam fire suppressant; however, it is unknown if the foam contained AFFF. The municipal fire department is known to use AFFF to extinguish fires. The released foam likely followed onsite surface water pathways towards the southwestern portion of the facility, where runoff collects in a detention basin until it evaporates or infiltrates to the subsurface. The facility layout has been reconstructed since the time of the crash, and the suspected crash area is now mostly covered by an impervious concrete surface (AECOM 2020).

3.2 AOI 2

3.2.1 Hangar

The hangar has been an active military facility since the signing of the property lease in December 1973. Based on a review of historical aerial photographs, the site was initially developed to include a hangar; however, no information regarding the previous fire suppression system associated with the original hangar was found. According to interviewees, at the completion of renovations of the hangar and administrative wing in 2011, the existing fire suppression system in the hangar was retrofitted with a Jet-X 2% high expansion foam concentrate system. During retrofitting, the previous system was discharged with an aqueous soap and water solution to test functionality before Jet-X was placed in the system. Prior to the installation of the Jet-X deluge system, the fire suppression system was equipped with foam which was suspected to be non-PFAS containing. However, interviewees could not confirm the foam type. The storage tank for the current deluge system is located inside the fire suppression equipment room, which is accessible from outside of the building. The foam deluge system, automatic sprinkler system, and dry pipe sprinkler system are all checked on a quarterly basis by Allegiant Fire Protection. A release in the hangar would follow surface water drainage pathways to the north, subsequently infiltrating in the surrounding grass. It is unknown if Jet X is PFAS-containing. However, there is uncertainty as to what type of foam was contained in the fire suppression system prior to the 2011 retrofitting. As a result, the ARNG conservatively operated under the potential for the historic (prior to 2011) fire suppression foam to be PFAS-containing.

3.3 ADJACENT SOURCES

Six potential off-facility sources of PFAS are adjacent to the facility and are not under the control of the Delaware ARNG (DEARNG). A description of each off-facility source is presented below and shown on **Figure 3-1**.

3.3.1 Delaware Auto Salvage Fire

A fire started in July 2018 at the Delaware Auto Savage, approximately 1.3 miles from the Duncan RC and AASF. An estimated 400 vehicles ignited, but it is unknown how the fire began. Emergency response units came from the surrounding cities in order to control the fire using only water, as reported by the local news agencies. There is no suspected PFAS release at this location attributable to the use of AFFF (AECOM 2020). The Delaware Auto Salvage Fire occurred downgradient and is unlikely to impact the facility.

3.3.2 Delaware State Fire School

Firefighting training exercises are conducted approximately 0.5 mile north of the Duncan RC and AASF at the Delaware State Fire School New Castle. It is unknown if the foam used during these trainings contains AFFF. The Delaware Fire School has been identified as a potential off-facility source of PFAS (AECOM 2020). The Delaware State Fire School is located downgradient and is unlikely to impact the facility.

3.3.3 Aircraft Crash Site

While on a test flight, a military aircraft touched the ground and ignited a small fire in 1991. The Delaware Air National Guard (DANG) fire department responded to this event, but it is unknown whether AFFF was used to extinguish the fire. Based on the prevalent use of AFFF by the DANG, the crash site has been identified as a potential off-facility source of PFAS (AECOM 2020). The Aircraft Crash Site is located upgradient and has the potential to impact the facility.

3.3.4 DANG Fire Training Area

The DANG's current operational Fire Training Area is located approximately 80 ft southwest of the southwestern corner of the Duncan RC and AASF property. Training with foam has been reported to occur at this location, but it is unknown if the foam is AFFF-containing. The DANG Fire Training Area has been identified as a potential off-facility source of PFAS (AECOM 2020). The DANG Fire Training Area is located up- and cross-gradient and has the potential to impact the facility.

3.3.5 Airplane Crash Site

An aircraft crashed due to malfunctioning landing gear at the adjacent ANG base in November of 2018. There was no fire associated with the crash, and no emergency action was taken. The Airplane Crash Site has no suspected PFAS release (AECOM 2020).

3.3.6 New Castle Air National Guard Base

In 2017, an SI was conducted at the New Castle Air National Guard Base (NCANGB), which is located less than a mile east and cross-gradient of Duncan RC and AASF.

During the investigation, sampling (soil, surface water, and groundwater) was conducted to determine the presence/absence of PFAS at eight potential release locations and the facility boundary (AMEC Foster Wheeler 2019). The results of the surface and subsurface soil analysis indicated that PFAS was detected above the laboratory reporting limit; however, no compounds exceeded the screening criteria in any soil samples. Analytical results from the groundwater samples indicated that two compounds (PFOA and PFOS) exceeded groundwater screening criteria.

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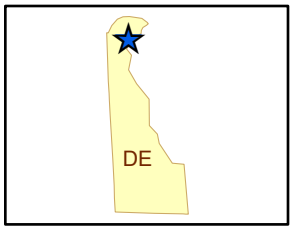
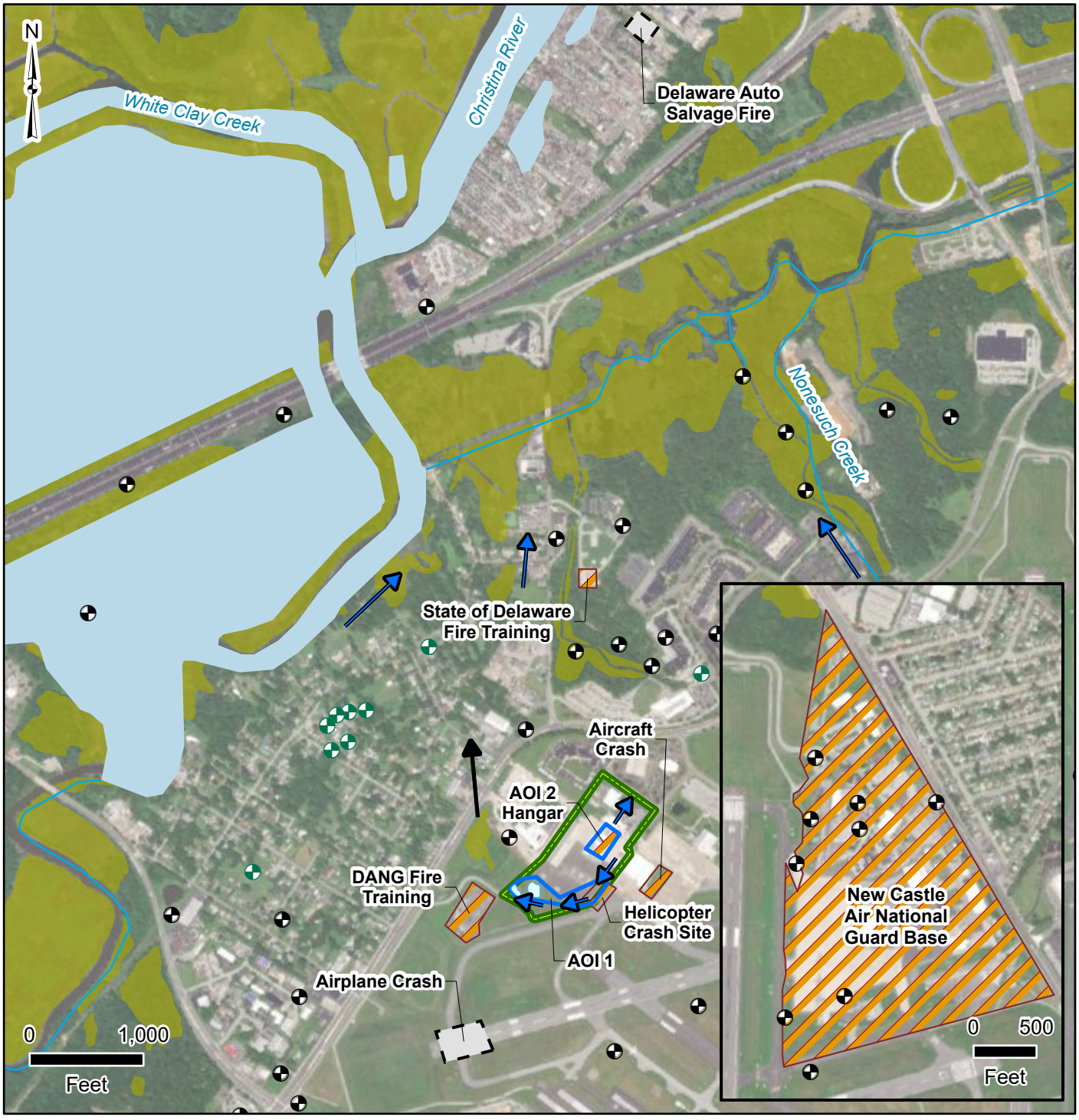
Army National Guard Site Inspections
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 3-1
Areas of Interest





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

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

Hydrology/Hydrogeology
- Domestic Well Location
- Monitoring Well Location
- Surface Water Flow Direction
- Inferred Shallow Groundwater Flow Direction
- Perennial Stream/Creek
- Retention Pond
- Waterbody
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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4. PROJECT DATA QUALITY OBJECTIVES

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data and define the level of certainty required to support the project decision-making process. The specific DQOs established for the Duncan RC and AASF are described below. These DQOs were developed in accordance with the USEPA's seven-step iterative process (USEPA 2006).

4.1 PROBLEM STATEMENT

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

The DoD has adopted a policy to retain facilities in the CERCLA process based on exceedances of risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 September 2021 (Deputy Assistant Secretary of Defense 2021). The ARNG program under which this SI was performed allows/follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the site will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS. Additionally, USEPA issued drinking water lifetime HAs for PFOA and PFOS in May 2016 (USEPA 2016a, 2016b). The USEPA lifetime HAs may also be used as SLs for groundwater samples collected at the facility boundary where off-facility drinking water wells are present downgradient. This determination will be based on localized groundwater flow direction established during the SI. The SLs are presented in **Section 6.1** of this SI Report.

The following quotes from the U.S. Department of the Army (DA) policy documents form the basis for this project (DA 2016b, 2018):

- "The Army will research and identify locations where PFOS and/or PFOA containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider fire training areas, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In additions, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."

- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."

- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels." (USEPA 2016a, 2016b).

4.2 GOALS OF THE STUDY

The goals of the SI include the following:

- Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.
- Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.
- Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.
- Collect or develop data to evaluate the release.
- Collect data to better characterize the release for more effective and rapid initiation of an RI.
- If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).

4.3 INFORMATION INPUTS

Primary information inputs for the SI include the following:

- The PA Report for the Duncan RC and AASF;
- Analytical data collected during other environmental sampling efforts at the Duncan RC and AASF;
- Groundwater, surface water, soil and/or sediment sample data collected in accordance with the Uniform Federal Policy (UFP) – Quality Assurance Project Plan (QAPP) Addendum (EA 2021b); and
- Field data collected including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter.

4.4 STUDY BOUNDARIES

The scope of the SI was bounded horizontally by the property limits of the facility (**Figure 2-1**). Off-facility sampling was not included in the scope of this SI. If future offsite sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s). The scope of the SI was vertically bounded as follows: groundwater (25–40 ft bgs), soil from hand auger borings (0–2 ft bgs) and soil from direct-push technology (DPT) borings (30–40 ft bgs).

4.5 ANALYTICAL APPROACH

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

PFAS data were compared to applicable SLs and decision rules as defined in the UFP-QAPP addendum (EA 2021b). Decision rules were developed for groundwater and soil. These rules governed response actions based on the results of the SI sampling effort.

The decision rules described in Worksheet #11 of the UFP-QAPP Addendum identify actions based on the following:

Groundwater:

1. Is there a human receptor within 4 miles of the facility?

2. What are the concentrations of PFOA, PFOS, and PFBS constituents at the potential source area?

3. What is the concentration of PFOA, PFOS, and PFBS constituents at the boundary?

4. What does the CSM suggest in terms of source, pathway, and receptor?

Soil:

1. What is the concentration of PFOA, PFOS, and PFBS constituents in shallow surface soil (0–2 ft bgs)?

2. What is the concentration of PFOA, PFOS, and PFBS constituents in soil (i.e., capillary fringe and bedrock interface) (2–39 ft bgs)?

3. What does the CSM suggest in terms of source, pathway, and receptor?

4.6 DATA USABILITY ASSESSMENT

The Data Usability Assessment is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution and the resulting data have met installation-specific DQOs. Both sampling and analytical activities are considered to assess whether the collected data are of the right type, quality, and quantity to support the decision-making.

Data Quality Indicators (DQIs) (precision, accuracy, representativeness, comparability, completeness, and sensitivity) are important components in assessing data usability. These DQIs are evaluated in the subsequent sections. The results of the evaluation demonstrate that the data presented in this SI report are of high quality overall. Although most of the SI data are considered reliable, a subset of the data was qualified to indicate increased uncertainty due to quality issues. Specific factors that contribute to uncertainty in the dataset are described below. The Data Validation Report (**Appendix A**) presents explanations for all qualified data in greater detail.

4.6.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences (RPDs), and laboratory precision is measured with RPDs for laboratory duplicates, such as laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) pairs and matrix spike (MS) and matrix spike duplicate (MSD) pairs.

LCS/LCSD pairs were prepared by addition of known concentrations of each analyte to a matrix-free media known to be free of target analytes. Results for LCS/LCSD pairs met the criterion of RPD≤30%, as specified in the QAPP Addendum (EA 2021b), demonstrating that the analytical system was in control during sample preparation and analysis.

MS/MSD pairs were prepared, analyzed, and reported for each preparation batch at a rate of 5%. MS/MSD results for PFAS met the criterion of RPD≤30%, as specified in the QAPP Addendum (EA 2021b), demonstrating good analytical precision for the matrix being tested. The MS/MSD pairs analyzed for TOC and laboratory duplicate analyzed for pH had RPDs of 4-5%.

Field duplicate samples were collected at a rate of 10% and analyzed for PFAS to assess the overall sampling and measurement precision for this sampling effort. The field duplicate samples were within the project established precision limits presented in the UFP-QAPP Addendum (50% for solid samples, 30% for water samples) (EA 2021b) or differences were less than the average limit of quantitation (LOQ), indicating acceptable sampling and analytical precision.

No data were qualified due to issues with precision.

4.6.2 Accuracy

Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in calibration verification samples, LCS/LCSD, and MS/MSD, and through extraction internal standards (EIS).

LCS/LCSD samples were prepared by addition of known concentrations of each analyte to a matrix-free media known to be free of target analytes. LCS/LCSD samples were analyzed for each analytical batch and demonstrated that the analytical system was in control during sample preparation and analysis, with the following exceptions. Perfluorooctanesulfonamide (PFOSA) recoveries were high at 190% and 187% in the LCS and LCSD, respectively. Because the LCS/LCSD indicated positive bias and PFOSA was not detected in the 12 associated samples, no data qualifying action was required.

MS/MSDs were performed on soil samples AOI01-HA-04-1 (PFAS), DAASF-03-SB-14-15 (PFAS and TOC), A0101-01-SB-13.5-14 (TOC), and groundwater sample MW15-GW (PFAS). Analyte recoveries in MS/MSD samples demonstrated that the analytical system was in control for both soil and water. Three analytes were outside acceptance limits in the MS and/or MSD performed on sample MW15-GW; however, the concentrations of these analytes detected in the parent sample were greater than four times the spike concentration, and therefore no data qualifying action was required.

EIS for PFAS were added by the laboratory during sample extraction to measure relative responses of target analytes and used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, mass spectrometry ionization efficiencies, and other associated preparation and analytical anomalies. Several field samples displayed EIS area counts less than the lower quality control (QC) limit of 50%. Two positive field sample results were associated with EIS recoveries less than the QC limit, but greater than 20%, and were qualified "J+"; these qualified results are considered usable as estimated values with a positive bias. Eight non-detect field sample results associated with EIS recoveries less than the QC limit, but greater than 20%, were qualified "UJ"; these qualified results are also considered usable. The non-detect results for N-methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA) and N-ethylperfluorooctane sulfonamidoacetic acid (NEtFOSAA) in three soil samples were associated with EIS recoveries less than 20%, and were qualified "X" by the validator, indicating that these results needed further evaluation during the data usability assessment. The project team determined these qualified results were usable for project purposes, and these six NMeFOSAA and NEtFOSAA soil results were therefore UJ qualified.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. All calibration verifications were within the project established precision limits presented in the UFP-QAPP Addendum (EA 2021b).

4.6.3 Representativeness

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

Relating to the use of standard analytical methods, the laboratory followed the method as established in PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15, including the specific preparation requirements (i.e., ENVI-Carb or equivalent used), mass calibration, spectra, all the ion transitions identified in table B-15 were monitored, standards that contained both branch and linear isomers when available were used, and isotopically labeled standards were used for quantitation. The laboratory also followed the required methods for analysis of pH (USEPA SW-846 Method 9045D) and TOC (USEPA SW-846 Method 9060A). The laboratory used approved standard methods in accordance with the UFP-QAPP Addendum (EA 2021b) for all analyses.

Field QC samples were collected to assess the representativeness of the data collected. Field duplicates were collected at a rate of 10% for analysis of PFAS and MS/MSD samples were collected at a rate of 5%. Appropriate preservation techniques were followed by the field staff, and maximum holding times for extraction and analysis were met by the laboratory.

Instrument blanks and method blanks were prepared by the laboratory in each batch as a negative control. Instrument blanks and method blanks were non-detect for all target analytes.

The potable water that was used for decontamination of drilling equipment was analyzed at the laboratory for PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15 prior to field activities. This source water sample was non-detect for all target analytes. The laboratory results for the source water sample are provided in appendix F and the data validation report is provided in appendix A.

Equipment blanks (EBs) and field blanks (FBs) were also collected for groundwater and soil samples for analysis of PFAS. All FBs were non-detect for target analytes. PFOS was above the detection limit in an EB associated with eight groundwater samples. Three detections of PFOS in associated field samples were less than five times the concentration detected in the blank, but greater than the LOQ, and were qualified "J+." These qualified results are considered usable as estimated values with a positive bias. Two detections of PFOS in associated field samples that were less than the limit of detection were qualified as "U." These results are usable as qualified and treated as non-detects. PFOS detections in associated samples that were greater than five times the concentration detected in the blank were not qualified.

4.6.4 Comparability

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures helps ensure comparability.

Standard field sampling and typical laboratory protocols were used during the SI and are considered comparable to ongoing investigations.

4.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. The laboratory provided data meeting system QC acceptance criteria for all samples tested. Project completeness was determined by evaluating the planned versus actual quantities of data. Percent completeness per parameter is as follows and reflects the exclusion of "R" flagged data:

- PFAS in groundwater by LC/MS/MS compliant with QSM 5.3 Table B-15 at 100%;
- PFAS in soil by LC/MS/MS compliant with QSM 5.3 Table B-15 at 100%
- pH in soil by USEPA SW-846 Method 9045D at 100%; and
- Total organic carbon (TOC) in soil by USEPA SW-846 Method 9060A at 100%.

4.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a detection limit study, and calibration standards at the LOQ. In order to meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project LOQs specified in the UFP-QAPP Addendum (EA 2021b). The laboratory provided applicable calibration standards at the LOQ and reported all field sample results at the lowest possible dilution. Additionally, any analytes detected below the LOQ and above the detection limit were reported and qualified "J" as estimated values by the laboratory.

4.6.7 Data Usability Summary

Overall, the data are usable for evaluating the presence or absence of PFAS at the facility. Sufficient usable data were obtained to meet the objectives of the SI and to complete the comparison to risk-based screening levels.

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5. SITE INSPECTION ACTIVITIES

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and was implemented in accordance with the following approved documents.

- *Final Preliminary Assessment Report, Duncan Armory AASF, New Castle, Delaware*, dated June 2020 (AECOM 2020);
- *Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide.* dated December 2020 (EA 2020a);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Duncan Readiness Center and Army Aviation Support Facility, New Castle, Delaware* dated May 2021 (EA 2021b);
- *Final Programmatic Accident Prevention Plan* dated November 2020 (EA 2020b); and
- *Final Site Safety and Health Plan, Duncan Readiness Center and Army Aviation Support Facility, Delaware,* dated February 2021 (EA 2021a).

The SI field activities started on 27 May 2021 with a site visit with USACE, DEARNG, DNREC, and EA to review sample locations and perform utility clearance activities. The SI drilling, sampling, surveying, and site restoration activities were conducted from 2 to 3 June 2021 and included hand auger coring and surface soil sample collection, DPT boring and soil sample collection, temporary monitoring well installation, and grab groundwater sample collection. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021b), except as noted in **Section 5.8**.

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

- Six surface soil samples from six locations (hand auger locations);
- 21 soil samples from seven locations (soil boring direct-push locations);
- Seven grab groundwater samples from seven temporary well locations; and
- One grab groundwater sample from one existing monitoring well location.

Figure 5-1 provides the sample locations for all media across the facility. **Table 5-1** presents the list of samples collected for each medium. Field documentation is provided in **Appendix B**. A log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 PRE-INVESTIGATION ACTIVITIES

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details of these activities are presented below.

5.1.1 Technical Project Planning

The USACE TPP Process, Engineer Manual (EM) 200-1-2 (DA 2016a) defines four phases to project planning: (1) defining the project phase; (2) determining data needs; (3) developing data collection strategies; and (4) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including quantitative and qualitative DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 19 March 2021, prior to SI field activities. Meeting minutes are provided in **Appendix D**. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2.

The stakeholders for this SI include ARNG, DEARNG, USACE, DNREC, representatives familiar with the facility, the regulations, and the community. Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the UFP-QAPP Addendum (EA 2021b). A future TPP meeting will provide an opportunity to discuss SI results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

EA contacted Miss Utility of Delmarva to notify them of intrusive work at the facility. Utility clearance was performed at each of the proposed boring locations on 27 May 2021 with input from the EA field team and DEARNG. General locating services were used to complete the clearance. Additionally, the first 5 ft of each boring were pre-cleared by EA's drilling subcontractor, GSI Mid Atlantic, using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

The potable water source used for decontamination of drilling equipment was confirmed to be PFAS-free prior to the start of field activities. A sample from a deionization water source at the EA Ecotoxicological Laboratory was collected on 31 March 2021, prior to mobilization, and analyzed for PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15. A discussion of the results is presented in **Section 4.6.3**.

5.2 SOIL BORINGS AND SOIL SAMPLING

Soil samples were collected via DPT drilling methods in accordance with Standard Operating Procedure 047 *Direct-Push Technology Sampling* (EA 2021b*).* A Geoprobe® 7822DT dual-tube

sampling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top 5 ft of the boring in compliance with utility clearance procedures.

Three discrete soil samples were planned to be collected for PFAS analysis from each soil boring: one surface soil sample (collected from 0 to 2 ft bgs) and two subsurface soil samples. One subsurface soil sample was to be collected approximately 1 ft above the groundwater table and one was to be collected at the mid-point between the surface and the groundwater table (not to exceed 15 ft bgs). Groundwater was encountered at depths ranging from 20 to 40 ft bgs during drilling. Total boring completion depths, to accommodate temporary well installation, ranged from 25 to 45 ft bgs. Additionally, six surface soil locations (AOI01-HA-01 through AOI01-HA-06) were completed to 2 ft bgs using a hand auger. One surface soil sample was taken from each hand auger boring. The soil borings are shown on **Figure 5-1**, and boring and sample depths are provided in **Table 5-1**. The soil boring locations were selected based on the AOI information provided in the PA (AECOM 2020) and as agreed upon by stakeholders during the TPP and review of the UFP-QAPP Addendum (EA 2021b).

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

Each sample was collected into a laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottle and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM Version 5.3 Table B-15), TOC (USEPA SW-846 Method 9060A) and pH (USEPA SW-846 Method 9045D) in accordance with the UFP-QAPP Addendum (EA 2021b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, EBs were collected at a rate of 5% and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 degrees Celsius (°C) during shipment.

DPT borings were converted to temporary wells, which were subsequently abandoned after sampling and surveying in accordance with the UFP-QAPP Addendum (EA 2021b). After removal of the casings, boreholes were abandoned using soil cuttings and bentonite chips. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces so no additional restoration services were required.

5.3 TEMPORARY WELL INSTALLATION AND GROUNDWATER GRAB SAMPLING

Seven temporary wells were installed using a GeoProbe® 7822DT dual-tube sampling system. Once the borehole was advanced to the desired depth at locations AOI01-01, AOI01-02, AOI01-03, AOI02-01, DAASF-01, DAASF-02, and DAASF-03, a temporary well was constructed of a 5-ft section of 3/4-inch Schedule 40 polyvinyl chloride (PVC) screen with sufficient casing to reach the ground surface. New PVC pipe and screen were used at each location to avoid cross-contamination between locations. The screen intervals for the temporary wells are provided in **Table 5-2**.

Seven temporary wells and one existing permanent well were sampled as part of the field efforts in accordance with existing plans. Groundwater samples were collected using an inertial pump with PFAS-free HDPE tubing. Each sample was collected in laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) after each grab sample was collected in a separate container. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 in accordance with the UFP-QAPP Addendum (EA 2021b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. Two FBs were collected in accordance with the UFP-QAPP Addendum (EA 2021b). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 °C during shipment.

5.4 EXISTING MONITORING WELL GROUNDWATER GRAB SAMPLING

An existing facility monitoring well, MW-15, was sampled as part of the field efforts in accordance with the UFP-QAPP Addendum (EA 2021b). MW-15 has a 2-inch diameter and is screened from 15-25 ft bgs. The groundwater samples were collected using a peristaltic pump with PFAS-free HDPE tubing. The samples were collected in a laboratory-supplied PFAS-free HDPE bottle and labeled using a PFAS-free marker. The monitoring well was purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form during sample collection. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 in accordance with the UFP-QAPP Addendum (EA 2021b).

5.5 SYNOPTIC WATER LEVEL MEASUREMENTS

Groundwater levels were used to monitor site-wide groundwater elevations and assess groundwater flow. Synoptic water level elevation measurements were collected from the newly

installed temporary monitoring wells and the existing well, which was taken from the survey mark on the northern side of the well casing. Groundwater elevation data is provided in **Table 5-3**.

5.6 SURVEYING

The northern side of each new temporary well casing, and the existing well, were surveyed by a state licensed surveyor from Merestone Consultants, Inc. Surveying was accomplished using a real-time kinematic differential global positioning system. Positions were collected in the applicable Universal Transverse Mercator zone projection with World Geodetic System 1984 datum (horizontal) and North American Vertical Datum 1988 (vertical). Surveying data were collected on 3 June 2021 and are provided in **Appendix B3**.

5.7 INVESTIGATION-DERIVED WASTE

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

Soil IDW (i.e., soil cuttings) was placed back into the boring and liquid IDW (i.e., purge water, development water, and decontamination fluids) generated during the SI activities was containerized in one 55-gallon drum which was labeled and secured within the cold storage building. The soil and liquid IDW was not sampled prior to its release or containment and assumes the PFAS characteristics of the associated soil or groundwater samples collected from those source locations. Containerized liquid IDW will be treated with granular activated carbon (GAC) and discharged to the ground as outlined in the Letter Work Plan for Investigation-Derived Material Disposal (EA 2021c).

Other solids such as spent personal protective equipment, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities were disposed of at a licensed solid waste landfill.

5.8 LABORATORY ANALYTICAL METHODS

Samples were analyzed for a subset of 24 PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 at Eurofins Lancaster Laboratories Env, LLC, a DoD ELAP-certified laboratory. The 24 PFAS compounds analyzed as part of the ARNG SI program include the following:

- 4:2 Fluorotelomer sulfonate (4:2 FTS)
- 6:2 Fluorotelomer sulfonate (6:2 FTS)
- 8:2 Fluorotelomer sulfonate (8:2 FTS)
- N-ethylperfluorooctane sulfonamidoacetic acid (NEtFOSAA)
- N-methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutane sulfonate (PFBS)
- Perfluorobutanoic acid (PFBA)

- Perfluorodecane sulfonate (PFDS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptane sulfonate (PFHpS)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexane sulfonate (PFHxS)
- Perfluorohexanoic acid (PFHxA)
- Perfluorononane sulfonate (PFNS)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanesulfonamide (PFOSA)
- Perfluorooctane sulfonate (PFOS)
- Perfluorooctanoic acid (PFOA)
- Perfluoropentane sulfonate (PFPS)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUnA).

Soil samples were also analyzed for TOC using USEPA Method 9060A, pH by USEPA SW-846 Method 9045D and grain size by ASTM D422.

5.9 DEVIATIONS FROM UFP-QAPP ADDENDUM

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

- Two temporary well boring locations, AOI01-01 and DAASF-03, were advanced to 45 ft bgs due to the encountered depth of groundwater. This deviation from the UFP-QAPP Addendum was discussed with and approved of by ARNG, USACE, and DNREC.

- Temporary wells were constructed of ¾-inch Schedule 40 PVC as opposed to the 1-inch Schedule 40 PVC that was proposed in the UFP-QAPP Addendum.

- Due to depth of some of the temporary wells (greater than predicted by available data), a peristaltic pump could not generate enough lift to bring groundwater to the surface; therefore, groundwater samples were collected using a stainless-steel check valve inertial pump. When using the inertial pump, a minimum of five well volumes of water was removed from each temporary well prior to recording water quality parameters and collecting the sample.

- Field duplicate samples were not collected and analyzed for total organic carbon or pH. Total organic carbon and pH are not undergoing formal data validation. These analyses are receiving data verification only.

Table 5-1.
Samples by Medium
Duncan RC and AASF, New Castle, Delaware
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA SW-846 Method 9060A)	pH (USEPA SW-846 Method 9045D)	Comments
Soil Samples						
AOI01-01-SB-1-2	06/02/2021	1-2	X			
AOI01-01-SB-13.5-14	06/02/2021	13.5-14	X	X	X	
AOI01-01-SB-34.5-35.5	06/02/2021	34.5-35.5	X			
AOI01-02-SB-1-2	06/02/2021	1-2	X			
AOI01-02-SB-14-15	06/02/2021	14-15	X			
AOI01-02-SB-19-20	06/02/2021	19-20	X			
AOI01-03-SB-1-2	06/02/2021	1-2	X			
AOI01-03-SB-14-15	06/02/2021	14-15	X			
AOI01-03-SB-22-23	06/02/2021	22-23	X			
AOI02-01-SB-1-2	06/02/2021	1-2	X			
AOI02-01-SB-14-15	06/02/2021	14-15	X			
AOI02-01-SB-21-22	06/02/2021	21-22	X			
DAASF-01-SB-1-2	06/02/2021	1-2	X			
DAASF-01-SB-14-15	06/02/2021	14-15	X			
DAASF-01-SB-31-32	06/02/2021	31-32	X			
DAASF-02-SB-1-2	06/02/2021	1-2	X			
DAASF-02-SB-14-15	06/02/2021	14-15	X			
DAASF-SB-FD1	06/02/2021	14-15	X			Field Duplicate
DAASF-02-SB-34-35	06/02/2021	34-35	X			
DAASF-03-SB-1-2	06/03/2021	1-2	X			
DAASF-SB-FD2	06/03/2021	1-2	X			Field Duplicate
DAASF-03-SB-14-15	06/03/2021	14-15	X	X	X	
DAASF-03-SB-36-37	06/03/2021	36-37	X			
AOI01-HA-01-1	06/02/2021	1	X			
DAASF-HA-FD1	06/02/2021	1	X			Field Duplicate
AOI01-HA-02-1	06/02/2021	1	X			
AOI01-HA-03-1	06/02/2021	1	X			
AOI01-HA-04-1	06/02/2021	1	X			
AOI01-HA-05-1	06/02/2021	1	X			
AOI01-HA-06-1	06/02/2021	1	X			
Groundwater Samples						
AOI01-01-GW	06/03/2021		X			
AOI01-02-GW	06/03/2021		X			
AOI01-03-GW	06/03/2021		X			
AOI02-01-GW	06/03/2021		X			
DAASF-01-GW	06/03/2021		X			
DAASF-GW-FD	06/03/2021		X			Field Duplicate
DAASF-02-GW	06/03/2021		X			
DAASF-03-GW	06/03/2021		X			
MW15-GW	06/03/2021		X			

Table 5-1.
Samples by Medium
Duncan RC and AASF, New Castle, Delaware
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA SW-846 Method 9060A)	pH (USEPA SW-846 Method 9045D)	Comments
Blank Samples						
DAASF-FB01	06/02/2021	-	X			Field Blank
DAASF-FB02	06/03/2021	-	X			Field Blank
DAASF-EB01	06/02/2021	-	X			Equipment Blank
DAASF-GW-EB1	06/03/2021	-	X			Equipment Blank
DAASF-SB-EB03	06/03/2021	-	X			Equipment Blank

Table 5-2.
Soil Boring Depths and Temporary Well Screen Intervals
Duncan RC and AASF, New Castle, Delaware
Site Inspection Report

Area of Interest	Boring Location	Soil Boring Depth (ft bgs)	Temporary Well Screen Interval (ft bgs)
AOI 1	AOI01-01	45.0	40.0-45.0
	AOI01-02	25.0	20.0-25.0
	AOI01-03	29.0	24.0-29.0
	AOI01-HA-01	2.0	-
	AOI01-HA-02	2.0	-
	AOI01-HA-03	2.0	-
	AOI01-HA-04	2.0	-
	AOI01-HA-05	2.0	-
	AOI01-HA-06	2.0	-
AOI 2	AOI02-01	29.0	24.0-29.0
Duncan RC and AASF Boundary	DAASF-01	37.5	32.5-37.5
	DAASF-02	40.0	35.0-40.0
	DAASF-03	45.0	40.0-45.0

Table 5-3.
Groundwater Elevation
Duncan RC and AASF, New Castle, Delaware
Site Inspection Report

Monitoring Well Identification	Top of Casing Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
AOI01-01	70.56	39.4	31.16
AOI01-02	51.42	20.8	30.62
AOI01-03	53.64	23.9	29.74
AOI02-01	50.08	22.16	27.92
DAASF-01	63.41	32.52	30.89
DAASF-02	68.54	35.65	32.89
DAASF-03	64.91	35.62	29.29
MW-15	37.88	12.0	25.88

Note:
btoc = Below top of casing.

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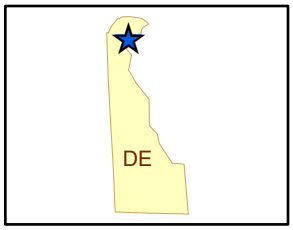
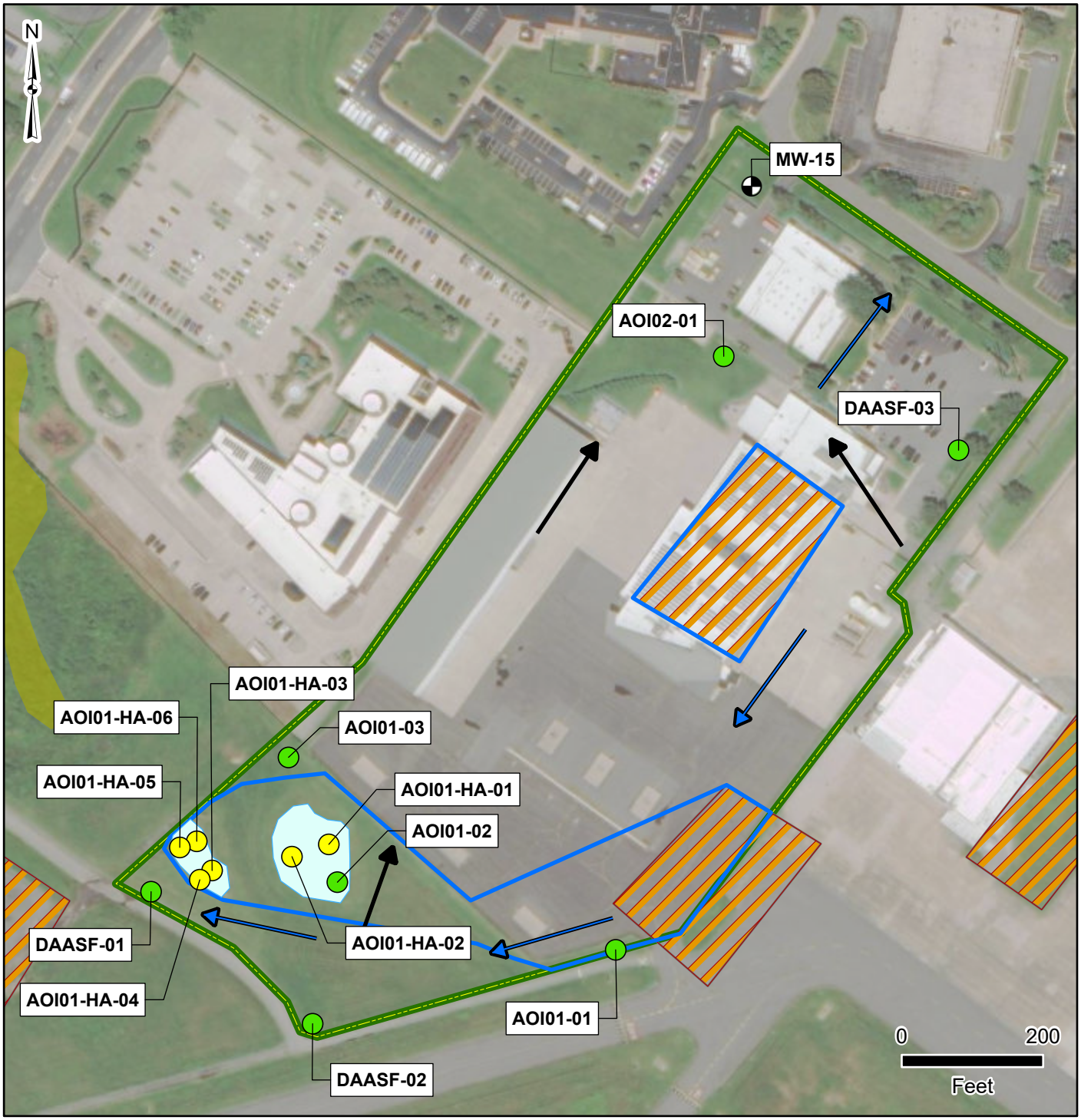
Army National Guard Site Inspections
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 5-1
Site Inspection Sample Locations





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

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Sample Locations
- DPT Boring/Temporary Well Location
- Existing Facility Well Location
- Hand Auger Soil Location

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....February 2021
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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6. SITE INSPECTION RESULTS

This section presents the analytical results of the SI for each AOI. The analytical results are reported and evaluated in the subsequent sections. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for each AOI is provided in **Section 6.3** and **Section 6.4**. **Table 6-2** through **Table 6-4** present PFAS results for samples with detections in soil and groundwater; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 SCREENING LEVELS

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 15 September 2021 (Deputy Assistant Secretary of Defense 2021). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, and the exceedances be attributed to ARNG, the site will proceed to the next phase under CERCLA, which is an RI. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table 6-1**.

All other PFAS results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, sediment, and surface water contain or do not contain PFAS within the boundaries of the facility.

Table 6-1. Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[1]	Industrial / Commercial Composite Worker (Soil) (µg/kg)[1]	Tap Water (Groundwater) (ng/L)[1]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:
1. Deputy Assistant Secretary of Defense. 2021. Risk-Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. 15 September 2021.

6.2 SOIL PHYSICOCHEMICAL ANALYSES

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

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms

include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions, and are therefore relatively mobile in groundwater (Xiao et al., 2015), but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins 2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC 2018).

6.3 AOI 1 – HELICOPTER CRASH SITE

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1, which includes the Helicopter Crash Site. The detected compounds are summarized in **Table 6-2** through **Table 6-4**. **Figures 6-1** through **Figure 6-4** present detections for PFOS, PFBS and PFOA in soil and groundwater.

6.3.1 Soil Analytical Results

PFOA, PFOS, and PFBS concentrations in soil, when detected, did not exceed the soil SLs at AOI 1. **Tables 6-2** and **Table 6-3** summarize the detected compounds in soil. **Figure 6-1** and **Figure 6-2** present the ranges of detections for PFOS, PFBS and PFOA in soil.

Soil was sampled in nine boring locations associated with one potential release area at AOI 1. Soil was sampled from three intervals at locations AOI01-01, AOI01-02, and AOI01-03, and one surface interval at locations AOI01-HA-01 through AOI01-HA-06.

PFOS was detected in the surface interval (1–2 ft bgs) of all boring locations, at concentrations ranging from 0.32 J microgram per kilogram (µg/kg) (AOI01-HA-04) to 6.9 µg/kg (AOI01-HA-03), below the SL of 130 µg/kg. PFOA was detected in all surface interval soil samples, except for boring locations AOI01-HA-04 and AOI-01-HA-05. PFOA concentrations ranged from 0.30 J µg/kg (AOI01-HA-01) to 1.3 µg/kg (AOI01-01), well below the SL of 130 µg/kg. PFBS was not detected in any surface interval samples.

PFOS was detected in one subsurface soil interval (13.4–14.0 ft bgs) at location AOI01-01, at a concentration of 0.67 µg/kg, below the SL of 1,600 µg/kg. PFOA was detected in the subsurface soil samples taken from both intervals (14–15 ft bgs and 22–23 ft bgs) at location AOI01-03, at concentrations of 0.22 J µg/kg and 0.27 J µg/kg, respectively. PFOA detections are below the SL of 1,600 µg/kg. PFBS was not detected in any subsurface interval samples.

6.3.2 Groundwater Analytical Results

Groundwater samples were collected from three temporary wells associated with one potential release area at AOI 1. PFOS and PFOA were detected in groundwater at concentrations exceeding the SL of 40 ng/L. Location AOI01-01, immediately west of the crash site, had a PFOA concentration of 120 ng/L. PFOS and PFBS were also detected in groundwater at this location; however, the detections did not exceed their associated SLs. Location AOI01-02, located west of the crash site within a man-made stormwater detention pond, had a PFOS

detection of 150 ng/L. PFOA and PFBS were also detected in groundwater at this location; however, the detections did not exceed their associated SLs. Location AOI01-03, located north of the detention pond and location AOI01-02, had a PFOS detection of 75 ng/L. PFOA and PFBS were also detected in groundwater at these locations; however, the detections did not exceed their respective SLs. PFBS detections in groundwater at the three locations ranged from 2.1 ng/L to 8.6 ng/L, well below the SL of 600 ng/L. PFOS detections in groundwater at the three locations ranged from 32 ng/L (AOI01-01) to 150 ng/L and PFOA detections ranged from 23 ng/L (AOI01-02) to 120 ng/L.

The detected compounds from groundwater are summarized in **Table 6-4**. **Figure 6-3** presents the ranges of detections for PFOS and PFOA.

6.3.3 Conclusions

Based on the results of the SI, PFBS was not detected in soil at AOI 1, and PFOS and PFOA were detected several orders of magnitude lower than the soil SLs. PFBS was detected in groundwater at concentrations below the SL at all locations. PFOS or PFOA were detected in groundwater at concentrations exceeding the individual SLs of 40 ng/L in all three temporary well locations associated with AOI 1. Based on the exceedances of the SL for PFOS and PFOA in groundwater, further evaluation at AOI 1 is warranted.

6.4 AOI 2 – HANGAR

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2, which includes the facility hangar. The detected compounds are summarized in **Table 6-2** through **Table 6-4**. **Figures 6-1** through **Figure 6-4** present detections for PFOS, PFBS, and PFOA in soil and groundwater.

6.4.1 Soil Analytical Results

PFOA, PFOS, and PFBS concentrations in soil, when detected, did not exceed the soil SLs at AOI 2. **Tables 6-2** and **Table 6-3** summarize the detected compounds in soil. **Figure 6-1** and **Figure 6-2** present the ranges of detections for PFOS and PFOA in soil.

Soil was sampled from three intervals in one boring location (AOI02-01) associated with one potential release area at AOI 2.

PFOS and PFOA were detected in the surface interval (1–2 ft bgs) with concentrations of 0.31 J µg/kg and 0.64 µg/kg, respectively, below the SL of 130 µg/kg. There were no detections of PFOS or PFOA in the subsurface soil sample intervals at this location. PFBS was not detected in any surface or subsurface interval samples.

6.4.2 Groundwater Analytical Results

Groundwater samples were collected from one temporary well associated with one potential release area at AOI 2, located north and hydraulically downgradient of the facility hangar as well as the 1970s Helicopter crash site. PFOA was detected in groundwater at a concentration of

230 ng/L, exceeding the SL of 40 ng/L. PFOS and PFBS were also detected at this location; however, the detections did not exceed their associated SLs (5.7 J+ ng/L and 3.5 ng/L, respectively).

The detected compounds from groundwater are summarized in **Table 6-4**. **Figure 6-3** presents the ranges of detections for PFOS and PFOA.

6.4.3 Conclusions

Based on the results of the SI, PFBS was not detected in soil at AOI 2, and PFOS and PFOA were detected several orders of magnitude lower than the soil SLs. PFBS and PFOS were detected in groundwater at concentrations below the SL. PFOA was detected in groundwater at a concentration exceeding the individual SL of 40 ng/L. Based on the exceedance of the SL for PFOA in groundwater, further evaluation at AOI 2 is warranted.

6.5 BOUNDARY SAMPLE LOCATIONS

This section presents the analytical results for soil and groundwater in comparison to SLs at the facility boundary. The detected compounds are summarized in **Table 6-2** through **Table 6-4**. **Figure 6-1** through **Figure 6-4** present the ranges of detections for PFOS and PFOA.

6.5.1 Soil Analytical Results

PFOA, PFOS, and PFBS concentrations in soil, when detected, did not exceed the soil SLs at the facility boundary. **Tables 6-2** and **Table 6-3** summarize the detected compounds in soil. **Figure 6-1** and **Figure 6-2** present the ranges of detections for PFOS and PFOA in soil.

Soil was sampled from three intervals in three boring locations along the facility boundary: one sample location at the southwestern corner of the facility (DAASF-01), adjacent to the DANG Fire Training area, and two locations along the eastern facility boundary (DAASF-02 and DAASF-03).

PFOS was detected in the surface interval (1–2 ft bgs) at these locations with concentrations ranging from 0.24 J µg/kg to 1.6 µg/kg, below the SL of 130 µg/kg. PFOA was detected within the surface interval at these locations with concentrations ranging from 0.52 J µg/kg to 1.2 µg/kg. PFOA was detected in the 14–15 ft bgs soil interval at locations DAASF-01 (0.77 µg/kg) and DAASF-03 (0.24 J µg/kg), below the SL of 130 µg/kg. PFBS was not detected in any surface or subsurface interval samples.

6.5.2 Groundwater Analytical Results

Groundwater samples were collected from three temporary well locations along the facility boundary (DAASF-01, DAASF-02, and DAASF-03) and one facility monitoring well (MW-15), located in the northernmost, downgradient corner of the facility. While PFOA and PFBS were detected in groundwater at location DAASF-01, there were no exceedances of the associated SLs. Additionally, PFOS was non-detect in groundwater at this location. PFOA was detected at levels which exceed the 40 ng/L SL in groundwater at locations DAASF-02 and DAASF-03,

with concentrations of 150 ng/L and 280 ng/L, respectively. PFOA was detected in groundwater at location MW-15 with a concentration of 100 ng/L, exceeding the SL. PFBS and PFOS were detected in groundwater at all three locations, below their respective SLs.

The detected compounds from groundwater are summarized in **Table 6-4**. **Figure 6-3** present the ranges of detections for PFOS and PFOA.

6.5.3 Conclusions

Based on the results of the SI, PFBS was not detected in soil at the boundary, and PFOS and PFOA were detected several orders of magnitude lower than the soil SLs. PFBS was detected in groundwater at concentrations below the SL at all locations. PFOS was detected in groundwater at concentrations below the SL at all locations, except at location DAASF-01. DAASF-01 had no detection of PFOS. PFOA was detected in groundwater at concentrations exceeding the individual SLs of 40 ng/L in temporary well locations DAASF-02 and DAASF-03, as well as the facility monitoring well location (MW-15). Based on the exceedance of the SL for PFOA in groundwater, further evaluation is warranted.

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Table 6-2 PFAS Detections in Surface Soil,
Site Inspection Report, Duncan RC and AASF

	Area of Interest	AOI01																			
	Location ID	AOI01-01				AOI01-02				AOI01-03				AOI01-HA-01				AOI01-HA-01			
	Sample Name	AOI01-01-SB-1-2				AOI01-02-SB-1-2				AOI01-03-SB-1-2				AOI01-HA-01-1				DAASF-HA-FD1			
	Parent Sample ID																	AOI01-HA-01-1-06022021			
	Depth	1 - 2 ft				1 - 2 ft				1 - 2 ft				1 ft				1 ft			
	Sample Date	6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Soil, PFAS (EPA 537) (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	UJ
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	UJ
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.7	3.2	U	<	1.7	3.2	U	<	1.6	3.1	U	<	1.8	3.4	U	<	1.9	3.5	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.42	2.1	U	<	0.43	2.2	U	<	0.41	2.0	U	<	0.45	2.3	U	<	0.47	2.3	X
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.42	2.1	U	<	0.43	2.2	U	<	0.41	2.0	U	<	0.45	2.3	U	<	0.47	2.3	X
Perfluorobutanesulfonic acid (PFBS)	1,900 [2]	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	U
Perfluorobutanoic acid (PFBA)	-	0.94	1.7	2.1	J	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorodecanoic acid (PFDA)	-	0.94	0.42	0.63		<	0.43	0.65	U	<	0.41	0.61	U	0.26	0.45	0.68	J	0.25	0.47	0.70	J
Perfluorododecanoic acid (PFDoA)	-	0.30	0.42	0.63	J	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluoroheptanoic acid (PFHpA)	-	0.60	0.42	0.63	J	<	0.43	0.65	U	0.27	0.41	0.61	J	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorohexanoic acid (PFHxA)	-	0.60	0.42	0.63	J	<	0.43	0.65	U	0.22	0.41	0.61	J	0.23	0.45	0.68	J	<	0.47	0.70	U
Perfluorononanesulfonic acid (PFNS)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorononanoic acid (PFNA)	-	1.5	0.42	0.63		0.31	0.43	0.65	J	0.37	0.41	0.61	J	0.32	0.45	0.68	J	0.27	0.47	0.70	J
Perfluorooctanesulfonamide (PFOSA)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorooctanesulfonic acid (PFOS)	130 [3]	4.8	0.42	0.63		1.7	0.43	0.65		0.48	0.41	0.61	J	1.7	0.45	0.68		1.3	0.47	0.70	
Perfluorooctanoic acid (PFOA)	130 [3]	1.3	0.42	0.63		0.35	0.43	0.65	J	0.77	0.41	0.61		0.38	0.45	0.68	J	0.30	0.47	0.70	J
Perfluoropentanesulfonic acid (PFPS)	-	<	0.42	3.2	U	<	0.43	3.2	U	<	0.41	3.1	U	<	0.45	3.4	U	<	0.47	3.5	U
Perfluoropentanoic acid (PFPA)	-	0.94	0.42	0.63		<	0.43	0.65	U	0.28	0.41	0.61	J	<	0.45	0.68	U	0.25	0.47	0.70	J+
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U
Perfluorotridecanoic acid (PFTriDA)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	0.24	0.47	0.70	J
Perfluoroundecanoic acid (PFUnA)	-	0.46	0.42	0.63	J	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	0.26	0.47	0.70	J

	Area of Interest	AOI01																			
	Location ID	AOI01-HA-02				AOI01-HA-03				AOI01-HA-04				AOI01-HA-05				AOI01-HA-06			
	Sample Name	AOI01-HA-02-1				AOI01-HA-03-1				AOI01-HA-04-1				AOI01-HA-05-1				AOI01-HA-06-1			
	Parent Sample ID																				
	Depth	1 ft				1 ft				1 ft				1 ft				1 ft			
	Sample Date	6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Soil, PFAS (EPA 537) (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.8	3.4	U	<	2.2	4.2	U	<	1.7	3.2	U	<	1.8	3.3	U	<	1.8	3.4	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.46	2.3	U	<	0.56	2.8	U	<	0.43	2.1	U	<	0.44	2.2	U	<	0.46	2.3	U
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.46	2.3	U	<	0.56	2.8	U	<	0.43	2.1	U	<	0.44	2.2	U	<	0.46	2.3	U
Perfluorobutanesulfonic acid (PFBS)	1,900 [2]	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U
Perfluorobutanoic acid (PFBA)	-	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluorodecanoic acid (PFDA)	-	0.33	0.46	0.69	J	2.0	0.56	0.84		0.24	0.43	0.64	J	0.76	0.44	0.66		0.67	0.46	0.68	J
Perfluorododecanoic acid (PFDoA)	-	0.30	0.46	0.69	J	2.2	0.56	0.84		1.6	0.43	0.64		1.1	0.44	0.66		1.3	0.46	0.68	
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluoroheptanoic acid (PFHpA)	-	0.23	0.46	0.69	J	0.37	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.46	0.69	U	1.1	0.56	0.84		<	0.43	0.64	U	<	0.44	0.66	U	0.51	0.46	0.68	J
Perfluorohexanoic acid (PFHxA)	-	<	0.46	0.69	U	0.40	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluorononanesulfonic acid (PFNS)	-	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluorononanoic acid (PFNA)	-	0.43	0.46	0.69	J	0.65	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.26	0.46	0.68	J
Perfluorooctanesulfonamide (PFOSA)	-	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U
Perfluorooctanesulfonic acid (PFOS)	130 [3]	2.5	0.46	0.69		6.9	0.56	0.84		0.32	0.43	0.64	J	0.56	0.44	0.66	J	2.5	0.46	0.68	
Perfluorooctanoic acid (PFOA)	130 [3]	0.32	0.46	0.69	J	0.74	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.32	0.46	0.68	J
Perfluoropentanesulfonic acid (PFPS)	-	<	0.46	3.4	U	<	0.56	4.2	U	<	0.43	3.2	U	<	0.44	3.3	U	<	0.46	3.4	U
Perfluoropentanoic acid (PFPA)	-	<	0.46	0.69	U	0.75	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.29	0.46	0.68	J
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.46	0.69	U	0.84	0.56	0.84		1.1	0.43	0.64		0.81	0.44	0.66		0.60	0.46	0.68	J
Perfluorotridecanoic acid (PFTriDA)	-	<	0.46	0.69	U	1.4	0.56	0.84		1.7	0.43	0.64		1.0	0.44	0.66		0.86	0.46	0.68	
Perfluoroundecanoic acid (PFUnA)	-	0.25	0.46	0.69	J	4.0	0.56	0.84		1.0	0.43	0.64		1.4	0.44	0.66		1.6	0.46	0.68	

	Area of Interest	AOI02				DAASF															
	Location ID	AOI02-01				DAASF-01				DAASF-02				DAASF-03				DAASF-03			
	Sample Name	AOI02-01-SB-1-2				DAASF-01-SB-1-2				DAASF-02-SB-1-2				DAASF-03-SB-1-2				DAASF-SB-FD2			
	Parent Sample ID																	DAASF-03-SB-1-2-06032021			
	Depth	1 - 2 ft				1 - 2 ft				1 - 2 ft				1 - 2 ft				1 - 2 ft			
	Sample Date	6/2/2021				6/2/2021				6/2/2021				6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Soil, PFAS (EPA 537) (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	UJ	<	1.7	2.1	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.7	3.2	U	<	1.7	3.2	U	<	1.7	3.2	U	<	1.7	3.2	U	<	1.7	3.2	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.43	2.1	U	<	0.43	2.1	U	<	0.43	2.1	U	<	0.42	2.1	X	<	0.43	2.1	X
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.43	2.1	U	<	0.43	2.1	U	<	0.43	2.1	U	<	0.42	2.1	X	<	0.43	2.1	X
Perfluorobutanesulfonic acid (PFBS)	1,900 [2]	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
Perfluorobutanoic acid (PFBA)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorodecanoic acid (PFDA)	-	<	0.43	0.64	U	<	0.43	0.64	U	0.42	0.43	0.64	J	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorododecanoic acid (PFDoA)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroheptanoic acid (PFHpA)	-	<	0.43	0.64	U	0.42	0.43	0.64	J	0.25	0.43	0.64	J	0.45	0.42	0.64	J	0.39	0.43	0.64	J
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.43	0.64	U	1.7	0.43	0.64		<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorohexanoic acid (PFHxA)	-	<	0.43	0.64	U	0.50	0.43	0.64	J	0.26	0.43	0.64	J	0.37	0.42	0.64	J	0.38	0.43	0.64	J
Perfluorononanesulfonic acid (PFNS)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorononanoic acid (PFNA)	-	<	0.43	0.64	U	0.25	0.43	0.64	J	0.53	0.43	0.64	J	0.35	0.42	0.64	J	0.52	0.43	0.64	J
Perfluorooctanesulfonamide (PFOSA)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorooctanesulfonic acid (PFOS)	130 [3]	0.31	0.43	0.64	J	0.84	0.43	0.64		1.6	0.43	0.64		<	0.42	0.64	U	0.24	0.43	0.64	J
Perfluorooctanoic acid (PFOA)	130 [3]	0.64	0.43	0.64		1.0	0.43	0.64		0.52	0.43	0.64	J	1.2	0.42	0.64		0.99	0.43	0.64	
Perfluoropentanesulfonic acid (PFPS)	-	<	0.43	3.2	U	<	0.43	3.2	U	<	0.43	3.2	U	<	0.42	3.2	U	<	0.43	3.2	U
Perfluoropentanoic acid (PFPA)	-	0.30	0.43	0.64	J	0.37	0.43	0.64	J	0.40	0.43	0.64	J	0.61	0.42	0.64	J	0.64	0.43	0.64	
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorotridecanoic acid (PFTriDA)	-	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroundecanoic acid (PFUnA)	-	<	0.43	0.64	U	0.34	0.43	0.64	J	0.28	0.43	0.64	J	<	0.42	0.64	U	<	0.43	0.64	U

Notes
J = Estimated concentration
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
X = Not validated
ng/g = Nanogram per gram
(1) The SL for soil is based on incidental ingestion of soil residential 0-2 ft.
(2) USEPA. 2021. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. Https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed 9 April.
(3) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in soil using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense 2019).
Values exceeding the Screening Level are shaded gray
AOI = Area of Interest
ft = Feet
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD

Table 6-3 - PFAS Detections in Subsurface Soil,
Site Inspection Report, Duncan RC and AASF

Area of Interest																					
Location ID		AOI01-01				AOI01-01				AOI01-02				AOI01-02				AOI01-03			
Sample Name		AOI01-01-SB-13.5-14				AOI01-01-SB-34.5-35.5				AOI01-02-SB-14-15				AOI01-02-SB-19-20				AOI01-03-SB-14-15			
Parent Sample ID																					
Depth		13.5 - 14 ft				34.5 - 35.5 ft				14 - 15 ft				19 - 20 ft				14 - 15 ft			
Sample Date		6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.7	3.2	U	<	1.8	3.4	U	<	1.7	3.1	U	<	1.8	3.4	U	<	1.7	3.2	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.43	2.1	U	<	0.45	2.3	U	<	0.41	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.43	2.1	U	<	0.45	2.3	U	<	0.41	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U
Perfluorobutanesulfonic acid (PFBS)	25,000 [2]	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U
Perfluorobutanoic acid (PFBA)	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorodecanoic acid (PFDA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorododecanoic acid (PFDoA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluoroheptanoic acid (PFHpA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorohexanoic acid (PFHxA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorononanesulfonic acid (PFNS)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorononanoic acid (PFNA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorooctanesulfonamide (PFOSA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorooctanesulfonic acid (PFOS)	1,600 [3]	0.67	0.43	0.64		<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorooctanoic acid (PFOA)	1,600 [3]	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	0.22	0.42	0.63	J
Perfluoropentanesulfonic acid (PFPS)	-	<	0.43	3.2	U	<	0.45	3.4	U	<	0.41	3.1	U	<	0.46	3.4	U	<	0.42	3.2	U
Perfluoropentanoic acid (PFPA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluorotridecanoic acid (PFTriDA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U
Perfluoroundecanoic acid (PFUnA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U

Area of Interest																					
Location ID		AOI01-03				AOI02-01				AOI02-01				DAASF-01				DAASF-01			
Sample Name		AOI01-03-SB-22-23				AOI02-01-SB-14-15				AOI02-01-SB-21-22				DAASF-01-SB-14-15				DAASF-01-SB-31-32			
Parent Sample ID																					
Depth		22 - 23 ft				14 - 15 ft				21 - 22 ft				14 - 15 ft				31 - 32 ft			
Sample Date		6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.7	3.2	U	<	1.9	3.5	U	<	1.8	3.4	U	<	1.7	3.1	U	<	1.9	3.5	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.42	2.1	U	<	0.47	2.3	U	<	0.45	2.2	U	<	0.42	2.1	U	<	0.46	2.3	U
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.42	2.1	U	<	0.47	2.3	U	<	0.45	2.2	U	<	0.42	2.1	U	<	0.46	2.3	U
Perfluorobutanesulfonic acid (PFBS)	25,000 [2]	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U
Perfluorobutanoic acid (PFBA)	-	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorodecanoic acid (PFDA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorododecanoic acid (PFDoA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluoroheptanoic acid (PFHpA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	0.21	0.42	0.63	J	<	0.46	0.70	U
Perfluorohexanoic acid (PFHxA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorononanesulfonic acid (PFNS)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorononanoic acid (PFNA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorooctanesulfonamide (PFOSA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorooctanesulfonic acid (PFOS)	1,600 [3]	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorooctanoic acid (PFOA)	1,600 [3]	0.27	0.42	0.64	J	<	0.47	0.70	U	<	0.45	0.67	U	0.77	0.42	0.63		<	0.46	0.70	U
Perfluoropentanesulfonic acid (PFPS)	-	<	0.42	3.2	U	<	0.47	3.5	U	<	0.45	3.4	U	<	0.42	3.1	U	<	0.46	3.5	U
Perfluoropentanoic acid (PFPA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluorotridecanoic acid (PFTriDA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U
Perfluoroundecanoic acid (PFUnA)	-	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U

Area of Interest																					
Location ID		DAASF-02				DAASF-02				DAASF-02				DAASF-03				DAASF-03			
Sample Name		DAASF-02-SB-14-15				DAASF-02-SB-34-35				DAASF-SB-FD1				DAASF-03-SB-14-15				DAASF-03-SB-36-37			
Parent Sample ID										DAASF-02-SB-14-15-06022021											
Depth		14 - 15 ft				34 - 35 ft				14 - 15 ft				14 - 15 ft				36 - 37 ft			
Sample Date		6/2/2021				6/2/2021				6/2/2021				6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (ng/g)																					
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.8	2.2	U	2.5	1.8	2.2		<	1.7	2.1	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	1.7	3.2	U	<	1.7	3.1	U	<	1.8	3.3	U	<	1.8	3.3	U	<	1.7	3.1	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	0.42	2.1	U	<	0.42	2.1	U	<	0.44	2.2	UJ	<	0.45	2.2	U	<	0.42	2.1	UJ
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	0.42	2.1	U	<	0.42	2.1	U	<	0.44	2.2	UJ	<	0.45	2.2	UJ	<	0.42	2.1	UJ
Perfluorobutanesulfonic acid (PFBS)	25,000 [2]	<	1.7	2.1	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
Perfluorobutanoic acid (PFBA)	-	<	1.7	2.1	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
Perfluorodecanesulfonic acid (PFDS)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorodecanoic acid (PFDA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorododecanoic acid (PFDoA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroheptanesulfonic acid (PFHpS)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroheptanoic acid (PFHpA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorohexanesulfonic acid (PFHxS)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorohexanoic acid (PFHxA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	0.28	0.45	0.67	J	<	0.42	0.63	U
Perfluorononanesulfonic acid (PFNS)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorononanoic acid (PFNA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanesulfonamide (PFOSA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanesulfonic acid (PFOS)	1,600 [3]	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanoic acid (PFOA)	1,600 [3]	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	0.24	0.45	0.67	J	<	0.42	0.63	U
Perfluoropentanesulfonic acid (PFPS)	-	<	0.42	3.2	U	<	0.42	3.1	U	<	0.44	3.3	U	<	0.45	3.3	U	<	0.42	3.1	U
Perfluoropentanoic acid (PFPA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	0.43	0.45	0.67	J	<	0.42	0.63	U
Perfluorotetradecanoic acid (PFTeDA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorotridecanoic acid (PFTriDA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroundecanoic acid (PFUnA)	-	<	0.42	0.63	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U

Perfluoroundecanoic acid (PFUnA)

Notes

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)

ng/g = Nanogram per gram

(1) The SL for soil is based on incidental ingestion of soil industrial/commercial worker >2 ft.

(2) USEPA. 2021. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. Https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed 9 April.

(3) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in soil using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense 2019).

Values exceeding the Screening Level are shaded gray

AOI = Area of Interest

ft = Feet

LOD = Limit of Detection

LOQ = Limit of Quantitation

Qual = Qualifier

< = analyte not detected above the LOD

Cells exceeding the standard in Column B are shaded gray

Table 6-4 - PFAS Detections in Groundwater
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Location ID		AOI01-01				AOI01-02				AOI01-03				AOI02-01				DAASF-01				DAASF-01				DAASF-02			
Sample Name		AOI01-01-GW				AOI01-02-GW				AOI01-03-GW				AOI02-01-GW				DAASF-01-GW				DAASF-GW-FD				DAASF-02-GW			
Parent Sample ID																						DAASF-01-GW-06032021							
Sample Date		6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (ng/L)																													
4:2 Fluorotelomer sulfonate (4:2 FTS)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
6:2 Fluorotelomer sulfonate (6:2 FTS)	-	<	4.3	5.4	U	<	3.8	4.8	U	<	4.0	5.0	U	2.9	4.6	5.8	J	<	4.1	5.1	U	<	3.9	4.9	U	<	4.0	5.0	U
8:2 Fluorotelomer sulfonate (8:2 FTS)	-	<	2.1	3.2	U	<	1.9	2.9	U	<	2.0	3.0	U	<	2.3	3.5	U	<	2.0	3.1	U	<	1.9	2.9	U	<	2.0	3.0	U
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	-	<	1.1	3.2	U	<	0.95	2.9	U	<	1.0	3.0	U	<	1.2	3.5	U	<	1.0	3.1	U	<	0.97	2.9	U	<	1.0	3.0	U
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	-	<	1.3	2.1	U	<	1.1	1.9	U	<	1.2	2.0	U	<	1.4	2.3	U	<	1.2	2.0	U	<	1.2	1.9	U	<	1.2	2.0	U
Perfluorobutanesulfonic acid (PFBS)	600	8.0	1.1	2.1		2.1	0.95	1.9		8.6	1.0	2.0		3.5	1.2	2.3		1.2	1.0	2.0	J	1.2	0.97	1.9	J	29	1.0	2.0	
Perfluorobutanoic acid (PFBA)	-	96	4.3	5.4		18	3.8	4.8		29	4.0	5.0		140	4.6	5.8		40	4.1	5.1		39	3.9	4.9		120	4.0	5.0	
Perfluorodecanesulfonic acid (PFDS)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorodecanoic acid (PFDA)	-	0.87	1.1	2.1	J	7.9	0.95	1.9		<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorododecanoic acid (PFDoA)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroheptanesulfonic acid (PFHpS)	-	1.7	1.1	2.1	J	1.6	0.95	1.9	J	1.5	1.0	2.0	J	0.98	1.2	2.3	J	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroheptanoic acid (PFHpA)	-	87	1.1	2.1		15	0.95	1.9		27	1.0	2.0		190	1.2	2.3		19	1.0	2.0		19	0.97	1.9		89	1.0	2.0	
Perfluorohexanesulfonic acid (PFHxS)	-	170	1.1	2.1		25	0.95	1.9		89	1.0	2.0		14	1.2	2.3		11	1.0	2.0		11	0.97	1.9		320	1.0	2.0	
Perfluorohexanoic acid (PFHxA)	-	98	1.1	2.1		22	0.95	1.9		38	1.0	2.0		280	1.2	2.3		36	1.0	2.0		34	0.97	1.9		140	1.0	2.0	
Perfluorononanesulfonic acid (PFNS)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorononanoic acid (PFNA)	-	16	1.1	2.1		35	0.95	1.9		8.0	1.0	2.0		5.4	1.2	2.3		0.57	1.0	2.0	J	0.54	0.97	1.9	J	<	1.0	2.0	U
Perfluorooctanesulfonamide (PFOSA)	-	1.0	1.1	2.1	J	1.9	0.95	1.9	J+	2.4	1.0	2.0		<	1.2	2.3	U	<	1.0	2.0	U	2.3	0.97	1.9		<	1.0	2.0	U
Perfluorooctanesulfonic acid (PFOS)	40	32	1.1	2.1		150	0.95	1.9		75	1.0	2.0		5.7	1.2	2.3	J+	<	1.0	2.0	U	<	0.97	1.9	U	2.4	1.0	2.0	J+
Perfluorooctanoic acid (PFOA)	40	120	1.1	2.1		23	0.95	1.9		36	1.0	2.0		230	1.2	2.3		29	1.0	2.0		27	0.97	1.9		150	1.0	2.0	
Perfluoropentanesulfonic acid (PFPS)	-	9.6	1.1	2.1		1.9	0.95	1.9		15	1.0	2.0		1.1	1.2	2.3	J	0.80	1.0	2.0	J	0.82	0.97	1.9	J	42	1.0	2.0	
Perfluoropentanoic acid (PFPA)	-	97	1.1	2.1		18	0.95	1.9		28	1.0	2.0		290	1.2	2.3		31	1.0	2.0		30	0.97	1.9		130	1.0	2.0	
Perfluorotetradecanoic acid (PFTeDA)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorotridecanoic acid (PFTriDA)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroundecanoic acid (PFUnA)	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U

Notes
J = Estimated concentration
J+ = Estimated concentration, bias high.
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/L = Nanogram(s) per liter
(1) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2021).
Values exceeding the Screening Level are shaded gray
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD
- = No screening level

Table 6-4 - PFAS Detections in Groundwater
Duncan Readiness Center and Army Aviation Support Facility, Delaware

	Location ID	DAASF-03				MW15-GW			
	Sample Name	DAASF-03-GW				MW15-GW			
	Parent Sample ID								
	Sample Date	6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
4:2 Fluorotelomer sulfonate	-	55	1.0	2.0		12	0.88	1.8	
6:2 Fluorotelomer sulfonate	-	1100	40	50		310	35	44	
8:2 Fluorotelomer sulfonate	-	<	2.0	3.0	U	<	1.8	2.6	U
N-ethyl perfluorooctanesulfonamidoacetic acid	-	<	1.0	3.0	U	<	0.88	2.6	U
N-methyl perfluorooctanesulfonamidoacetic acid	-	<	1.2	2.0	U	<	1.1	1.8	U
Perfluorobutanesulfonic acid (PFBS)	600	7.0	1.0	2.0		3.5	0.88	1.8	
Perfluorobutanoic acid	-	190	4.0	5.0		130	3.5	4.4	
Perfluorodecanesulfonic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorodecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorododecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluoroheptanesulfonic acid	-	5.4	1.0	2.0		3.3	0.88	1.8	
Perfluoroheptanoic acid	-	180	1.0	2.0		110	0.88	1.8	
Perfluorohexanesulfonic acid	-	130	1.0	2.0		43	0.88	1.8	
Perfluorohexanoic acid	-	400	1.0	2.0		230	0.88	1.8	
Perfluorononanesulfonic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorononanoic acid	-	4.6	1.0	2.0		4.1	0.88	1.8	
Perfluorooctanesulfonamide (PFOSA)	-	1.4	1.0	2.0	J	<	0.88	1.8	U
Perfluorooctanesulfonic acid (PFOS)	40	12	1.0	2.0	J+	37	0.88	1.8	
Perfluorooctanoic acid (PFOA)	40	280	1.0	2.0		100	0.88	1.8	
Perfluoropentanesulfonic acid	-	6.0	1.0	2.0		3.6	0.88	1.8	
Perfluoropentanoic acid	-	520	10	20		250	0.88	1.8	
Perfluorotetradecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorotridecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluoroundecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U

Notes
J = Estimated concentration
J+ = Estimated concentration, bias high.
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/L = Nanogram(s) per liter
(1) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2021).
Values exceeding the Screening Level are shaded gray
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD
- = No screening level

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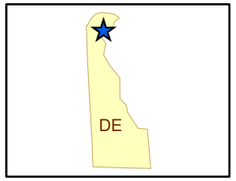
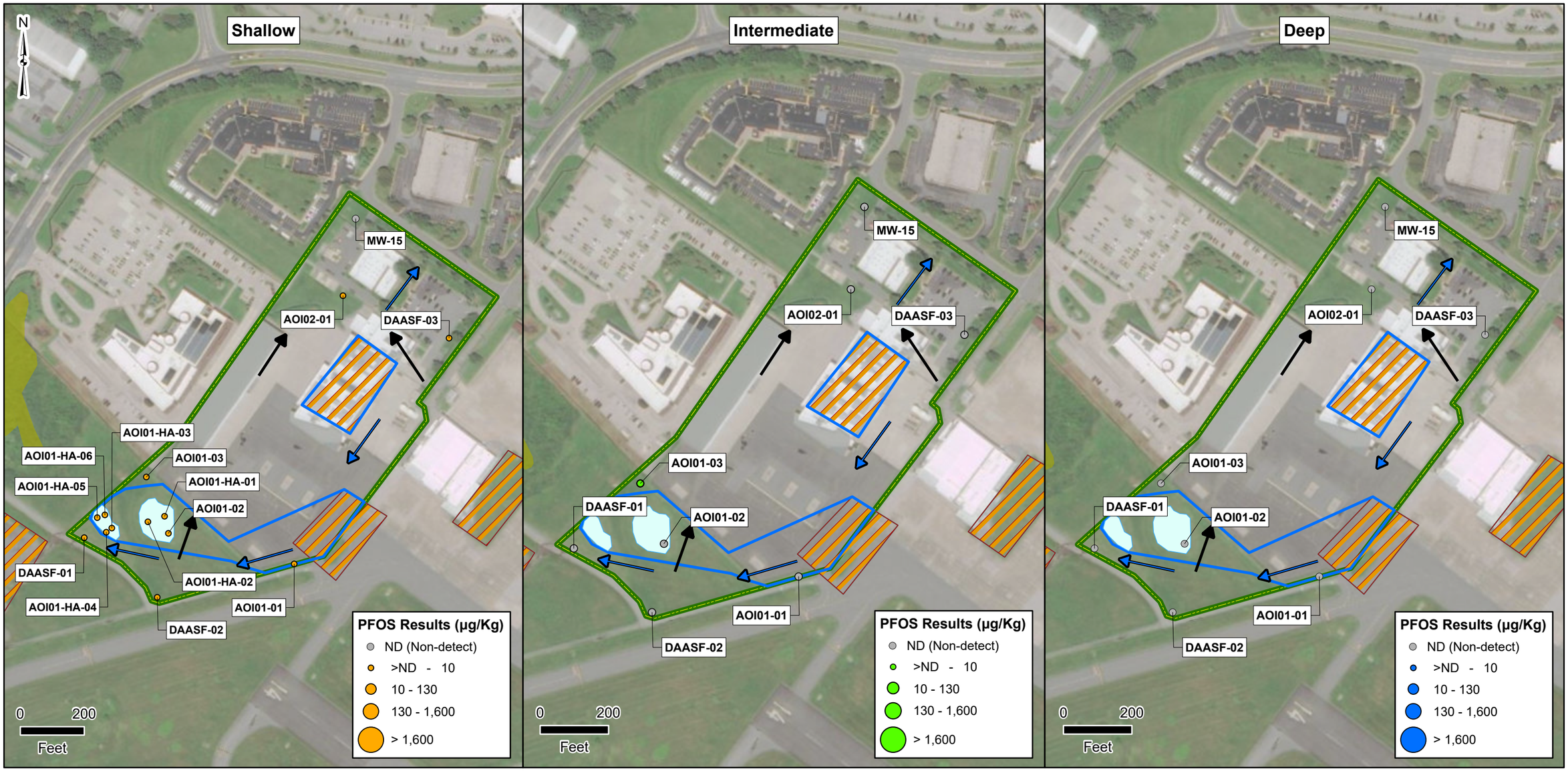
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 6-1
PFOS Detections in Soil (AOI 1 and AOI 2)





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Hydrology/Hydrogeology
- Groundwater Flow Direction
- Surface Water Flow Direction
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_6342503831\PROJECTS\SIReport\DuncanArmory\DuncanArmory.aprx

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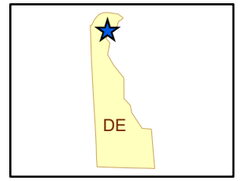
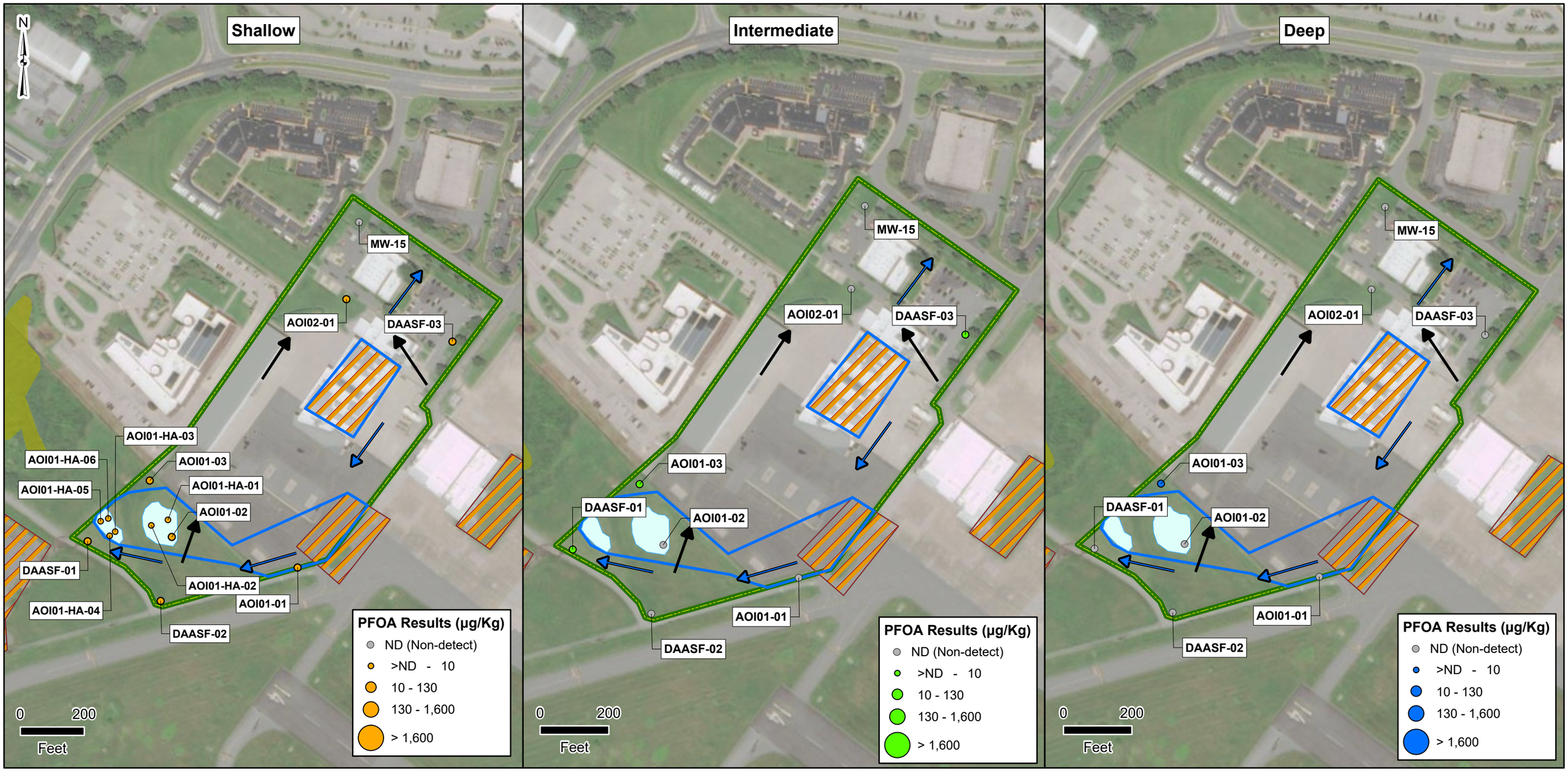
Figure 6-2
PFOA Detections in Soil (AOI 1 and AOI 2)





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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

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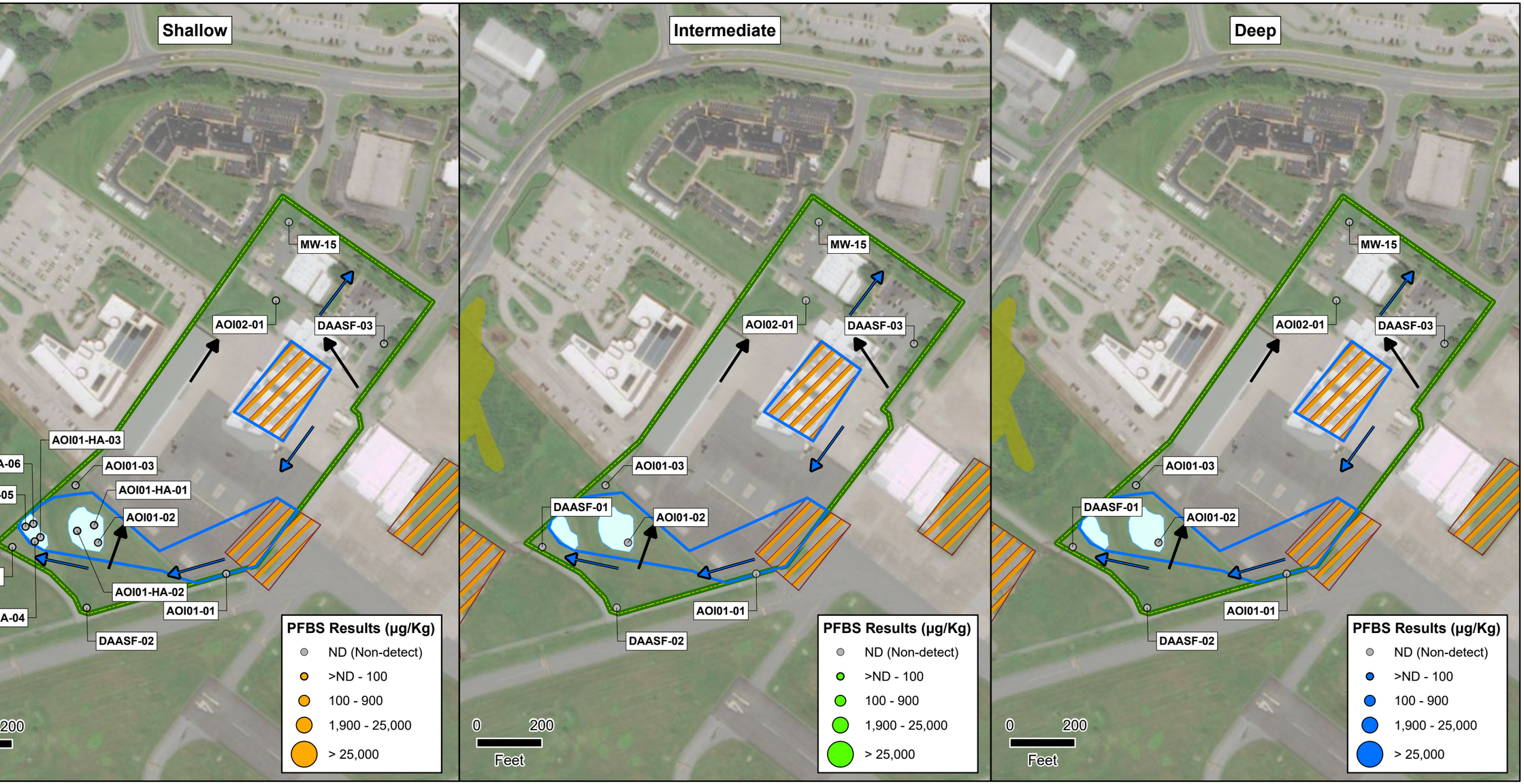
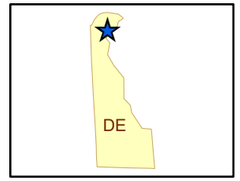
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 6-3
PFBS Detections in Soil (AOI 1 and AOI 2)





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

Path: \\lovetongis\GIS\data\Federal\Nationwide\PFAS\MAE5_634250383\PROJECTS\SIReport\DuncanArmory\DuncanArmory.aprx

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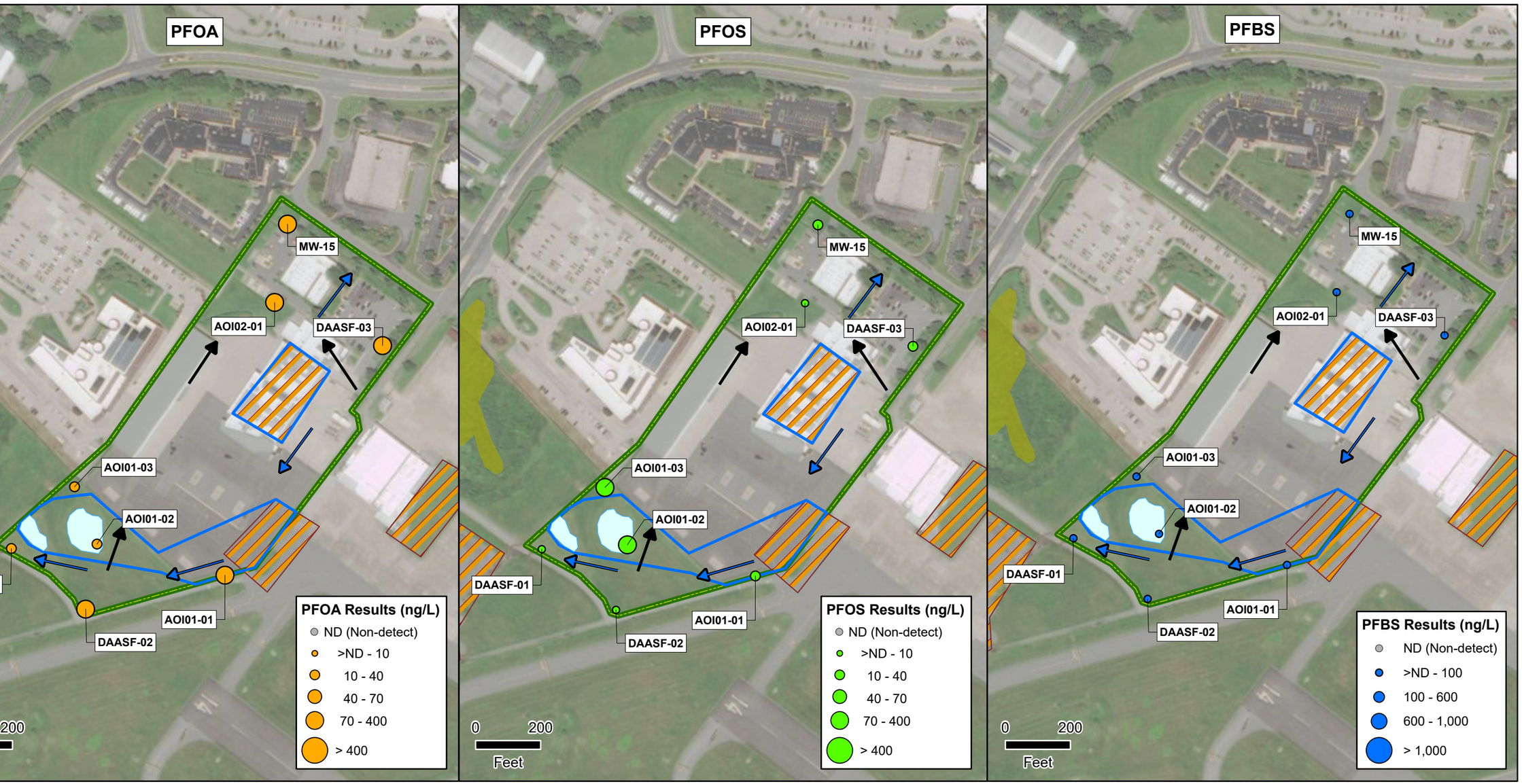
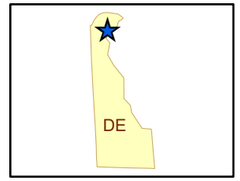
Site Inspection Report
Duncan RC and AASF, Delaware

Figure 6-4
PFOA, PFOS and PFBS Detections in Groundwater (AOI 1 and AOI 2)





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction
- Retention Pond
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.....March 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 18N

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

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7. EXPOSURE PATHWAYS

The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1**. A CSM presents the current understanding of the site conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

1. Contaminant source;
2. Environmental fate and transport;
3. Exposure point;
4. Exposure route; and
5. Potentially exposed populations.

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with no identified complete pathway generally warrant no further action. However, the pathway is considered potentially complete if PFOA, PFOS, or PFBS are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of PFOA, PFOS, or PFBS above the SLs. Areas with an identified potentially complete pathway and a complete pathway may warrant further investigation.

In general, the potential PFAS exposure pathways are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of PFAS toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, off-facility residents, and trespassers (though unlikely due to restricted access). The CSM for AOIs 1 and 2, revised based on the SI findings, are presented on **Figure 7-1** and **Figure 7-2**.

7.1 SOIL EXPOSURE PATHWAY

The SI results for PFOA, PFOS, and PFBS in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria.

7.1.1 AOI 1 – Helicopter Crash Site

AFFF was potentially released in one area associated with AOI 1 when an ARNG helicopter crashed on the boundary between the facility and the New Castle Airport property. PFOA and PFOS were detected in soil at low levels at nine boring locations completed at AOI 1, confirming a potential release of PFAS to soil at AOI 1. Based on the results of the SI in AOI 1, ground-disturbing activities to surface soil could result in site worker, construction worker, and trespasser exposure to PFOA and PFOS via inhalation of dust and ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in construction worker exposure to

PFOS via ingestion. Therefore, the exposure pathways for inhalation and ingestion are potentially complete for these receptors. The CSM is presented in **Figure 7-1**.

7.1.2 AOI 2 – Hangar

AOI 2 encompasses the facility hangar. The hangar fire suppression system currently contains a Jet-X 2% high expansion foam concentrate system, the contents of which are not disclosed. While there is no known release at this location, firsthand interviewee knowledge only extends back to 1991. PFOA and PFOS were detected in one boring location at AOI 2 at low levels within the surface and shallow subsurface soil, confirming a potential release of PFAS to soil at AOI 2. Based on the results of the SI in AOI 2, ground-disturbing activities to surface soil could result in site worker and construction worker exposure to PFOA and PFOS via inhalation of dust. Therefore, the exposure pathways for inhalation and ingestion are potentially complete for these receptors. The CSM is presented in **Figure 7-2**.

7.2 GROUNDWATER EXPOSURE PATHWAY

The SI results for PFOA, PFOS, and PFBS in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors at each AOI based on the aforementioned criteria.

7.2.1 AOI 1 – Helicopter Crash Site

PFOA, PFOS and PFBS were detected in groundwater from all three temporary wells. PFOA exceeded the SL at one temporary well location (AOI01-01) and PFOS exceeded the SL at two temporary well locations (AOI01-02 and AOI01-03). Domestic, private wells are located less than 1 mile downgradient of the facility, the closest of which is located approximately 1,500 ft north of the facility boundary; however, the depth of the well and source aquifer are unknown. Based on this information, the ingestion exposure pathway is potentially complete for off-facility residents. The ingestion exposure pathway for construction workers was deemed incomplete due to the depth of groundwater underlying the facility (up to 35 ft bgs), and the likelihood that trenching activities would not reach those depths. The CSM is presented in **Figure 7-1**.

7.2.2 AOI 2 – Hangar

PFOA, PFOS, and PFBS were detected in groundwater from the temporary well associated with AOI 2, with the PFOA concentration exceeding the SL. Domestic, private wells are located less than 1 mile downgradient of the facility, the closest of which is located approximately 1,500 ft north of the facility boundary; however, the depth of the well and source aquifer are unknown. Based on this information, the ingestion exposure pathway is potentially complete for off-facility residents. The ingestion exposure pathway for construction workers was deemed incomplete due to the depth of groundwater underlying the facility (up to 35 ft bgs), and the likelihood that trenching activities would not reach those depths. The CSM is presented in **Figure 7-2**.

7.3 SURFACE WATER AND SEDIMENT EXPOSURE PATHWAY

The ingestion exposure pathways for surface water and sediment are potentially complete for site workers, construction workers, and trespassers based on the surface soil concentrations found in the facility detention ponds. PFAS are water soluble and can migrate readily from soil to surface water through migration of sediment via storm flow. Additionally, regional shallow groundwater flow within the area is inferred to flow towards the Christina River. Therefore, the ingestion exposure pathways for surface water and sediment are also potentially complete for recreational users of the Christina River. Surface water and sediment were not sampled as part of this SI, as the scope of sampling was limited to the presence or absence of PFOS, PFOA, and PFBS in soil and groundwater within the facility boundary.

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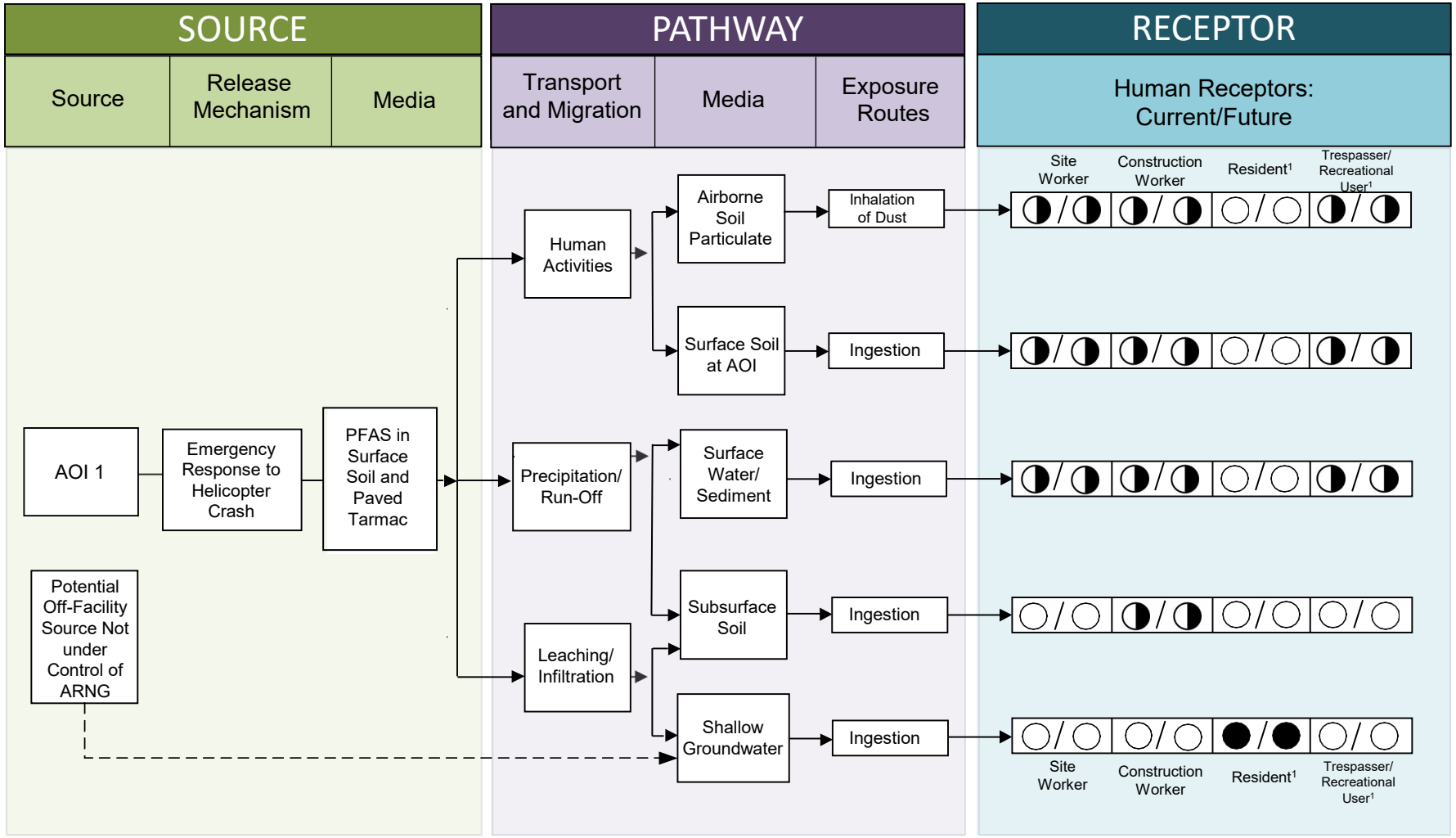

LEGEND

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

Notes:

1. The resident and recreational users refer to off-site receptors.
2. Dermal contact exposure pathway is incomplete for PFAS.

Figure 7-1
Conceptual Site Model
AOI 1 Duncan RC and AASF

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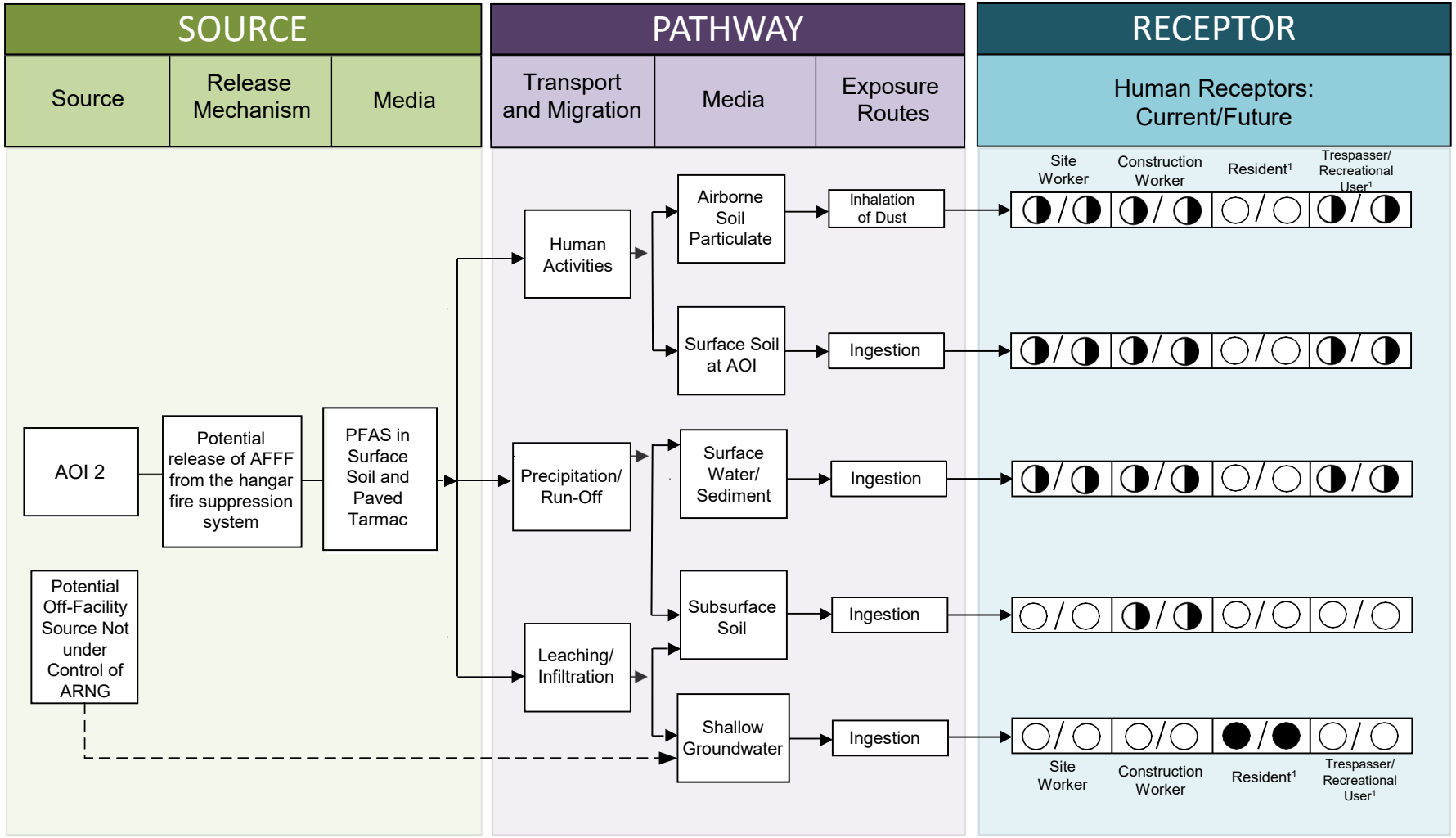

LEGEND

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

Notes:

1. The resident and recreational users refer to off-site receptors.
2. Dermal contact exposure pathway is incomplete for PFAS.

Figure 7-2
Conceptual Site Model
AOI 2 Duncan RC and AASF

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8. SUMMARY AND OUTCOME

This section summarizes SI activities and findings. The most significant findings are summarized in this section and are reproduced directly or abstracted from information contained in this report. The outcome provides general and comparative interpretations of the findings relative to the SLs.

8.1 SI ACTIVITIES SUMMARY

The SI field activities at the facility were conducted on 23 May and on 2 and 3 June 2021. The SI field activities included soil and groundwater sampling. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021b), except as previously noted in **Section 5.8**.

To fulfill the project DQOs set forth in the approved SI UFP-QAPP Addendum (EA 2021b), samples were collected and analyzed for a subset of 24 PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 as follows. The 24 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.7** of this SI Report. The following sampling was conducted:

- 30 soil grab samples collected from 13 boring locations (seven soil borings and six surface soil hand auger locations);

- Eight grab groundwater samples from seven temporary well locations and one existing facility monitoring well;

The information gathered during this investigation was used to determine PFOA, PFOS, and PFBS were present at or above SLs. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at the AOIs, which are described in **Chapter 7**.

8.2 SI GOALS EVALUATION

As described in **Section 4.2**, the SI activities were designed to achieve six main goals or DQOs. This section describes the SI goals and the conclusions that can be made for each based on the data collected during this investigation.

1. *Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs at the facility.*

   PFOA, PFOS, and PFBS were detected at the facility in groundwater, whereas PFOA and PFOS were detected in soil. PFOA, PFOS, and PFBS were detected both at source areas as well as near the facility boundary between the source areas and the potential drinking water receptors. Detections in groundwater exceeded the SLs for PFOA and PFOS.

2. *Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.*

   PFOA, PFOS, and PFBS were detected in groundwater samples associated with both AOIs. All four of the groundwater samples collected during the SI exceeded the SLs. Therefore, none of the release areas have been eliminated from further consideration.

3. *Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.*

   Based on the data collected during this SI, no need for a removal action was identified.

4. *Collect or develop data to evaluate the release.*

   Out of the six surface soil (hand auger) borings and two soil borings samples collected across the preferential surface flow pathway leaving the Helicopter Crash Site (AOI 1), PFOS or PFOA were detected in all surface interval samples. Though these detections were low, this may indicate that AFFF migrated along this pathway, collecting in the stormwater detention ponds. Similarly, AOI02-01 had detections of PFOS and PFOA in the surface interval samples. This may suggest that AFFF was released from the facility Hangar fire suppression system or within the surrounding area. Additionally, PFOS or PFOA were detected at low levels in the surface interval samples taken along the boundary, which may suggest that AFFF was released outside of the Duncan RC and AASF property.

5. *Collect data to better characterize the release for more effective and rapid initiation of an RI (if determined necessary).*

   The collected geological data indicate a highly permeable and conductive environment with soils dominated by sand and silt, with some interbedded, thin clay lenses. The depth to groundwater observed during the SI ranged from approximately 25.9 to 32.9 ft bgs. Localized groundwater flow direction under the site is to the northwest. These geologic and hydrogeologic observations can be used in development of technical approach for the RI.

6. *If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).*

   Based upon the qualitative evaluation of soil results in combination with quantitative groundwater results and groundwater flow direction analysis, the source of detected PFOA, PFOS, and PFBS at AOI 1 is likely the result of AFFF expended by the municipal fire department in response to the 1970s helicopter crash; however, PFOA, PFOS, and

PFBS were detected in temporary wells installed upgradient of AOIs 1 and 2, one of which exceeded the SLs in groundwater, suggesting an off-facility source may also be impacting the facility. Additionally, PFOA exceeded the SL in the sample taken from the temporary well location along the northeastern facility boundary.

8.3 OUTCOME

Based on the CSMs developed and revised based on the SI findings, there is potential for exposure to residential drinking water receptors from potential releases of AFFF at the Duncan RC and AASF, and potentially from off-facility sources.

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

- AOI 1 – PFOS or PFOA were detected in groundwater at concentrations exceeding the individual SLs of 40 nanograms per liter (ng/L) in all temporary well locations associated with AOI 1, with maximum concentrations of PFOS at 150 ng/L and PFOA at 120 ng/L at locations AOI01-02 and AOI01-01, respectively. PFBS was detected in groundwater at AOI 1, but did not exceed the SL.

- AOI 2 – PFOA, PFOS, and PFBS were detected in groundwater at AOI 2. PFOA exceeded the SL in groundwater with a concentration of 230 ng/L at AOI02-01. PFOS and PFBS did not exceed the SLs.

- AOI 1 and 2 – PFOA and PFOS were detected in soil at both AOI 1 and 2 at low concentrations, several orders of magnitude below the SLs. There were no detections of PFBS at either AOI.

- Upgradient Boundary Samples – PFOA, PFOS, and PFBS were detected in groundwater upgradient of AOI 1 and AOI 2 in samples taken from locations DAASF-01 and DAASF-02. The sample taken from location DAASF-02 exceeded the PFOA SL with a concentration of 150 ng/L, but there were no exceedances in the sample taken from location DAASF-01. The sample taken from location DAASF-03, located along the northeastern facility boundary, also exceeded the SL for PFOA with a concentration of 280 ng/L.

- Downgradient Boundary Samples - PFOA was detected in groundwater at downgradient location MW-15 with a concentration of 100 ng/L, exceeding the SL. PFBS and PFOS were detected at this location below their respective SLs.

- Recommendations – Based on the results of the SI, further evaluation of AOIs 1 and 2 are warranted in a Remedial Investigation.

Table 8-1 summarizes the SI results for soil and groundwater. Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure to residential drinking water

receptors caused by potential DoD activities at the facility as well as potential and known off-facility adjacent sources.

Table 8-2 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOIs 1 and 2: Helicopter Crash Site and Hangar.

Table 8-1. Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary
1	Helicopter Crash Site	◐	●	●
2	Hangar	◐	●	●

Legend:
● = Detected; exceedance of screening levels.
◐ = Detected; no exceedance of screening levels.
○ = Not detected.

Table 8-2. Site Inspection Recommendations

AOI	Description	Rationale	Future Action
1	Helicopter Crash Site	Exceedances of the SLs in groundwater at source area. No exceedances of SLs in soil.	Proceed to RI
2	Hangar	Exceedances of SLs in groundwater at source area. No exceedances of SLs in soil.	Proceed to RI

9. REFERENCES

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Appendix A

Data Validation Reports

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Data Validation Report

Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites
Army National Guard Installations Nationwide
Project # 3031200026.3000.****

Prepared for:

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400, Hunt Valley, Maryland 21031

4/21/2021

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Table

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List of Acronyms

%	percent
ARNG	Army National Guard
CCV	continuing calibration verification
COC	chain of custody
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc. PBC
Eurofins	Eurofins Environment Testing America
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
MS	matrix spike
MSD	matrix spike duplicate
PFAS	per- and polyfluoroalkyl substances
QAPP	quality assurance project plan
QC	quality control
QSM	Quality Systems Manual for Environmental Laboratories
RPD	relative percent difference
Wood	Wood Environment & Infrastructure, Solutions, Inc.

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1.0 Introduction

EA Engineering, Science, and Technology, Inc. PBC (EA) collected one water sample on 31 March 2021. EA submitted the sample to Eurofins Environment Testing America (Eurofins), located in Lancaster, Pennsylvania, where the sample was assigned to job number 410-34226 and analyzed for per and polyfluoroalkyl substances (PFAS) by liquid chromatography tandem mass spectrometry compliant with Table B 15 of the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM), Version 5.3. The field sample identification (ID), collection date, and laboratory sample ID is presented in Table 1.

2.0 Data Validation Methodology

Wood Environment & Infrastructure Solutions, Inc. (Wood) performed DoD Stage 2B validation on 100 percent (%) of the data from field samples. The Stage 2B validation includes review of the quality control (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 accordance with:

- EA, 2020. Final Programmatic Uniform Federal Policy Quality Assurance Project Plan (QAPP), Site Inspection for Per- and Polyfluoroalkyl Substances Impacted Sites, Army National Guard (ARNG) Installations, Nationwide, December.
- DoD, 2019a. DoD QSM, Version 5.3. May.
- DoD, 2019b. General Data Validation Guidelines, Revision 1. November.
- DoD, 2020. Data Validation Guidelines Module 3: Data Validation Procedure of Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15. May.

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 (ICAL), 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 LCS/LCS duplicate (LCSD), laboratory duplicates, or MS/MS duplicate (MSD);

- Sampling and analytical precision as RPD of analyte concentration between primary samples and field duplicates;
- Assessment of field contamination as demonstrated by equipment and field blanks; and
- 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 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 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 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 blanks are processed by the laboratory using the same procedures as the field samples.

3.4 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

The qualifiers used in the text are the qualifiers applied for each individual QC issue and may not reflect the final qualifiers applied to the data.

J The reported result is an estimated quantity with an unknown bias.

J+ The result is an estimated quantity, but the result may be biased high.

J- The result is an estimated quantity, but the result may be biased low.

U The analyte was not detected and was reported as less than the limit of detection (LOD). The LOD has been adjusted for any dilution or concentration of the sample.

UJ The analyte was not detected and was reported as less than the LOD. However, the associated numerical value is approximate.

X The sample results were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team, but exclusion of the data is recommended.

5.0 Qualification Reason Codes

Wood did not apply reason codes to the data during validation.

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 within the QAPP specified temperature range of 2 to 6 degrees Celsius.

7.0 Specific Data Validation Findings

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

7.1 Per- and Polyfluoroalkyl Substances Analysis

PFAS results generated by Eurofins are usable with the limitations described in Sections 7.1.1 through 7.1.11.

7.1.1 Holding Time Compliance

The samples were extracted for PFAS within the QAPP-specified maximum holding time of 14 days from sample collection for water samples and the extracts were analyzed within the QAPP-specified maximum hold time of 28 days from extraction.

7.1.2 Initial Calibration Compliance

The ICAL associated with the analysis of these samples met the QAPP-specified criteria of the calibration standards calculating to 70 to 130% of their true concentrations and either correlation coefficients greater than or equal to 0.99 or relative standard deviations of the response factors less than or equal to 20%.

7.1.3 Initial Calibration Verification Accuracy

ICV recoveries were within the QAPP-specified 70% to 130% limits.

7.1.4 Continuing Calibration Verification Accuracy

CCV recoveries were within the QAPP-specified 70 to 130% limits.

7.1.5 Laboratory Blank Detections

PFAS were not detected in the laboratory blank associated with this sample.

7.1.6 Equipment and Field Blank Detections

EA did not collect equipment or field blanks with the sample reviewed in this report.

7.1.7 Laboratory Control Sample Accuracy and Precision

LCS recoveries were within QSM 5.3-specified limits and RPDs between LCS and LCSD results were less than or equal to the QAPP-specified maximum of 30%.

7.1.8 Matrix Spikes/ Matrix Spike Duplicate Accuracy and Precision

Eurofins did not perform MS and MSD analyses on the sample reviewed in this report.

7.1.9 Laboratory Duplicate Precision

Eurofins did not perform duplicate analysis on the sample reviewed in this report.

7.1.10 Internal Standard Accuracy

Internal standard recoveries were within the QAPP-specified limits of 50 to 150% of areas measured in the ICAL midpoint standard or 50 to 150% of the areas measured in the initial CCV on days when ICAL is not performed.

7.1.11 Data Reporting and Analytical Procedures

There were no data reporting or analytical procedure anomalies associated with the analysis of the sample reviewed in this report.

8.0 Field Duplicate Precision

EA did not collect a field duplicate with the sample reviewed in this report.

9.0 Summary and Conclusions

Wood reviewed a total of 24 records from the field sample during this validation. No data were qualified during validation and the data may be considered 100% usable without limitations.

10.0 References

EA, 2020. Final Programmatic Uniform Federal Policy Quality Assurance Project Plan, Site Inspection for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide, December.

DoD, 2019a. DoD QSM, Version 5.3. May.

DoD, 2019b. General Data Validation Guidelines, Revision 1. November.

DoD, 2020. Data Validation Guidelines Module 3: Data Validation Procedure of Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15.

11.0 Limitations

This report was prepared exclusively for EA by Wood Environment & Infrastructure Solutions, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Wood services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Data Validation report is intended to be used by EA for the Nationwide ARNG Installations Site Inspections for Per- and Polyfluoroalkyl Substances project only, subject to the terms and conditions of its contract with Wood. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

Table

Table 1
Field Sample Submitted to Eurofins Lancaster Laboratories Environmental
Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites
ARNG Sites, Nationwide

Field Sample Identification	Collection Date and Time	Matrix	Laboratory Sample Identification
EA-H2O	3/31/2021 9:00	Water	410-34226-1

Data Validation Report

Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware
Project # 3031200026.3000.****

Prepared for:

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400, Hunt Valley, Maryland 21031

7/9/2021

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List of Acronyms

%	percent
4:2 FTS	4:2 fluorotelomer sulfonic acid
6:2 FTS	6:2 fluorotelomer sulfonic acid
ARNG	Army National Guard
CCV	continuing calibration verification
COC	chain of custody
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc. PBC
EIS	extracted internal standard
EPA	United States Environmental Protection Agency
Eurofins	Eurofins Environment Testing America
FOSA	perfluorooctanesulfonamide
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 quantitation
MS	matrix spike
MSD	matrix spike duplicate
NEtFOSAA	ethyl perfluorooctanesulfonamidoacetic acid
ng/L	nanograms per liter
NMeFOSAA	methylperfluorooctanesulfonamidoacetic acid
PFAS	per- and polyfluoroalkyl substances
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid
QAPP	quality assurance project plan
QC	quality control
QSM	Quality Systems Manual for Environmental Laboratories
RPD	relative percent difference
UFP	Uniform Federal Policy

Wood Wood Environment & Infrastructure, Solutions, Inc.

1.0 Introduction

EA Engineering, Science, and Technology, Inc. PBC (EA) collected 33 solid samples (including 3 field duplicates) and 14 water samples (including 1 field duplicate, 3 equipment blanks, and two field blanks) on 2 and 3 June 2021. EA submitted the sample to Eurofins Environment Testing America (Eurofins), located in Lancaster, Pennsylvania, where the samples were received on 4 June 2021 and assigned to job number 410-42478-1. Eurofins analyzed the samples for per- and polyfluoroalkyl substances (PFAS) by liquid chromatography tandem mass spectrometry compliant with Table B 15 of the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM), Version 5.3, PH by United States Environmental Protection Agency (EPA) Method 9045D, total organic carbon by EPA Method 9060A, percent (%) moisture, and/or grain side by ASTM International D422. The field sample identifications (IDs), sample matrices, collection dates, and laboratory sample IDs are presented in Table 1.

2.0 Data Validation Methodology

Wood Environment & Infrastructure Solutions, Inc. (Wood) performed DoD Stage 2B validation on 100% of the PFAS data from the field samples. The Stage 2B validation includes review of the quality control (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 accordance with:

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- EA, 2021. Final Site Inspection UFP-QAPP Addendum, Duncan Readiness Center and Army Aviation Support Facility, New Castle, Delaware, May.
- DoD, 2019a. DoD QSM, Version 5.3. May.
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- Holding time compliance;
- QC sample frequency;
- Initial calibration (ICAL), 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 LCS/LCS duplicate (LCSD), laboratory duplicates, or MS/MS duplicate (MSD);
- Sampling and analytical precision as RPD of analyte concentration between primary samples and field duplicates;
- Assessment of field contamination as demonstrated by equipment and field blanks; and
- 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 Accuracy

LCSs 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 Accuracy and Precision

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 Blank Detections

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 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 blanks are processed by the laboratory using the same procedures as the field samples.

3.4 Laboratory and Field Duplicate Precision

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

The qualifiers used in the text are the qualifiers applied for each individual QC issue and may not reflect the final qualifiers applied to the data.

J The reported result is an estimated quantity with an unknown bias.

J+ The result is an estimated quantity, but the result may be biased high.

J- The result is an estimated quantity, but the result may be biased low.

U The analyte was not detected and was reported as less than the limit of detection (LOD). The LOD has been adjusted for any dilution or concentration of the sample.

UJ The analyte was not detected and was reported as less than the LOD. However, the associated numerical value is approximate.

X The sample results were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team, but exclusion of the data is recommended.

5.0 Qualification Reason Codes

Wood applied the following reason codes to the data during validation:

DL The detected concentration is less than the limit of quantitation (LOQ).

EB The analyte was detected in the associated equipment blank.

EM The transition ion ratio was outside specified limits.

LI Low extracted internal standard (EIS) recovery.

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 within the QAPP specified temperature range of 2 to 6 degrees Celsius, with the following exceptions:

- According to the case narrative, sample DAASF-GW-FD was not recorded on the COC. Eurofins analyzed the sample for PFAS.
- According to the case narrative, the samples recorded on the COC as AOI01-01-SB-1-2 and AOI01-02-SB-1-2 were labeled AOI01-01-SB-0-2 and AOI01-02-SB-0-2, respectively. Eurofins logged in the samples using the IDs recorded on the COC.
- The three solid samples for grain size analysis were recoded on the COC as being water samples. Eurofins properly logged the samples in as being solids.

7.0 Specific Data Validation Findings

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

7.1 Per- and Polyfluoroalkyl Substances Analysis

PFAS results generated by Eurofins are usable with the limitations described in Sections 7.1.1 through 7.1.11.

7.1.1 Holding Time Compliance

The samples were extracted for PFAS within the QAPP-specified maximum holding time of 14 days from sample collection for water samples and 28 days from sample collection for solid samples. The extracts were analyzed within the QAPP-specified maximum hold time of 28 days from extraction.

7.1.2 Initial Calibration Compliance

The ICAL associated with the analysis of these samples met the QAPP-specified criteria of the calibration standards calculating to 70 to 130% of their true concentrations and either correlation coefficients greater than or equal to 0.99 or relative standard deviations of the response factors less than or equal to 20%.

7.1.3 Initial Calibration Verification Accuracy

ICV recoveries were within the QAPP-specified 70% to 130% limits.

7.1.4 Continuing Calibration Verification Accuracy

CCV recoveries were within the QAPP-specified 70 to 130% limits.

7.1.5 Laboratory Blank Detections

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

7.1.6 Equipment and Field Blank Detections

Target analytes were not detected in the equipment or field blanks reviewed in this report, with the following exception:

- Perfluorooctanesulfonic acid (PFOS) was detected at a concentration of 2.4 nanograms per liter (ng/L) in equipment blank DAASF-GW-EB1, associated with field samples AOI01-01-GW, AOI01-02-GW, AOI01-03-GW, DAASF-01-GW, DAASF-02-GW, DAASF-03-GW, DAASF-GW-FD, and MW15-GW. Data limitations are summarized below.
  - Wood J+ qualified the PFOS results from samples AOI02-01-GW (5.7 ng/L), DAASF-02-GW (2.4 ng/L), and DAASF-03-GW (12 ng/L) because the concentrations detected in the samples were greater than the LOQ and less than or equal to five times the concentration detected in the blank. (Qualifier and reason code: J+ EB)
  - Wood U qualified the detected PFOS result from samples DAASF-01-GW (0.73 ng/L) and DAASF-GW-FD (0.67 ng/L) at the LODs of 1.0 ng/L and 0.97 ng/L, respectively, because the concentrations detected in the samples were less than their respective LODs. (Qualifier and reason code: U EB)

  - PFOS concentrations detected in the remaining samples were more than five times the concentration detected in the blank and data usability is not adversely affected by the blank detection.

7.1.7 Laboratory Control Sample Accuracy and Precision

LCS recoveries were within QSM 5.3-specified limits and RPDs between LCS and LCSD results were less than or equal to the QAPP-specified maximum of 30%, with the following exception:

- Perfluorooctanesulfonamide (FOSA) recoveries were high at 190% and 187% in the LCS and LCSD, respectively, associated with the extraction of samples AOI01-01-SB-1-2, AOI01-01-SB-34.5-35.5, AOI01-02-SB-1-2, AOI01-03-SB-1-2, AOI01-03-SB-14-15, AOI02-01-SB-1-2, DAASF-01-SB-14-15, DAASF-02-SB-1-2, DAASF-02-SB-14-15, DAASF-02-SB-34-35, AOI01-HA-01-1, and AOI01-HA-02-1. FOSA was not detected in the associated samples and data usability is not adversely affected by the high LCS and LCSD recoveries.

7.1.8 Matrix Spikes/ Matrix Spike Duplicates Accuracy and Precision

Eurofins performed MS and MSD analyses on samples AOI01-HA-04-1, DAASF-03-SB-14-15, and MW15-GW. Recoveries were within QSM 5.3-specified limits and RPDs between LCS and LCSD results were less than or equal to the QAPP-specified maximum of 30%, with the following exceptions:

- Perfluorobutanoic acid (71%, MS), perfluoropentanoic acid (PFPeA, 48%, MSD), perfluorohexanoic acid (141%, MS), and 6:2 fluorotelomer sulfonic acid (6:2 FTS, 219%, MSD) were outside of limits in the MS or MSD performed on sample MW15-GW. The concentrations detected in the unspiked native sample were greater than four times the spike concentrations and it is not possible to assess data usability for these analytes in this sample based on the MS recoveries.

7.1.9 Laboratory Duplicate Precision

Eurofins did not perform duplicate analysis on the samples reviewed in this report.

7.1.10 Extracted Internal Standard Accuracy

EIS recoveries were within the QAPP-specified limits of 50 to 150% of areas measured in the ICAL midpoint standard or 50 to 150% of the areas measured in the initial CCV on days when ICAL is not performed, with the following exceptions:

- Recoveries of the EISs M2-4:2 fluorotelomer sulfonic acid (4:2 FTS, 48%), d3-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA, 9%), and d5-ethylperefluorooctanesulfonamidoacetic acid (NEtFOSAA, 13%) were low in sample DAASF-03-SB-1-2. Data limitations are summarized below.
  - Wood X qualified the NMeFOSAA and NEtFOSAA results from this sample because of the extremely low internal standard recoveries. (Qualifier and reason code: X LI)
  - In accordance with the DoD data validation guidelines, Wood UJ qualified the non-detected 4:2 FTS result from this sample because of the low internal standard recovery. (Qualifier and reason code: UJ LI)
- Recovery of the EIS d3-NMeFOSAA was low at 46% in sample DAASF-03-SB-14-15. In accordance with the DoD data validation guidelines, Wood UJ qualified the non-detected NMeFOSAA result from this sample because of the low EIS recovery. (Qualifier and reason code: UJ LI)

- Recoveries of the EISs d3-NMeFOSAA and d5-NEtFOSAA were low at 21% and 31%, respectively, in sample DAASF-03-SB-36-37. In accordance with the DoD data validation guidelines, Wood UJ qualified the non-detected NMeFOSAA and NEtFOSAA results from this sample because of the low EIS recoveries. (Qualifier and reason code: UJ LI)
- Recovery of the EIS $^{13}C_8$-FOSA was low at 48% in sample AOI01-02-GW. Wood J+ qualified the detected FOSA result from this sample because of potential high analytical bias. (Qualifier and reason code: J+ LI)
- Recoveries of the EISs M2-4:2 FTS (41%), M2-6:2 FTS (48%), d3-NMeFOSAA (6%), d5-NEtFOSAA (8%), and $^{13}C_5$-PFPeA (49%) were low in sample DAASF-HA-FD1. Data limitations are summarized below.
  - Wood X qualified the NMeFOSAA and NEtFOSAA results from this sample because of the extremely low EIS recoveries. (Qualifier and reason code: X LI)
  - Wood J+ qualified the detected PFPeA result from this sample because of potential high analytical bias. (Qualifier and reason code: J+ LI)
  - In accordance with the DoD data validation guidelines, Wood UJ qualified the non-detected 4:2 FTS and 6:2 FTS results from this sample because of the low EIS recoveries. (Qualifier and reason code: UJ LI)
- Recoveries of the EISs d3-NMeFOSAA and d5-NEtFOSAA were low at 20% and 26%, respectively, in sample DAASF-SB-FD1. In accordance with the DoD data validation guidelines, Wood UJ qualified the non-detected NMeFOSAA and NEtFOSAA results from this sample because of the low EIS recoveries. (Qualifier and reason code: UJ LI)
- Recoveries of the EISs d3-NMeFOSAA and d5-NEtFOSAA were low at 13% and 16%, respectively, in sample DAASF-SB-FD2. Wood X qualified the NMeFOSAA and NEtFOSAA results from this sample because of the extremely low EIS recoveries. (Qualifier and reason code: X LI)
- Recovery of the EISs d3-NMeFOSAA and d5-NEtFOSAA were low at 25% and 38%, respectively, in the MS performed on sample DAASF-03-SB-14-15. Wood did not qualify data in the unspiked native sample based on EIS recoveries in the MS.
- Recovery of the EIS d3-NMeFOSAA was low at 42% in the MSD performed on sample DAASF-03-SB-14-15. Wood did not qualify data in the unspiked native sample based on EIS recovery in the MSD.

7.1.11 Data Reporting and Analytical Procedures

Eurofins J qualified detected results with concentrations less than the LOQ. Wood agrees these results are quantitatively uncertain and has maintained Eurofins' J qualifiers. (Qualifier and reason code: J DL)

Eurofins I qualified data when the transition ion ratios were outside QSM-specified limits. Wood applied J qualifiers to all of Eurofins' I qualified results. (Qualifier and reason code: J EM)

8.0 Field Duplicate Precision

EA collected field duplicates with samples:

- AOI01-HA-01-1 (DAASF-HA-FD1),
- DAASF-02-SB-14-15 (DAASF-SB-FD1),
- DAASF-03-SB-1-2 (DAASF-GW-FD), and

- DAASF-01-GW (DAASF-GW-FD).

RPDs between primary and field duplicate results were less than the QAPP-specified maximum of 50% for solid samples or 30% for water samples, or differences between results were less than the average LOQ, indicating acceptable sampling and analytical precision. Detections in the primary samples and their field duplicates are summarized in Table 2.

9.0 Summary and Conclusions

Wood reviewed a total of 936 records from field samples and applied the following qualifiers to the data during validation:

- X: 6 records (0.64%) were X qualified as needing further evaluation during data usability assessment because of extremely low EIS recoveries;
- J+: 5 records (0.53%) were J+ qualified as being estimated concentrations with potential high analytical bias because of a detection in the associated equipment blank or low EIS recoveries;
- J: 84 records (9.0%) were J qualified as being estimated values without apparent bias because the detected concentrations were less than the LOQ;
- U: 2 records (0.21%) were U qualified, turning detected results into non-detected results, because of a detection in the associated equipment blank; and
- UJ: 8 records (0.85%) were UJ qualified as being estimated non-detected values because of low EIS recoveries.

10.0 References

EA, 2020. Final Programmatic UFP-QAPP, Site Inspection for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide, December.

EA, 2021. Final Site Inspection UFP-QAPP Addendum, Duncan Readiness Center and Army Aviation Support Facility, New Castle, Delaware, May.

DoD, 2019a. DoD QSM, Version 5.3. May.

DoD, 2019b. General Data Validation Guidelines, Revision 1. November.

DoD, 2020. Data Validation Guidelines Module 3: Data Validation Procedure of Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15.

11.0 Limitations

This report was prepared exclusively for EA by Wood Environment & Infrastructure Solutions, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Wood services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Data Validation report is intended to be used by EA for the Nationwide ARNG Installations Site Inspections for Per- and Polyfluoroalkyl Substances project only, subject to the terms and conditions of its contract with Wood. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

Tables

Table 1
Field Samples Submitted to Eurofins Environment Testing America
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Field Sample Identification	Matrix	Collection Date and Time	Laboratory Sample Identification	Notes
AOI01-01-SB-1-2	Solid	6/2/2021 7:02	410-42478-1	
AOI01-01-SB-13.5-14	Solid	6/2/2021 9:12	410-42478-2	
AOI01-01-SB-34.5-35.5	Solid	6/2/2021 9:26	410-42478-3	
AOI01-02-SB-1-2	Solid	6/2/2021 14:05	410-42478-4	
AOI01-02-SB-14-15	Solid	6/2/2021 14:09	410-42478-5	
AOI01-02-SB-19-20	Solid	6/2/2021 14:12	410-42478-6	
AOI01-03-SB-1-2	Solid	6/2/2021 13:20	410-42478-7	
AOI01-03-SB-14-15	Solid	6/2/2021 13:27	410-42478-8	
AOI01-03-SB-22-23	Solid	6/2/2021 13:33	410-42478-9	
AOI02-01-SB-1-2	Solid	6/2/2021 15:18	410-42478-10	
AOI02-01-SB-14-15	Solid	6/2/2021 15:38	410-42478-11	
AOI02-01-SB-21-22	Solid	6/2/2021 15:39	410-42478-12	
DAASF-01-SB-1-2	Solid	6/2/2021 11:36	410-42478-13	
DAASF-01-SB-14-15	Solid	6/2/2021 11:46	410-42478-14	
DAASF-01-SB-31-32	Solid	6/2/2021 12:07	410-42478-15	
DAASF-02-SB-1-2	Solid	6/2/2021 9:44	410-42478-16	
DAASF-02-SB-14-15	Solid	6/2/2021 10:16	410-42478-17	
DAASF-02-SB-34-35	Solid	6/2/2021 10:23	410-42478-18	
DAASF-03-SB-1-2	Solid	6/3/2021 8:43	410-42478-19	
DAASF-03-SB-14-15	Solid	6/3/2021 8:51	410-42478-20	
DAASF-03-SB-36-37	Solid	6/3/2021 8:57	410-42478-21	
AOI01-HA-01-1	Solid	6/2/2021 13:15	410-42478-22	
AOI01-HA-02-1	Solid	6/2/2021 13:25	410-42478-23	
AOI01-HA-03-1	Solid	6/2/2021 7:30	410-42478-24	
AOI01-HA-04-1	Solid	6/2/2021 7:20	410-42478-25	
AOI01-HA-05-1	Solid	6/2/2021 7:30	410-42478-26	
AOI01-HA-06-1	Solid	6/2/2021 7:35	410-42478-27	
AOI01-01-GW	Water	6/3/2021 6:45	410-42478-28	
AOI01-02-GW	Water	6/3/2021 7:30	410-42478-29	
AOI01-03-GW	Water	6/3/2021 10:33	410-42478-30	
AOI02-01-GW	Water	6/3/2021 10:57	410-42478-31	
DAASF-01-GW	Water	6/3/2021 10:17	410-42478-32	
DAASF-02-GW	Water	6/3/2021 8:30	410-42478-33	
DAASF-03-GW	Water	6/3/2021 11:26	410-42478-34	
MW15-GW	Water	6/3/2021 12:45	410-42478-35	
DAASF-HA-FD1	Solid	6/2/2021 12:00	410-42478-36	Field duplicate of AOI01-HA-01-1
DAASF-SB-FD1	Solid	6/2/2021 12:00	410-42478-37	Field duplicate of DAASF-02-SB-14-15
DAASF-SB-FD2	Solid	6/3/2021 12:00	410-42478-38	Field duplicate of DAASF-03-SB-1-2
AOI01-03-SB-8-9	Solid	6/2/2021 13:31	410-42478-39	Analyzed for grain size only, not validated
DAASF-01-SB-13-14	Solid	6/2/2021 10:23	410-42478-40	Analyzed for grain size only, not validated
DAASF-01-SB-6-8	Solid	6/2/2021 0:00	410-42478-41	Analyzed for grain size only, not validated

Table 1
Field Samples Submitted to Eurofins Environment Testing America
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Field Sample Identification	Matrix	Collection Date and Time	Laboratory Sample Identification	Notes
DAASF-FB01	Water	6/2/2021 15:17	410-42478-42	Field blank
DAASF-FB02	Water	6/3/2021 15:17	410-42478-43	Field blank
DAASF-EB01	Water	6/2/2021 16:21	410-42478-44	Equipment blank
DAASF-GW-EB1	Water	6/3/2021 11:35	410-42478-45	Equipment blank
DAASF-SB-EB03	Water	6/3/2021 15:30	410-42478-46	Equipment blank
DAASF-GW-FD	Water	6/3/2021 12:00	410-42478-47	Field duplicate of DAASF-01-GW

Table 2
Target Analyte Detections in Primary and Field Duplicate Samples
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Analyte	Average Limit of Quantitation	Primary Result	Field Duplicate Result	Relative Percent Difference	Notes
Samples AOI01-HA-01-1 and DAASF-HA-FD1					
Perfluoropentanoic acid	0.69 ng/g	0.45 U	0.25 J	NC	
Perfluorohexanoic acid	0.69 ng/g	0.23 J	0.47 U	NC	
Perfluorononanoic acid	0.69 ng/g	0.32 J	0.27 J	17%	
Perfluorodecanoic acid	0.69 ng/g	0.26 J	0.24 J	8.0%	
Perfluoroundecanoic acid	0.69 ng/g	0.45 U	0.26 J	NC	
Perfluorooctanesulfonic acid	0.69 ng/g	1.7	1.3	27%	
Samples DAASF-02-SB-14-15 and DAASF-SB-FD1					
No target analyte detections					
Samples DAASF-03-SB-1-2 and DAASF-SB-FD2					
Perfluoropentanoic acid	0.64 ng/g	0.61 J	0.64	4.8%	
Perfluorohexanoic acid	0.64 ng/g	0.37 J	0.38 J	2.7%	
Perfluoroheptanoic acid	0.64 ng/g	0.45 J	0.39 J	14%	
Perfluorooctanoic acid	0.64 ng/g	1.2	0.99	19%	
Perfluorononanoic acid	0.64 ng/g	0.35 J	0.52 J	39%	
Perfluorooctanesulfonic acid	0.64 ng/g	0.42 U	0.24 J	NC	
Samples DAASF-01-GW and DAASF-GW-FD					
Perfluorohexanoic acid	2.0 ng/L	36	34	5.7%	
Perfluoroheptanoic acid	2.0 ng/L	19	19	0.0%	
Perfluorooctanoic acid	2.0 ng/L	29	27	7.1%	
Perfluorononanoic acid	2.0 ng/L	0.57 J	0.54 J	5.4%	
Perfluorobutanesulfonic acid	2.0 ng/L	1.2 J	1.2 J	0.0%	
Perfluorohexanesulfonic acid	2.0 ng/L	11	11	0.0%	
Perfluorooctanesulfonic acid	2.0 ng/L	0.73 J	0.67 J	8.6%	
Perfluoropentanesulfonic acid	2.0 ng/L	0.80 J	0.82 J	2.5%	
Perfluorobutanoic acid	2.0 ng/L	40	39	2.5%	
Perfluoropentanoic acid	2.0 ng/L	31	30	3.3%	

Notes:
NC = not calculable
ng/g = nanograms per gram
ng/L = nanograms per liter

Qualifier Definitions:
J = The reported result is an estimated quantity with an unknown bias.
U = The analyte was not detected and was reported as less than the limit of detection.

Table 3
Qualifiers Applied During Validation
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Sample Identification	Analyte	Concentration	Qualifier and Reason Code
AOI01-01-GW-06032021	Perfluorodecanoic acid	0.87 ng/L	J DL
AOI01-01-GW-06032021	Perfluoroheptanesulfonic acid	1.7 ng/L	J DL
AOI01-01-GW-06032021	Perfluorooctanesulfonamide	1.0 ng/L	J DL
AOI01-01-SB-1-2-06022021	Perfluorobutanoic acid	0.94 ng/g	J DL
AOI01-01-SB-1-2-06022021	Perfluorohexanoic acid	0.60 ng/g	J DL
AOI01-01-SB-1-2-06022021	Perfluoroheptanoic acid	0.60 ng/g	J DL
AOI01-01-SB-1-2-06022021	Perfluoroundecanoic acid	0.46 ng/g	J DL
AOI01-01-SB-1-2-06022021	Perfluorododecanoic acid	0.30 ng/g	J DL
AOI01-02-GW-06032021	Perfluoroheptanesulfonic acid	1.6 ng/L	J DL
AOI01-02-GW-06032021	Perfluorooctanesulfonamide	1.9 ng/L	J+ LI
AOI01-02-SB-1-2-06022021	Perfluorooctanoic acid	0.35 ng/g	J DL
AOI01-02-SB-1-2-06022021	Perfluorononanoic acid	0.31 ng/g	J DL
AOI01-03-GW-06032021	Perfluoroheptanesulfonic acid	1.5 ng/L	J DL
AOI01-03-SB-1-2-06022021	Perfluoropentanoic acid	0.28 ng/g	J DL
AOI01-03-SB-1-2-06022021	Perfluorohexanoic acid	0.22 ng/g	J DL
AOI01-03-SB-1-2-06022021	Perfluoroheptanoic acid	0.27 ng/g	J DL
AOI01-03-SB-1-2-06022021	Perfluorononanoic acid	0.37 ng/g	J DL
AOI01-03-SB-1-2-06022021	Perfluorooctanesulfonic acid	0.48 ng/g	J DL
AOI01-03-SB-14-15-06022021	Perfluorooctanoic acid	0.22 ng/g	J DL
AOI01-03-SB-22-23-06022021	Perfluorooctanoic acid	0.27 ng/g	J DL
AOI01-HA-01-1-06022021	Perfluorohexanoic acid	0.23 ng/g	J DL
AOI01-HA-01-1-06022021	Perfluorooctanoic acid	0.38 ng/g	J DL
AOI01-HA-01-1-06022021	Perfluorononanoic acid	0.32 ng/g	J DL
AOI01-HA-01-1-06022021	Perfluorodecanoic acid	0.26 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluoroheptanoic acid	0.23 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluorooctanoic acid	0.32 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluorononanoic acid	0.43 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluorodecanoic acid	0.33 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluoroundecanoic acid	0.25 ng/g	J DL
AOI01-HA-02-1-06022021	Perfluorododecanoic acid	0.30 ng/g	J DL
AOI01-HA-03-1-06022021	Perfluoropentanoic acid	0.75 ng/g	J DL
AOI01-HA-03-1-06022021	Perfluorohexanoic acid	0.40 ng/g	J DL
AOI01-HA-03-1-06022021	Perfluoroheptanoic acid	0.37 ng/g	J DL
AOI01-HA-03-1-06022021	Perfluorooctanoic acid	0.74 ng/g	J DL
AOI01-HA-03-1-06022021	Perfluorononanoic acid	0.65 ng/g	J DL
AOI01-HA-04-1-06022021	Perfluorodecanoic acid	0.24 ng/g	J DL
AOI01-HA-04-1-06022021	Perfluorooctanesulfonic acid	0.32 ng/g	J DL
AOI01-HA-05-1-06022021	Perfluorooctanesulfonic acid	0.56 ng/g	J DL
AOI01-HA-06-1-06022021	Perfluoropentanoic acid	0.29 ng/g	J DL
AOI01-HA-06-1-06022021	Perfluorooctanoic acid	0.32 ng/g	J DL
AOI01-HA-06-1-06022021	Perfluorononanoic acid	0.26 ng/g	J DL
AOI01-HA-06-1-06022021	Perfluorodecanoic acid	0.67 ng/g	J DL

Table 3
Qualifiers Applied During Validation
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Sample Identification	Analyte	Concentration	Qualifier and Reason Code
AOI01-HA-06-1-06022021	Perfluorotetradecanoic acid	0.60 ng/g	J DL
AOI01-HA-06-1-06022021	Perfluorohexanesulfonic acid	0.51 ng/g	J DL
AOI02-01-GW-06032021	Perfluoropentanesulfonic acid	1.1 ng/L	J DL
AOI02-01-GW-06032021	Perfluoroheptanesulfonic acid	0.98 ng/L	J DL
AOI02-01-GW-06032021	Perfluorooctanesulfonic acid	5.7 ng/L	J+ EB, EM
AOI02-01-GW-06032021	6:2 Fluorotelomer sulfonic acid	2.9 ng/L	J DL
AOI02-01-SB-1-2-06022021	Perfluoropentanoic acid	0.30 ng/g	J DL
AOI02-01-SB-1-2-06022021	Perfluorooctanesulfonic acid	0.31 ng/g	J DL
DAASF-01-GW-06032021	Perfluorononanoic acid	0.57 ng/L	J DL
DAASF-01-GW-06032021	Perfluorobutanesulfonic acid	1.2 ng/L	J DL
DAASF-01-GW-06032021	Perfluoropentanesulfonic acid	0.80 ng/L	J DL
DAASF-01-GW-06032021	Perfluorooctanesulfonic acid	1.0 ng/L	U EB
DAASF-01-SB-1-2-06022021	Perfluoropentanoic acid	0.37 ng/g	J DL
DAASF-01-SB-1-2-06022021	Perfluorohexanoic acid	0.50 ng/g	J DL
DAASF-01-SB-1-2-06022021	Perfluoroheptanoic acid	0.42 ng/g	J DL
DAASF-01-SB-1-2-06022021	Perfluorononanoic acid	0.25 ng/g	J DL
DAASF-01-SB-1-2-06022021	Perfluoroundecanoic acid	0.34 ng/g	J DL
DAASF-01-SB-14-15-06022021	Perfluorohexanesulfonic acid	0.21 ng/g	J DL
DAASF-02-GW-06032021	Perfluorooctanesulfonic acid	2.4 ng/L	J+ EB, EM
DAASF-02-SB-1-2-06022021	Perfluoropentanoic acid	0.40 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluorohexanoic acid	0.26 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluoroheptanoic acid	0.25 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluorooctanoic acid	0.52 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluorononanoic acid	0.53 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluorodecanoic acid	0.42 ng/g	J DL
DAASF-02-SB-1-2-06022021	Perfluoroundecanoic acid	0.28 ng/g	J DL
DAASF-03-GW-06032021	Perfluorooctanesulfonic acid	12 ng/L	J+ EB, EM
DAASF-03-GW-06032021	Perfluorooctanesulfonamide	1.4 ng/L	J DL
DAASF-03-SB-1-2-06032021	Perfluoropentanoic acid	0.61 ng/g	J DL
DAASF-03-SB-1-2-06032021	Perfluorohexanoic acid	0.37 ng/g	J DL
DAASF-03-SB-1-2-06032021	Perfluoroheptanoic acid	0.45 ng/g	J DL
DAASF-03-SB-1-2-06032021	Perfluorononanoic acid	0.35 ng/g	J DL
DAASF-03-SB-1-2-06032021	4:2 Fluorotelomer sulfonic acid	1.7 ng/g	UJ LI
DAASF-03-SB-1-2-06032021	NMeFOSAA	0.42 ng/g	X LI
DAASF-03-SB-1-2-06032021	NEtFOSAA	0.42 ng/g	X LI
DAASF-03-SB-14-15-06032021	Perfluoropentanoic acid	0.43 ng/g	J DL
DAASF-03-SB-14-15-06032021	Perfluorohexanoic acid	0.28 ng/g	J DL
DAASF-03-SB-14-15-06032021	Perfluorooctanoic acid	0.24 ng/g	J DL
DAASF-03-SB-14-15-06032021	NMeFOSAA	0.45 ng/g	UJ LI
DAASF-03-SB-36-37-06032021	NMeFOSAA	0.42 ng/g	UJ LI
DAASF-03-SB-36-37-06032021	NEtFOSAA	0.42 ng/g	UJ LI
DAASF-GW-FD-06032021	Perfluorononanoic acid	0.54 ng/L	J DL

Table 3
Qualifiers Applied During Validation
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Sample Identification	Analyte	Concentration	Qualifier and Reason Code
DAASF-GW-FD-06032021	Perfluorobutanesulfonic acid	1.2 ng/L	J DL
DAASF-GW-FD-06032021	Perfluoropentanesulfonic acid	0.82 ng/L	J DL
DAASF-GW-FD-06032021	Perfluorooctanesulfonic acid	0.97 ng/L	U EB
DAASF-HA-FD1-06022021	Perfluoropentanoic acid	0.25 ng/g	J+ LI, DL
DAASF-HA-FD1-06022021	Perfluorooctanoic acid	0.30 ng/g	J DL
DAASF-HA-FD1-06022021	Perfluorononanoic acid	0.27 ng/g	J DL
DAASF-HA-FD1-06022021	Perfluorodecanoic acid	0.25 ng/g	J DL
DAASF-HA-FD1-06022021	Perfluoroundecanoic acid	0.26 ng/g	J DL
DAASF-HA-FD1-06022021	Perfluorotridecanoic acid	0.24 ng/g	J DL
DAASF-HA-FD1-06022021	4:2 Fluorotelomer sulfonic acid	1.9 ng/g	UJ LI
DAASF-HA-FD1-06022021	6:2 Fluorotelomer sulfonic acid	1.9 ng/g	UJ LI
DAASF-HA-FD1-06022021	NMeFOSAA	0.47 ng/g	X LI
DAASF-HA-FD1-06022021	NEtFOSAA	0.47 ng/g	X LI
DAASF-SB-FD1-06022021	NMeFOSAA	0.44 ng/g	UJ LI
DAASF-SB-FD1-06022021	NEtFOSAA	0.44 ng/g	UJ LI
DAASF-SB-FD2-06032021	Perfluorohexanoic acid	0.38 ng/g	J DL
DAASF-SB-FD2-06032021	Perfluoroheptanoic acid	0.39 ng/g	J DL
DAASF-SB-FD2-06032021	Perfluorononanoic acid	0.52 ng/g	J DL
DAASF-SB-FD2-06032021	Perfluorooctanesulfonic acid	0.24 ng/g	J DL
DAASF-SB-FD2-06032021	NMeFOSAA	0.43 ng/g	X LI
DAASF-SB-FD2-06032021	NEtFOSAA	0.43 ng/g	X LI

Notes:
NEtFOSAA = ethylperfluorooctanesulfonamidoacetic acid
ng/g = nanograms per gram
ng/L = nanograms per liter
NMeFOSAA = methylperfluorooctanesulfonamidoacetic acid

Qualifier Definitions:
J = The reported result is an estimated quantity with an unknown bias.
J + = The result is an estimated quantity, but the result may be biased high.
U = The analyte was not detected and was reported as less than the limit of detection (LOD). The LOD has been adjusted for any dilution or concentration of the sample.
UJ = The analyte was not detected and was reported as less than the LOD. However, the associated numerical value is approximate.
X = The sample results were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team, but exclusion of the data is recommended.

Table 3
Qualifiers Applied During Validation
Duncan Readiness Center and Army Aviation Support Facility
New Castle, Delaware

Sample Identification	Analyte	Concentration	Qualifier and Reason Code

Reason Codes:

DL = The detected concentration is less than the limit of quantitation.

EB = The analyte was detected in the associated equipment blank.

EM = The transition ion ratio was outside specified limits.

LI = Low extracted internal standard recovery.

Appendix B

Field Documentation

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Appendix B1

Logs of Daily Notice of Field Activities

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Log of Daily Notice of Field Activity
Duncan RC and AASF. New Castle, DE

Date	EA Personnel	Weather	Summary Daily Activities	Issues	Progress to Date	Subcontractor(s)/ Visitors
5/27/2021	Mike Kepner and Mike O'Neill	Sunny, 85 degrees	Performed sample location reconnaissance for the existing monitoring well (MW15), temporary well points, and hand auger locations. Based on observations, there will be no changes at locations: DAASF-01, DAASF-02, AOI01-01,AOI01-03, AOI01-HA-01 through AOI01-HA-02, and MW15. Changes to the remaining locations are as follows: DAASF-03 – This location was moved approximately 15 feet north based potential electric utilities. Delmarva power representative was on site and mentioned we should be safe with soft digging down to 5 feet. AOI02-01- If the drill rig can traverse the slope, we will move this location approximately 50 feet northeast along the fence line. This will shorten the length of the linear feet required to reach groundwater and assesses potential mobilization along the steep gradient AOI01-02- There is potential that proposed location AOI-02 is underlain by geotextile liner. If that is the case, we will off-set the temporary well approximately 50 ft southeast of the current location. This location will be outside of the pond, but still within the drainage pathway (downgradient of the crash site) associated with AOI01. AOI01-HA-03 through AOI01-HA-06 – Based on observations, the secondary drainage pond is completely lined with rip rap, which is underlain by geotextile fabric. However, approximately 5-7 inches of soil has been deposited along the northwest and southeastern areas of the pond. Based on the nature and depth of this soil, we will collect 4 samples from this pond using a metal trowel as opposed to a hand auger as originally proposed.	No	Utility clearence and sample location reconnaissance complete. Field work is scheduled for the 2-3 June 2021.	Tim Peck (USACE), Brian Nichols (DEARNG), Emily Whiting (DEARNG), Kevin Popowich (DNREC), and Steph Gordon (DNREC)
6/2/2021	Mike Kepner, Amy Mallonee, and Elizabeth Eyer		Installed Temporary Wells and collected soil boring samples at the following locations : DAASF-01, DAASF-02, AOI01-01,AOI01-02, AOI01-03, AOI02-01. Collected shallow soil and hand auger samples from the following locations: AOI01-HA-01 through AOI01-HA-06. Sampling notes: As previously discussed, the location of AOI02-01 was moved approximately 50 feet northeast along the fence line.	Unable to pull groundwater samples from AOI01-01 and AOI01-03 using peristaltic pump and tubing. Sample collected from AOI01-01 using inertia pump. Will reattempt sampling of AOI01-03 using peristaltic pump on 6/3/2021. If lift can't be created, bailers will be used.	Installation of 6 of 7 wells and associated soil sampling complete. Shallow soil sampling complete. Installation of DAASF-03 and associated soil sampling to occur on 6/3/2021. All gauging, groundwater sampling, surveying, and abandonment to occur on 6/3/2021.	Tim Peck (USACE), Brian Nichols (DEARNG), Emily Whiting (DEARNG), Amanda Sullivan (ARNG G9), Jennifer Li (ARNG G9), and GSI Mid-Atlantic (2 man team).

Log of Daily Notice of Field Activity
Duncan RC and AASF. New Castle, DE

Date	EA Personnel	Weather	Summary Daily Activities	Issues	Progress to Date	Subcontractor(s)/ Visitors
6/3/2021	Mike Kepner, Amy Mallonee, and Elizabeth Eyer		Installed temporary well DAASF-03 and collected associated soil sampling at boring. Collected groundwater samples at all 7 temporary wells using inertia pump. Collected low flow sample at MW-15 using peristaltic pump. Gauged groundwater elevation in all wells from top of casing. Surveyed top of casing and ground elevation at each temporary well and MW-15. Abandoned all temporary wells and returned cuttings to associated holes. Containerized all liquid IDW in one 55 gallon drum and secured it within cold storage building.	Unable to collect groundwater samples from temporary wells using peristaltic pump or bailers. Used inertia pump at all temporary wells.	Field work is complete and samples will be shipped to lab for analysis 6/4/2021.	Tim Peck (USACE), Brian Nichols (DEARNG), Emily Whiting (DEARNG), Amanda Sullivan (ARNG G9), Jennifer Li (ARNG G9), Matthew Lowe (Merestone), and GSI Mid-Atlantic (2 man team).

Appendix B2

Sampling Forms

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BORING/WELL LOG

HOLE NUMBER: AOI01-01

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC	2. DRILL SUBCONTRACTOR: GSI - mid Atlantic	SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness Center AASF	4. PROPERTY ADDRESS: [redacted]	5 / 6. AREA AND MEASUREMENTS
7. NAME OF DRILLER: Kevin Pumphrey	8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT	
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT TYPE OF LINER USED, IF APPLICABLE: 3/4" acetate	10. SURFACE ELEVATION AND CONDITIONS: grass on edge of airfield	
11. DIRECT READING PARAMETERS: N/A	12. DATE STARTED: 6-2-21	13. DATE COMPLETED: 6-2-21
14. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED: [redacted]' 35.5'	
16. DEPTH DRILLED INTO ROCK: N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
18. TOTAL DEPTH OF HOLE: 45.0'	19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	
20. WELL INSTALLED? yes — IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary	SAMPLE TYPE: 4-oz jar	
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS	LAB ANALYSIS: PFAS, TOC
22. DISPOSITION OF HOLE — IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite	23. GEOLOGIST: A. Mallonee	

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0' – 0.25	Topsoil and grass				5'	2.8'	
	0.25 – 2.5'	Damp light brown (7.5YR 4/3) sandy silt, some gravel (Fill)	0.2					AOI01-01 (0-2) 0702 6/2/21
	2.5 – 4.6'	Damp orange brown (5YR 5/8) sandy silt	0.0			5'	3.7'	
	4.6' – 30.0'	Moist light gray (7.5YR 8/2) silty sand, trace clay	0.0'			5'	3.8'	AOI01-01 (13.5-14) 0912 (TOC + PFAS)
	30.0' – 45.0'	Moist light gray and orange (10YR 8/6) sandy silt, little clay	0.0'			5'	3.9'	AOI01-01 (34.5-35.5') 0926
			0.0'			5'	4.2'	[redacted]
			0.0'			5'	4.4'	
			0.0'			5'	5'	
			0.0'			5'	4.2'	
		Boring to 45'						
		Well screened 40-45'						

PROJECT: James N. Robey PSTC, Howard County

HOLE NO.: AOI01-01

BORING/WELL LOG

HOLE NUMBER: A0101-02

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC
2. DRILL SUBCONTRACTOR: GSI - Mid-Atlantic
SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness Center AASF
4. PROPERTY ADDRESS:
5 / 6. AREA AND MEASUREMENTS:
7. NAME OF DRILLER: Kevin Pumphrey
8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT
TYPE OF LINER USED, IF APPLICABLE: 3/4" Acetate
10. SURFACE ELEVATION AND CONDITIONS: grass in retention pond
11. DIRECT READING PARAMETERS: N/A
12. DATE STARTED: 6/2/21
13. DATE COMPLETED: 6/2/21
14. OVERBURDEN THICKNESS:
15. DEPTH GROUNDWATER ENCOUNTERED: 20.0'
16. DEPTH DRILLED INTO ROCK: N/A
17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
18. TOTAL DEPTH OF HOLE: 25.0'
19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):
20. WELL INSTALLED? yes
IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary
SAMPLE TYPE: 4-oz jar
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS:
SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS:
LAB ANALYSIS: PFAS
22. DISPOSITION OF HOLE
IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite
23. GEOLOGIST: A. Malonee

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0 0.5'	Damp brown (5YR 5/6) sandy silt	0.0'			5'	2.6'	A0101-02-SB-1-2 1405
	0.5 2.5'	Damp brown silty sand and gravel	0.0			5'	3.1'	
	2.5' 15.0'	Damp brown (7.5YR 4/6) to tan (7.5YR 6/6) silty sand	0.0			5'	3.3'	A0101-02-SB-14-15 1409
	15.0' 16.5'	wet gray (7.5YR 8/1) sandy silt	0.0'			5'	4'	A0101-02-SB-A-20 1412
	16.5' 25.0'	Wet gray (7.5YR 8/1) silty sand	0.0'			5'	4.1'	
		Boring to 25.0'						
		well screened 20-25'						

PROJECT: James W. Bobey, PSTC, Howard Cuddy

HOLE NO.: A0101-02

BORING/WELL LOG

HOLE NUMBER: AOI01-03

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC	2. DRILL SUBCONTRACTOR: GSI- Mid Atlantic	SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness center AASF	4. PROPERTY ADDRESS	5 / 6. AREA AND MEASUREMENTS
7. NAME OF DRILLER: Kevin Pumphrey	8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT	
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT TYPE OF LINER USED, IF APPLICABLE: 3/4" acetate	10. SURFACE ELEVATION AND CONDITIONS: grass slope	
11. DIRECT READING PARAMETERS: N/A	12. DATE STARTED: 6/2/21	13. DATE COMPLETED: 6/2/21
14. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED: 23.0'	
16. DEPTH DRILLED INTO ROCK: N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
18. TOTAL DEPTH OF HOLE: 29.0'	19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 23.9 at 6/3/21	
20. WELL INSTALLED? yes / IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary	SAMPLE TYPE: 4oz jar	
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS	LAB ANALYSIS: PFAS and grain size
22. DISPOSITION OF HOLE / IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite	23. GEOLOGIST: A. Mallonee	

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0' 5.0'	Topsoil, damp brown (7.5YR 4/6) silt, little sand, trace gravel	0.1			5'	3.0'	AOI01-03-SB-1-2 1320
	5.0' 9.0'	Moist brown (7.5YR 4/6) silty clay	0.0			5'	4.3'	AOI01-03-SB-8-9 1331
	9.0' 23.0'	Damp brown (5YR 4/6) to tan (7.5YR 7/8) silty sand	0.0			5'	4.0'	AOI01-03-SB-14-15 1327
	23.0' 29.0	Wet light gray (2.5Y 8/2) silty sand	0.0			5'	4.25'	
			0.0			5'	4.8	
			0.0			4'	4'	AOI01-03-SB-22-23
		Boring to 29'						1333
		Well screened 24-29'						

PROJECT: James N. Rooney RSTO, Howard County

HOLE NO.: AOI01-03

BORING/WELL LOG

HOLE NUMBER	A0102-01
1. COMPANY NAME	EA Engineering, Science, and Technology, Inc., PBC
2. DRILL SUBCONTRACTOR	GSI- Mid Atlantic
SHEET 1 OF SHEETS 1	
3. PROJECT	Duncan Readiness Center AASF
4. PROPERTY ADDRESS	
5 / 6. AREA AND MEASUREMENTS	
7. NAME OF DRILLER	Kevin Pumphrey
8. MANUFACTURER'S DESIGNATION OF DRILL	Geoprobe- DPT
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" barrel DPT
TYPE OF LINER USED, IF APPLICABLE	3/4" acetate
10. SURFACE ELEVATION AND CONDITIONS	bottom of grassy slope
11. DIRECT READING PARAMETERS:	N/A
12. DATE STARTED	6/2/21
13. DATE COMPLETED	6/2/21
14. OVERBURDEN THICKNESS	—
15. DEPTH GROUNDWATER ENCOUNTERED	22.0'
16. DEPTH DRILLED INTO ROCK	N/A
17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	N/A
18. TOTAL DEPTH OF HOLE	29.0'
19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	22.16 on 6/3/21
20. WELL INSTALLED?	yes
IF SO COMPLETE CONSTRUCTION DIAGRAM	temporary
SAMPLE TYPE:	4 oz jar
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	
SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS	
LAB ANALYSIS	PFAS
22. DISPOSITION OF HOLE	
IF NOT A WELL, BACKFILLED WITH:	cuttings and bentonite
23. GEOLOGIST	A. Mallonee

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0'–4.5'	topsoil, damp brown (5YR 5/8) sandy silt	0.1			5'	2.3'	A0102-01-SB-1-2 1518
	4.5'–10.0	Moist gray (7.5YR 8/1) silty sand	0.2			5'	3.5'	
	10.0–22.5	moist tan to gray (7.5YR 8/1) silty sand, little clay	0.0			5'	3.3'	A0102-01-SB-14-15 1538
	22.5–23.0'	Moist gray (7.5YR 8/1) sandy silt	0.0			5'	4'	
	23.0'–29.0'	Moist tan (7.5YR 7/8) and gray (7.5YR 8/1) silty sand	0.0			5'	4.5'	A0102-01-SB-21-22 1539
			0.0			4'	3.8'	
		Boring to 29.0						
		Well screened 24-29'						

PROJECT: James W. Robey PCTC, Howard County

HOLE NO.: A0102-01

BORING/WELL LOG

HOLE NUMBER: DAASF-01

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC	2. DRILL SUBCONTRACTOR: GSI - Mid Atlantic	SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness Center	4. PROPERTY ADDRESS	5 / 6. AREA AND MEASUREMENTS
7. NAME OF DRILLER: Kevin Pumphrey	8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT	
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT TYPE OF LINER USED, IF APPLICABLE: 3/4" acetate	10. SURFACE ELEVATION AND CONDITIONS: top of grassy slope	
11. DIRECT READING PARAMETERS: N/A	12. DATE STARTED: 6/2/21	13. DATE COMPLETED: 6/2/21
14. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED: 32.5'	
16. DEPTH DRILLED INTO ROCK: N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
18. TOTAL DEPTH OF HOLE: 37.5'	19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 32.52' on 6/3/21	
20. WELL INSTALLED? yes; IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary	SAMPLE TYPE: 4-oz and 120z jars	
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS	LAB ANALYSIS: PFAS and grain size
22. DISPOSITION OF HOLE; IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite	23. GEOLOGIST: A. Mallonee	

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0'	topsoil, damp brown (10YR 4/1)						
	2.5'	sandy silt, little gravel	0.0			5'	3.2'	DAASF-01-SB-1-2 1136
	2.5'	crushed rock						
	2.8'	GLEY1 6/1						
	2.8'	moist brown (10YR 4/1) clayey silt, little sand	0.0			5'	2.8'	
			0.0			5'	3.1'	DAASF-01-SB-14-15 1146
			0.0			5'	3.8'	DAASF-01-SB-10-12 1217
	20.0'		0.0			5'	3.9'	
	30.0'	Damp orange-brown (7.5YR 5/6) silty sand	0.0			5'	3.5'	offset 10' after first
	32.0' 37.5'	wet light gray (10YR 8/1) silty sand	0.0			5'	3.5'	boring terminated
								at 9.0' - hit concrete
		Boring to 37.5'						
		Well screened 32.5'-37.5'						DAASF-01-SB-31-32 1207

PROJECT: James N. Bobey PSTC- Howard County

HOLE NO.: DAASF-01

BORING/WELL LOG

HOLE NUMBER: DAASF-02

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC
2. DRILL SUBCONTRACTOR: GSI - Mid Atlantic
SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness Center
4. PROPERTY ADDRESS
5 / 6. AREA AND MEASUREMENTS
7. NAME OF DRILLER: Kevin Pumphrey
8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT
TYPE OF LINER USED, IF APPLICABLE: 3/4" acetate
10. SURFACE ELEVATION AND CONDITIONS: top of grassy slope
11. DIRECT READING PARAMETERS: N/A
12. DATE STARTED: 6/2/21
13. DATE COMPLETED: 6/2/21
14. OVERBURDEN THICKNESS
15. DEPTH GROUNDWATER ENCOUNTERED: 35.0'
16. DEPTH DRILLED INTO ROCK: N/A
17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
18. TOTAL DEPTH OF HOLE: 40.0'
19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)
20. WELL INSTALLED? yes — IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary
SAMPLE TYPE: 4oz jar
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS
SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS
LAB ANALYSIS: PFAS
22. DISPOSITION OF HOLE — IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite
23. GEOLOGIST: A. Mallonee

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0 2.5'	topsoil, damp brown (10YR 4/4) sandy silt, some gravel (fill)	0.0			5'	2.1	DAASF-02-SB-0-1 0944
	2.5 16.0'	moist brown (7.5YR 4/2) sandy silty	0.0'			5'	2.5'	
	16.0 21.0'	moist dark gray (10YR 4/1) clayey silt, little sand	0.0'			5'	3.2'	DAASF-02-SB-14-15
	21.0 25.0	Damp dark gray (5YR 5/2) sandy silt	0.0'			5'	4.0'	(DAASF-FD1)
	25.0	moist gray (7.5YR 7/1) silty sand	0.0'			5'	3.5'	
			0.0'			5'	3.5'	
			0.0'			5'	4.25'	DAASF-02-34-35 1023
	39.5' 40.0'	Damp gray (7.5YR 8/1) and orange clay (5YR 6/8)	0.0'			5'	4.0'	
		Boring to 40.0'						
		well screened 35-40'						

7.5YR 4/2

10YR 5/6

PROJECT: James N. Robey PSTC, Howard County

HOLE NO.: DAASF-02

BORING/WELL LOG

HOLE NUMBER: DAASF-03

1. COMPANY NAME: EA Engineering, Science, and Technology, Inc., PBC	2. DRILL SUBCONTRACTOR: GSI - Mid Atlantic	SHEET 1 OF SHEETS 1
3. PROJECT: Duncan Readiness Center AASF	4. PROPERTY ADDRESS	5 / 6. AREA AND MEASUREMENTS
7. NAME OF DRILLER: Kevin Pumphrey	8. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe- DPT	
9. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" barrel DPT TYPE OF LINER USED, IF APPLICABLE: 3/4" acetate	10. SURFACE ELEVATION AND CONDITIONS: grass	
11. DIRECT READING PARAMETERS: N/A	12. DATE STARTED: 6/3/21	13. DATE COMPLETED: 6/3/21
14. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED: 37.5	
16. DEPTH DRILLED INTO ROCK: N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
18. TOTAL DEPTH OF HOLE: 45.0'	19. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 35.62' @ ~3hrs later 6/3/21	
20. WELL INSTALLED? yes; IF SO COMPLETE CONSTRUCTION DIAGRAM: temporary	SAMPLE TYPE: 4oz jars	
21. SAMPLE INTERVAL AND DESIGNATION FOR LAB ANALYSIS	SAMPLE INTERVAL AND DESIGNATION FOR FIELD SCREENING ANALYSIS	LAB ANALYSIS: PFAS and TOC
22. DISPOSITION OF HOLE; IF NOT A WELL, BACKFILLED WITH: cuttings and bentonite	23. GEOLOGIST: A. Mallonee	

USCS LOG (a)	DEPTH (FT) (b)	DESCRIPTION OF MATERIALS (c)	DIRECT READING (d) VOC (ppm)	DIRECT READING (d) RAD (uR/hr)	ANALYTICAL SAMPLE DESIGN. (e)	DEPTH (FT) (f)	RECOVERY (IN.) (g)	REMARKS
	0.0' 3.5'	Topsoil, damp brown (7.5YR 5/8) sandy silt, some gravel	0.0			5'	2'	DAASF-03-SB-1-2 (FD 2) 0843
	3.5' 8.0'	Damp brown (5YR 5/6) silty sand	0.0			5'	4.2'	
	8.0' 15.0'	Damp gray (5YR 8/1) and orange-brown (7.5YR 5/8)	0.0			5'	4.8'	
	[illegible]	sandy silt, little clay	0.0			5'	3.7'	DAASF-03-SB-14-15 (in 5 (10.0) 0851
	15.0' 20.0'	Damp gray (5YR 8/1) to orange-brown (7.5YR 5/8)	0.1			5'	3.6'	
		sand, some silt	0.0			5'	5'	
	20.0' 25.0'	Damp gray (7.5YR 8/1) silt, little sand	0.0'			5'	5'	
	30.0' 37.5'	Damp gray (7.5YR 8/1) sand, some silt	0.0			5'	4.75'	DAASF-03-SB-36-37 0903
	37.5' 45.0'	Damp gray (7.5YR 8/1) silty clay, little sand Wet gray (7.5YR 8/1) silty sand	0.0			5'	5'	
		Boring to 45'						
		well screened 40-45'						

PROJECT: James N. Rebe, PSTC, Howard County

HOLE NO.: DAASF-03

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID MW15 SAMPLE NO. MW15-GW

WELL/SITE DESCRIPTION Duncan Readiness Center AAF

DATE 6/3/21 TIME 1200 AIR TEMP. 75°F

WELL DEPTH 24.8 ft CASING HEIGHT — ft

WATER DEPTH 12.0 ft WELL DIAMETER 3/4 in

WATER COL. HEIGHT 12.8' ft SANDPACK DIAM. — in

EQUIVALENT VOLUME OF STANDING WATER 0.29 (gal) (L)

PUMP RATE 0.1 (gpm) (LPM)

PUMP TIME 30 min

WELL WENT DRY? ( ) Yes (✓) No PUMP TIME 30 min

VOL. REMOVED ✓ (gal) (L) RECOVERY TIME — min

PURGE AGAIN? ( )Yes (✓) No TOTAL VOL. REMOVED 3 (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µS/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate gpm
6/3/21	1205	0	5.61	175.5	16.2	209.3	66.7	7.77	12.05'	0.1
6/3/21	1210	0.5	5.02	176.5	16.1	245.9	85.7	7.45	12.05	0.1
6/3/21	1215	1.0	4.95	178.7	16.5	159.6	86.5	7.32	12.05	0.1
6/3/21	1220	1.5	4.94	181.7	17.0	266.6	75.1	7.26	12.05	0.1
6/3/21	1225	2.0	4.94	179.1	16.6	274.3	62.0	7.31	12.05	0.1
6/3/21	1230	2.5	4.93	178.8	16.7	278.1	56.9	7.31	12.05	0.1
6/3/21	1235	3.0	4.91	177.9	16.6	279.9	55.8	7.23	12.05	0.1

COMMENTS

SIGNATURE 6/3/21

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID DAASF-03 SAMPLE NO. DAASF-03-GW
WELL/SITE DESCRIPTION grass northeastern boundary

DATE 06/03/21 TIME 1173 AIR TEMP. —

WELL DEPTH 44.47 ft TOC
WATER DEPTH 35.62 ft TOC
WATER COL. HEIGHT ____ ft
CASING HEIGHT ____ ft
WELL DIAMETER 3/4 in
SANDPACK DIAM. N/A in
EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)
PUMP RATE N/A (gpm) (LPM)
PUMP TIME N/A min
WELL WENT DRY? ( ) Yes ( ) No
PUMP TIME N/A min
VOL. REMOVED N/A (gal) (L)
RECOVERY TIME ____ min
PURGE AGAIN? ( )Yes ( ) No
TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. mS/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
06/03	1173		6.21	497.9	19.0	15.6	>3,000	3.51		

COMMENTS Sample collected with Inertial pump

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID DAASF-02 SAMPLE NO. DAASF-02-GW

WELL/SITE DESCRIPTION grass southern corner

DATE 06/03/21 TIME 0815 AIR TEMP. —

WELL DEPTH 39.9 ft TOC CASING HEIGHT ____ ft

WATER DEPTH 35.65 ft TOC WELL DIAMETER 3/4 in

WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in

EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)

PUMP RATE N/A (gpm) (LPM)

PUMP TIME N/A min

WELL WENT DRY? ( ) Yes ( ) No PUMP TIME N/A min

VOL. REMOVED N/A (gal) (L) RECOVERY TIME ____ min

PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µS/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
06/03	0815		5.42	140.3	16.9	57.1	7,000	0.83		

COMMENTS Sample collected with inertial pump

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID DAASF-01 SAMPLE NO. DAASF-01-GW

WELL/SITE DESCRIPTION grass Southwestern corner

DATE 06/03/2021 TIME 1022 AIR TEMP. —

WELL DEPTH 38.8 ft TOC CASING HEIGHT ____ ft

WATER DEPTH 37.52 ft TOC WELL DIAMETER 3/4 in

WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in

EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)

PUMP RATE N/A (gpm) (LPM)

PUMP TIME N/A min

WELL WENT DRY? ( ) Yes ( ) No PUMP TIME N/A min

VOL. REMOVED N/A (gal) (L) RECOVERY TIME ____ min

PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µS/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
6/3	1022		6.50	283.1	18.8	25.7	>1,000	1.73		

COMMENTS Sample collected w/ Inertial pump

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID A0102-01 SAMPLE NO. a0102-01-GW

WELL/SITE DESCRIPTION grass north of hangar

DATE 06 / 03 / 21 TIME 1057 AIR TEMP. —

WELL DEPTH 29.6 ft TOC CASING HEIGHT ____ ft

WATER DEPTH 22.16 ft TOC WELL DIAMETER 3/4 in

WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in

EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)

PUMP RATE N/A (gpm) (LPM)

PUMP TIME N/A min

WELL WENT DRY? ( ) Yes ( ) No PUMP TIME N/A min

VOL. REMOVED N/A (gal) (L) RECOVERY TIME ____ min

PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µS/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
6/3	1057		5.61	216.9	20.7	21.0	>1000	8.9		

COMMENTS Sample collected w/ Inertial pump

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID A0101-02 SAMPLE NO. A0101-02-GW

WELL/SITE DESCRIPTION retention pond - grass

DATE 06 / 03 / 21 TIME 0730 AIR TEMP. —

WELL DEPTH 24.35 ft TOC CASING HEIGHT ____ ft

WATER DEPTH 20.8 ft TOC WELL DIAMETER 3/4 in

WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in

EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)

PUMP RATE N/A (gpm) (LPM)

PUMP TIME N/A min

WELL WENT DRY? ( ) Yes ( ) No PUMP TIME ____ min

VOL. REMOVED N/A (gal) (L) RECOVERY TIME ____ min

PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µs/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
6/3	0730		6.35	177.3	15.3	123.0	72,000	0.56		

COMMENTS Inertial pump used to collect sample

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID A0101-01 SAMPLE NO. A0101-01-GW
WELL/SITE DESCRIPTION Southern boundary in grass

DATE 06 / 03 / 21 TIME 0647 AIR TEMP. —

WELL DEPTH 45.0 ft TOC CASING HEIGHT ____ ft
WATER DEPTH 39.4 ft TOC WELL DIAMETER 3/4 in
WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in
EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)
PUMP RATE N/A (gpm) (LPM)
PUMP TIME N/A min
WELL WENT DRY? ( ) Yes ( ) No PUMP TIME ____ min
VOL. REMOVED ____ (gal) (L) RECOVERY TIME ____ min
PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µs/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
6/3	0647		7.95	227.6	16.5	25.7	>2,000	3.71		

COMMENTS Inertial pump used to collect sample

SIGNATURE

EA Engineering, Science, and Technology, Inc.

WELL PURGING AND SAMPLING RECORD

WELL ID A0101-03 SAMPLE NO. A0101-03-GW

WELL/SITE DESCRIPTION grass along southwestern boundary

DATE 06/03/21 TIME 1033 AIR TEMP. —

WELL DEPTH 29.6 ft TOC CASING HEIGHT ____ ft

WATER DEPTH 23.9 ft TOC WELL DIAMETER 3/4 in

WATER COL. HEIGHT ____ ft SANDPACK DIAM. N/A in

EQUIVALENT VOLUME OF STANDING WATER ____ (gal) (L)

PUMP RATE N/A (gpm) (LPM)

PUMP TIME N/A min

WELL WENT DRY? ( ) Yes ( ) No PUMP TIME N/A min

VOL. REMOVED N/A (gal) (L) RECOVERY TIME ____ min

PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED ____ (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond. µs/cm	Temp. °C	ORP mV	Turb. NTU	DO mg/L	Depth to Water from TOC	Pump Rate
			5.84	213.3	15.9	52.3	>2,000	1.13		

COMMENTS Inertial pump used to collect sample

SIGNATURE

Appendix B3

Survey Data

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Duncan Armory AASF, New Castle, DE - Well Survey June 3, 2021

Well ID	DE SPC Northing (US Survey Feet)	DE SPC Easting (US Survey Feet)	Top of Casing (Feet)	Ground Elevation (Feet)	WGS84 UTM Zone 18 Northing (Meters)	WGS84 UTM Zone 18 Easting (Meters)
AOI01-01	612384.72	599987.81	70.56	68.08	4392558.97	447151.86
AOI01-02	612504.47	599601.96	51.42	50.34	4392596.00	447034.46
AOI01-03	612684.29	599544.17	53.64	52.63	4392650.87	447017.11
AOI02-01	613210.70	600191.97	50.08	48.79	4392810.34	447215.23
DAASF-01	612507.37	599339.00	63.41	62.31	4392597.26	446954.34
DAASF-02	612307.31	599554.75	68.54	68.25	4392536.00	447019.80
DAASF-03	613057.91	600514.14	64.91	63.69	4392763.34	447313.17
MW-15	613448.10	600246.42	37.88	38.35	4392882.60	447232.16
Bench Mark - ANCHOR	612638.01	599662.98	NA	60.86	4392636.60	447053.24

Datum: Horizontal - NAD83 (NA2011) Epoch 2010.00 Delaware SPC (US Survey Feet) & WGS84 UTM Zone 18 (Meters)
Vertical - NAVD88 (GEOID 12B) (Feet)

Appendix C

Photographic Log

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Appendix C - Photographic Log

Site Inspection for PFAS	Duncan Readiness Center and Army Aviation Support Facility	New Castle, Delaware

Photograph No. 01

Date 6/2/2021
Time 8:00

Description:
GSI Mid-Atlantic advancing boring at AOI01-01 with Geoprobe.

Orientation:
Southwest

Photograph No. 02

Date 6/2/2021
Time 9:30

Description:
Sample team characterizing soil and collecting sample from AOI01-01.

Orientation:
Northwest

Appendix C - Photographic Log

Site Inspection for PFAS	Duncan Readiness Center and Army Aviation Support Facility	New Castle, Delaware

Photograph No. 03

Date 6/3/2021
Time 8:15

Description:
GSI Mid-Atlantic advancing boring at DAASF-03 with Geoprobe.

Orientation:
Northeast

Photograph No. 04

Date 6/3/2021
Time 12:00

Description:
Sample team collecting groundwater sample from MW-15.

Orientation:
Southeast

Appendix D

TPP Meeting Minutes

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Meeting Minutes
Duncan Readiness Center and Army Aviation Support Facility – Site Inspection (SI)
Technical Project Planning (TPP) – Meeting 1/Meeting 2
SI for Per- and Polyfluoroalkyl Substances Impacted Sites, Army National Guard (ARNG) Installations, Nationwide
Contract Number (No.) W912DR-19-D-0005, Task Order No. W912DR20F0383
Friday, 19 March 2021
0900 to 1015 hrs

Participants			
Name	Affiliation*	Phone	E-Mail
Stephanie Gordon	DNREC	--	stephanie.gordon@delaware.gov
Kevin Popowich	DNREC	--	kevin.popowich@delaware.gov
Dr. Emily Whiting	DEARNG	--	emily.d.whiting3.nfg@mail.mil
Brian Nichols	DEARNG	--	brian.s.nichols2.nfg@mail.mil
Amanda Sullivan	ARNG G9	304-642-6000	amanda.d.sullivan7.ctr@mail.mil
Tim Peck	USACE - Baltimore	410-320-9506	timothy.j.peck@usace.army.mil
Kim Berg	USACE - Baltimore	--	kimberly.a.berg@usace.army.mil
Mike O'Neill	EA	410-329-5142	moneill@eaest.com
Mike Kepner	EA	410-329-5132	mkepner@eaest.com
Caitlin Helms	EA	410-329-5174	chelms@eaest.com

*ARNG G9 – Army National Guard; DEARNG – Delaware Army National Guard; DNREC – Delaware Natural Resources and Environmental Control; USACE – United States Army Corps of Engineers; and EA – EA Engineering, Sciences, and Technology, Inc., PBC

Michael Kepner (EA SI Task Manager/Site Lead & Deputy Project Manager) welcomed participants and began the meeting with an overview of the agenda and a roll call with introductions. He noted the purpose of the meeting is to discuss the SI sampling for per- and polyfluoroalkyl substance (PFAS) to determine presence/absence of releases at the Duncan Readiness Center (RC) and Army Aviation Support Facility (AASF). The meeting was held virtually so there is no sign in sheet for attendees. The TPP briefing slides are included as **Attachment A** to these meeting minutes.

Mr. Kepner began the presentation with a safety reminder, noting that the SI will conform to requirements in United States Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1. Site-specific safety procedures will be planned for and followed during SI field work, including establishing controlled work zones during field activities. Key points discussed during the presentation are provided below.

Programmatic Discussion:

- The TPP process is a USACE-established process with the main goal of engaging stakeholders in project planning and reporting. The ARNG has embraced a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) model for the SIs nationwide that will incorporate state-specific guidance, as necessary. The TPP1 meeting (which served as an introduction to the ARNG program/SI process)

and the TPP2 meeting (which focused on a discussion of Data Quality Objectives (DQOs), sampling locations, etc.) have been combined in an effort to streamline the process.
- This TPP1/TPP2 meeting will provide an opportunity for stakeholders to discuss the SI Work Plan and sampling locations and rationale which will be reviewed later in the presentation. Regulatory stakeholders will be afforded the opportunity to formally review and comment on the SI Work Plan.
- Another TPP meeting will occur (TPP3) to present the SI Report findings to all stakeholders; again, regulatory stakeholders will be afforded the opportunity to review and comment on the SI Report.
- The ARNG PFAS program is centrally contracted through USACE and managed by ARNG. Every ARNG facility nationwide responded to a questionnaire on potential PFAS releases. Facilities were prioritized by the likelihood of release and proximity to drinking water sources. The facility-wide Preliminary Assessment (PA) for Duncan RC and AASF was completed in June 2020.
- There are nearly 200 facilities on the ARNG's nationwide PA list.

Duncan RC and AASF PA Findings:
- Mr. Kepner provided a brief overview of the PA findings. During the PA, one potential source area was identified (Area of Interest [AOI] 1) for the Duncan RC and AASF. An additional source area was identified during the SI scoping process (AOI 2) based on discussions with ARNG personnel. These locations are described in the briefing slides, and more detail was provided during the SI overview. The potential PFAS releases were attributed to aqueous film forming foam (AFFF) release and storage.
- Potential adjacent sources of PFAS, outside of the facility boundary, were also discussed during the overview.

Duncan RC and AASF SI Overview:
- During the SI planning phase, DQOs were established in order to collect the appropriate data to feed into the conceptual site model (CSM).
- The primary goal of the SI is to determine the presence/absence of a release from potential source areas.
- Mr. Kepner reviewed the two AOIs:
    - AOI 1 Helicopter Crash Site
    - AOI 2 Hangar
- Geologic and hydrogeological data will inform the CSM, specifically with respect to the direction and rate of groundwater flow. The ARNG PFAS program includes consideration of enhanced DQOs that assess PFAS at the point of exposure and at the Duncan RC and AASF boundary.

Duncan RC and AASF SI Proposed Activities:
- Proposed sampling methods, locations and rationale were discussed. Sampling is planned as follows:

  - Continuous soil cores to target depth will be collected during the field work in and around the potential source areas. Continuous logging of borings will support understanding lithologic controls of preferential pathways.
  - Three soil samples to include surface soil and subsurface soil (midway down the boring and above the water table) will be collected at the potential source areas.
  - Temporary monitoring wells will be installed in the boreholes to a depth of between 30-40 ft below ground surface (bgs) (depending on groundwater elevation) and groundwater will be purged/sampled using low flow techniques.
  - The group discussed Investigation Derived Waste (IDW) and agreed that solid IDW (soil cuttings) will be placed back within the borings (with a preference for surface soils to remain at the surface). DNREC requested that liquid IDW be containerized. The liquid containerized IDW will be sampled for PFAS and, if present, will be filtered with a granular activated carbon (GAC) prior to disposal to the ground surface. See additional discussions below.
- Document Review and Distribution was discussed as follows:
  - EA asked about the current distribution process which include delivering documents electronically.
  - DNREC concurred that SI documents (IDW work plan and SI Report) can be sent electronically to the identified DNREC personnel on the TPP call.

Questions and Open Discussion:

- Stephanie Gordon (Project Manager, DNREC) informed the group that only one active domestic well was found downgradient of the facility during a well search (of unknown radius) for a previous PFAS investigation conducted by the United States Environmental Protection Agency (USEPA). PFAS concentrations for this well were reported to be below the provisional Health Advisory (HA) limit and above the lifetime HA limit.
- Ms. Gordon expressed concern over the proposed temporary well screen length (5 feet [ft]) and suggested a 10-ft screen to account for seasonal variations. Tim Peck (SI Program Manager, USACE Baltimore District) suggested that depth of the boring will correlate with the depth at which groundwater is encountered, plus an additional 5 ft to account for the screen interval; therefore, seasonal variations in groundwater will not be a concern.
- Ms. Gordon informed the group that DNREC temporary well permits are required for the installation of any well that encounters the groundwater table.
- Mike O'Neill (SI Project Manager, EA) asked if the facility monitoring well (MW15), located in the northern corner of the facility, is available/viable for sampling. Dr. Emily Whiting (Environmental Protection Specialist, DEARNG) stated that accessibility of the well is still unknown. Mr. O'Neill suggested including a potential boring/temporary well location in that area of the facility when submitting paperwork for the temporary well

permits in the event that MW15 is inaccessible or inactive and a temp well needs to be installed in that location.

- Ms. Gordon suggested adding a boring location between AOI 1 and AOI 2. Mr. Peck stated that although pavement may have the potential to absorb PFAS, sampling locations are dictated by the facility infrastructure and it is unlikely that contamination would have infiltrated at that location.
- Mr. Peck suggested that if solid IDW (soil cuttings) could be placed back into the borings, it would prevent long-term storage of solid IDW, as there are limited disposal facilities that accept solid IDW.
- Ms. Gordon stated that nearby DNREC-approved PFAS investigations utilized GAC filters during the containerization of liquid IDW. After carbon treatment, the liquid IDW should then be resampled for PFAS to determine the appropriate disposal procedure (offsite disposal or released directly to the ground).
- Mr. Peck asked if there is a PFAS concentration limit that would not require GAC treatment prior to the disposal of liquid IDW back onto the ground. Ms. Gordon stated she would review previous DNREC/Air National Guard investigations and confirm the procedures/discharge levels to remain consistent. This information will be provided to EA.
- Mr. Peck confirmed that liquid IDW will be treated with GAC subsequent to receiving groundwater sampling results that indicate unacceptable limits of PFAS concentrations, resampled, and then placed back onto the ground in order to eliminate the storage of liquid IDW.
- Amanda Sullivan (SI Project Manager, ARNG G9) asked Ms. Gordon if liquid IDW would need to be processed through a municipal wastewater system or if it could be placed back on the ground.
- Ms. Sullivan asked if additions to the IDW SOP are needed, would a “work plan letter” be necessary. Mr. O’Neill confirmed that if a “work plan” is needed it would reflect what is agreed upon by all stakeholders involved for the site.
- Dr. Whiting confirmed that DEARNG will not be hiring a private utility locator for utility mark out. Dr. Whiting confirmed that having a one-call utility locating system access the site is acceptable if there is pre-coordination with the facility and the flight schedule.
- It was confirmed that Ms. Gordon, Kevin Popowich (Environmental Scientist, DNREC), Amanda Sullivan, and Dr. Whiting or Brian Nichols (Environmental Program Manager, DEARNG) would likely be present during the site walk/sampling event.
- Dr. Whiting confirmed that valid ID and escort by either Dr. Whiting or Mr. Nichols are required for Duncan RC and AASF entry.
- Dr. Whiting informed the group that AASF staff are working a limited schedule (Monday through Thursday) approximately 6 am thru 5 pm.
- Ms. Sullivan asked if the sampling event could be completed within the 4 days available via the schedule Dr. Whiting presented or if it would require more time. Mr. Kepner confirmed that the event should be able to be completed within the 4 days.
- Ms. Sullivan asked Dr. Whiting about the facility vertical limits based on the facility site plan and if they would affect drilling (i.e. drill rig height). Dr. Whiting confirmed she will

follow-up with facility operations staff and report back on any restrictions/waivers if needed.

Visual Reconnaissance:

- Proposed sample locations were not visually inspected during this TPP due to travel restrictions. The proposed sample locations will be visually inspected concurrently with the utility clearance.

Action Items:

- EA will issue the Final Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) Addendum upon issuance of DNREC comments on the Draft Final UFP-QAPP Addendum and concurrence with responses to DNREC comments.
- Obtain the location of the domestic well identified in the previous USEPA PFAS investigation from Ms. Gordon.
- Obtain groundwater IDW discharge criteria/procedures from Ms. Gordon.
- Obtain vertical limit confirmation from Dr. Whiting.
- Confirm the liquid IDW disposal procedure and the associated PFAS detection requirement with Ms. Gordon.

Meeting Minutes
Duncan Readiness Center (RC) and Army Aviation Support Facility (AASF)
– Site Inspection (SI)
Technical Project Planning (TPP) – Meeting 3
SI for Per- and Polyfluoroalkyl Substances Impacted Sites, Army National Guard (ARNG) Installations, Nationwide
Contract Number (No.) W912DR-19-D-0005, Task Order No. W912DR20F0383
Monday, 7 March 2022
1000 to 1040 hrs

Participants			
Name	Affiliation*	Phone	E-Mail
Amy Bryson	DNREC	--	amy.bryson@delaware.gov
Stephanie Gordon	DNREC	--	stephanie.gordon@delaware.gov
Kevin Popowich	DNREC	--	kevin.popowich@delaware.gov
Mike Penzone	DNREC	--	mike.penzone@delaware.gov
Dr. Emily Whiting	DEARNG	--	emily.d.whiting3.nfg@army.mil
Brian Nichols	DEARNG	--	brian.s.nichols2.nfg@army.mil
Amanda Sullivan	ARNG G-9	304-642-6000	amanda.d.sullivan7.ctr@army.mil
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Mike O'Neill	EA	410-329-5142	moneill@eaest.com
Mike Kepner	EA	410-329-5132	mkepner@eaest.com
Caitlin Helms	EA	410-329-5174	chelms@eaest.com
*ARNG G-9 – Army National Guard; DEARNG – Delaware Army National Guard; DNREC – Delaware Natural Resources and Environmental Control; USACE – United States Army Corps of Engineers; and EA – EA Engineering, Sciences, and Technology, Inc., PBC			

Mr. Michael Kepner (EA SI Task Manager/Site Lead) welcomed participants and began the meeting at 1000. Introductions were made by attending participants. The meeting focused on the results of the SI for potential per- and polyfluoroalkyl substances (PFAS) releases at Duncan RC and AASF. Briefing slides are included as **Attachment A**. Key points discussed during the presentation are provided below.

The TPP meeting goals and overview of the ARNG Preliminary Assessment (PA)/ SI program and work phases were presented.

TPP 1 & 2 Review:

- Provide an overview of ARNG PA/SI Program
- Define objectives for SI data collection
- Encourage stakeholder involvement
- Review project schedule
- Capture action items
- Discuss proposed SI approach

TPP 3:

- ARNG CERCLA program overview

- Revisit the PA findings
- Present SI results and revised conceptual site model (CSM)
- Resolve comments/concerns and gain concurrence on findings in the Draft Final SI Report
- Discuss future actions at the site
- The Final PA for Duncan RC and AASF was completed by ARNG in June 2020
- SI fieldwork was completed in June 2021
- The Draft Final SI Report was provided to DNREC with results presented today

PA – Summary of Findings:

- A brief overview of the PA findings was presented. During the PA, one potential source area was identified as Area of Interest (AOI) 1. During the scoping for this SI, an additional potential source area was identified as a second AOI.
- Potential PFAS release areas were attributed to potential aqueous film forming foam (AFFF) release/s and storage onsite. The AOIs included:
    - AOI 1 – Helicopter Crash Site
    - AOI 2 – Hangar

SI – Data Quality Objectives/Summary of Approach:

- During the PA and SI planning phase, data quality objectives (DQOs) were established in order to determine the presence or absence of PFAS in soil and groundwater, as well as to collect the appropriate data to refine the conceptual side model (CSM).
- Fieldwork involved the installation of soil borings/temporary monitoring wells using direct-push technology (DPT) and the collection of soil and groundwater samples.
    - Borings were advanced across the facility and three soil samples were collected from each boring: a surface soil sample (0 to 2 feet below ground surface [bgs]), an intermediate sample (not to exceed 15 ft bgs), and a deep sample (approximately 1 foot [ft] above the groundwater table).
    - Temporary monitoring wells were installed for groundwater grab samples.
- In total, 21 soil grab samples were collected from seven borings, six surface soil samples were collected from six hand auger borings, seven groundwater grab samples were collected from seven temporary well locations, and one groundwater grab sample was collected from one existing monitoring well location onsite.
- Data for three compounds (Perfluorooctanesulfonic Acid [PFOS], Perfluorooctanoic Acid [PFOA], and perfluorobutanesulfonic acid [PFBS]) were compared to the Office of the Secretary of Defense (OSD) Screening Levels (SLs) for soil and groundwater. Exceedances of the OSD SLs determine if an AOI is recommended for a Remedial Investigation (RI).

SI – Summary of Findings:

- PFOA and PFOS were detected in soil but all concentrations were below the SLs. PFBS was not detected in soil.

- Groundwater concentrations exceeded the SLs at AOIs 1 (Helicopter Crash Site) and 2 (Hangar)
    - The highest detection of PFOS in groundwater at AOI 1 was 150 ng/L. There were no exceedances of PFOA in groundwater at AOI 1.
    - The highest detection of PFOA in groundwater at AOI 2 was 230 ng/L. There were no exceedances of PFOS in groundwater at AOI 2.
    - The highest detection of PFOA onsite was 280 ng/L at the northeastern facility boundary (DAASF-03).
    - PFBS was detected in groundwater at all temporary well locations below the SL.
- Mr. Kepner reviewed the results relative to the sample locations for soil and groundwater.
- A revised CSM was presented for the facility.
    - There is a potentially complete pathway to site workers, construction workers, and trespassers via inhalation of dust from PFOA and PFOS in soil.
    - There is a potentially complete pathway to site workers, construction workers, and trespassers via ingestion of PFOA and PFOS in surface soil.
    - There is a potentially complete pathway to construction workers via ingestion of PFOA and PFOS in subsurface soil.
    - There is a potentially complete pathway to site workers, construction workers, and off-facility recreational users via ingestion of PFOA and PFOS in surface water and sediment.
    - There is a potentially complete pathway (with an exceedance of SL) to off-facility residents via ingestion of shallow groundwater.
- Mr. Kepner reviewed the release areas and AOIs that will proceed to the RI based on the exceedances of the SLs.

Next Steps:

- EA will issue the Final SI Report.
- Based on the results of the SI, it is recommended that the Duncan RC and AASF proceed to an RI.

Open Discussion:

- Mr. Mike Penzone (DNREC) informed the group that Delaware is planning to adopt statewide Maximum Contaminant Levels (MCLs) for PFOA and PFOS that are lower than the current SLs used in the SI. Ms. Amanda Sullivan (ARNG G-9) requested a timeline for the proposed MCLs. Mr. Penzone indicated that the MCLs could be finalized by October/November 2022. Mr. Penzone provided the group with the press release associated with the proposed MCLs.
- Ms. Stephanie Gordon (DNREC) informed the group that both the USEPA and DNREC had tried to contact the property owner of the downgradient residential well that was sampled in 2016 but has been unsuccessful and it appears that the property is vacant.
- Ms. Gordon indicated that EA's response to DNREC's comments on the Draft Final SI were acceptable and requested that, during the RI phase, the lab would report the analytical results in the same unit of measure (ng/L) as the SLs. Ms. Sullivan asked if it

would be acceptable to list both units of measure in the SL tables for the RI. Ms. Gordon and Mr. Penzone agreed that would be acceptable.

- Mr. Brian Nichols (DNREC) asked if a new agreement would be developed for the transition into the RI. Ms. Sullivan informed DNREC that she submitted a Defense Environmental Restoration Program (DERP) eligibility packet that would provide access to funds and allow DNREC to then access through the DSMOA portal. Ms. Sullivan explained that the lead ARNG G-9 Project Manager would be giving a presentation. Ms. Sullivan explained the DERP eligibility packet is with the General Counsel and Ms. Sullivan is also working on a Relative Risk Site Evaluation (RRSE) to also be submitted. Ms. Sullivan indicated Duncan RC and AASF RI is going to be included in the next award grouping. Ms. Amy Bryson (DNREC) asked Ms. Sullivan if the RI would be included in the next DSMOA grant cycle (2022-2024) or the following grant cycle. Ms. Sullivan indicated that she would follow up with DNREC when more information is available regarding the grant cycle and timeline for the RI.
- Ms. Gordon asked if Ms. Sullivan had a timeframe in mind for the submittal of the RRSE and if regulators would be allowed to review prior to public comment. Ms. Sullivan indicated that she would follow up with Ms. Gordon with further information regarding the timeline and procedure for regulatory comment.
- Mr. Nichols indicated that an additional conversation will be necessary to determine if DNREC needs to apply for additional funding moving forward into the RI.
- Mr. Kepner asked if concurrence was required in writing to move forward with the Final SI Report and Ms. Sullivan indicated that it would be best to receive written concurrence from DNREC.

Appendix E

Boring Logs and
Well Construction Diagrams

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EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.681227, -75.616265
Surface Elevation: 68.08 ft
Casing Elevation: 70.56 ft
GW level at time of drilling: 36.5 ft bgs
GW level at time of sampling: 36.9 ft bgs

Job. No.	Client:
634250383	ARNG
Drilling Method:	Boring No.
Direct Push Technology (DPT)	AOI01-01
Sampling Method:	
DPT/Continuous Core	Sheet 1 of 1
	Drilling

Water Level	37.5 TOC	Start	Finish
Time	8:40	0700	0840
Date	6/2/2021		

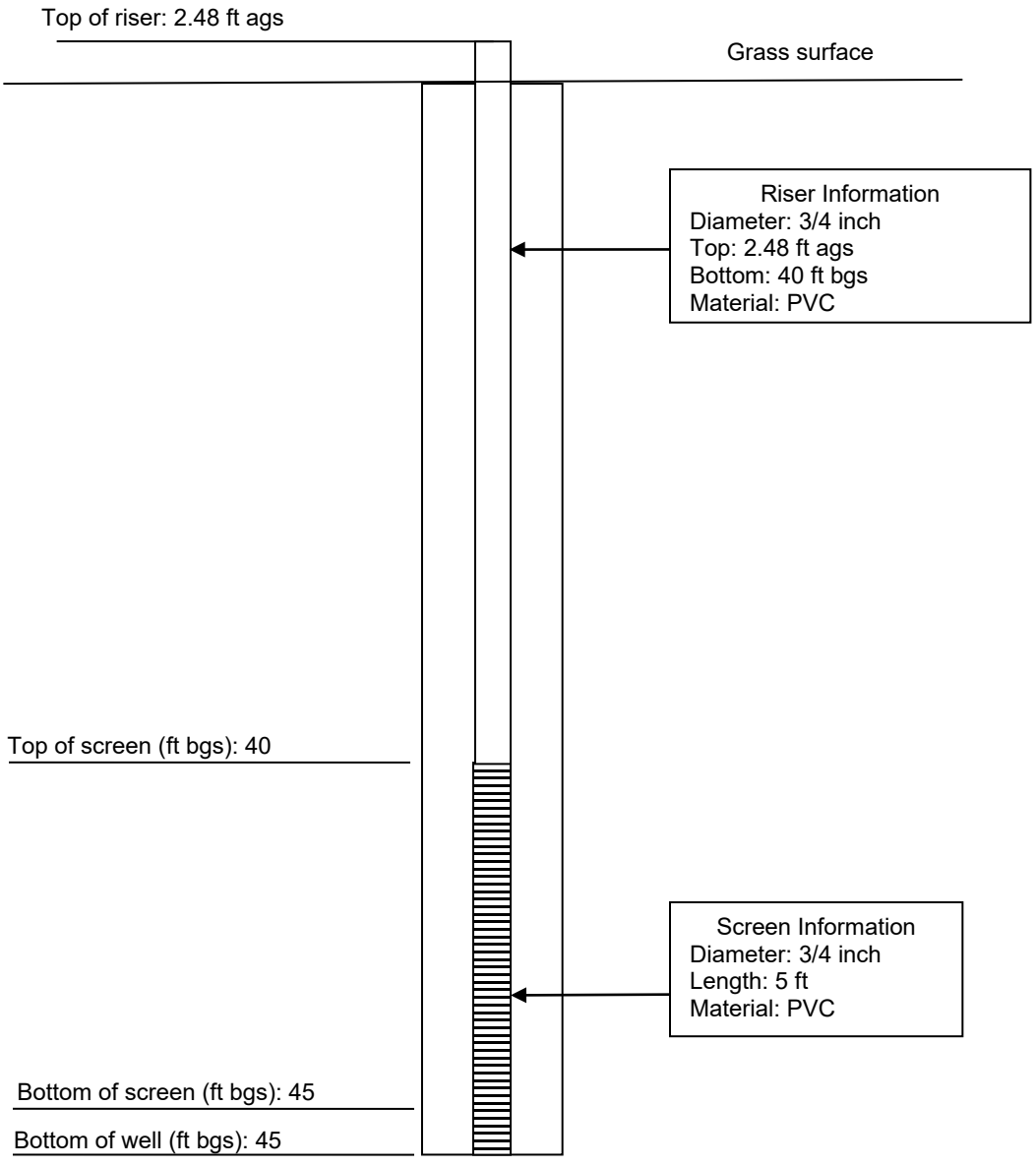
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions: grass
			0.25		Top soil and grass
AOI01-01-SB-1-2	5'/2.8'	0.0	2.5	SM	Damp, light brown (7.5 YR 4/3) sandy silt, some gravel (fill)
			4.6	SM	Damp, orange-brown (5 YR 5/8) sandy silt
	5'/3.7'	0.2			
AOI01-01-SB-13.5-14	5'/3.8'	0.0			
	5'/3.9'	0.0			
	5'/4.2'	0.0			
	5'/4.4'	0.0	30	SM	Moist, light gray (7.5YR 8/2) silty sand, trace clay
	5'/5'	0.0			
AOI01-01-SB-34.5-35.5	5'/4.2'	0.0			
	5'/5'	0.0	45	SM	Moist, light gray (7.5YR 8/2) and orange (10YR 8/6) sandy silt, little clay

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: AOI01-01
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 0700 Time Finished: 0800
Location: southern facility boundary	Depth to Water: 36.9 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.681553, -75.617636
Surface Elevation: 50.34
Casing Elevation: 51.42
GW level at time of drilling: 20 ft bgs
GW level at time of sampling: 19.7 ft bgs

Job. No.	Client:
634250383	ARNG
Drilling Method:	Boring No.
Direct Push Technology (DPT)	AOI01-02
Sampling Method:	
DPT/Continuous Core	Sheet 1 of 1
	Drilling
Time 14:15	Start 1400 / Finish 1450
Date 6/2/2021	

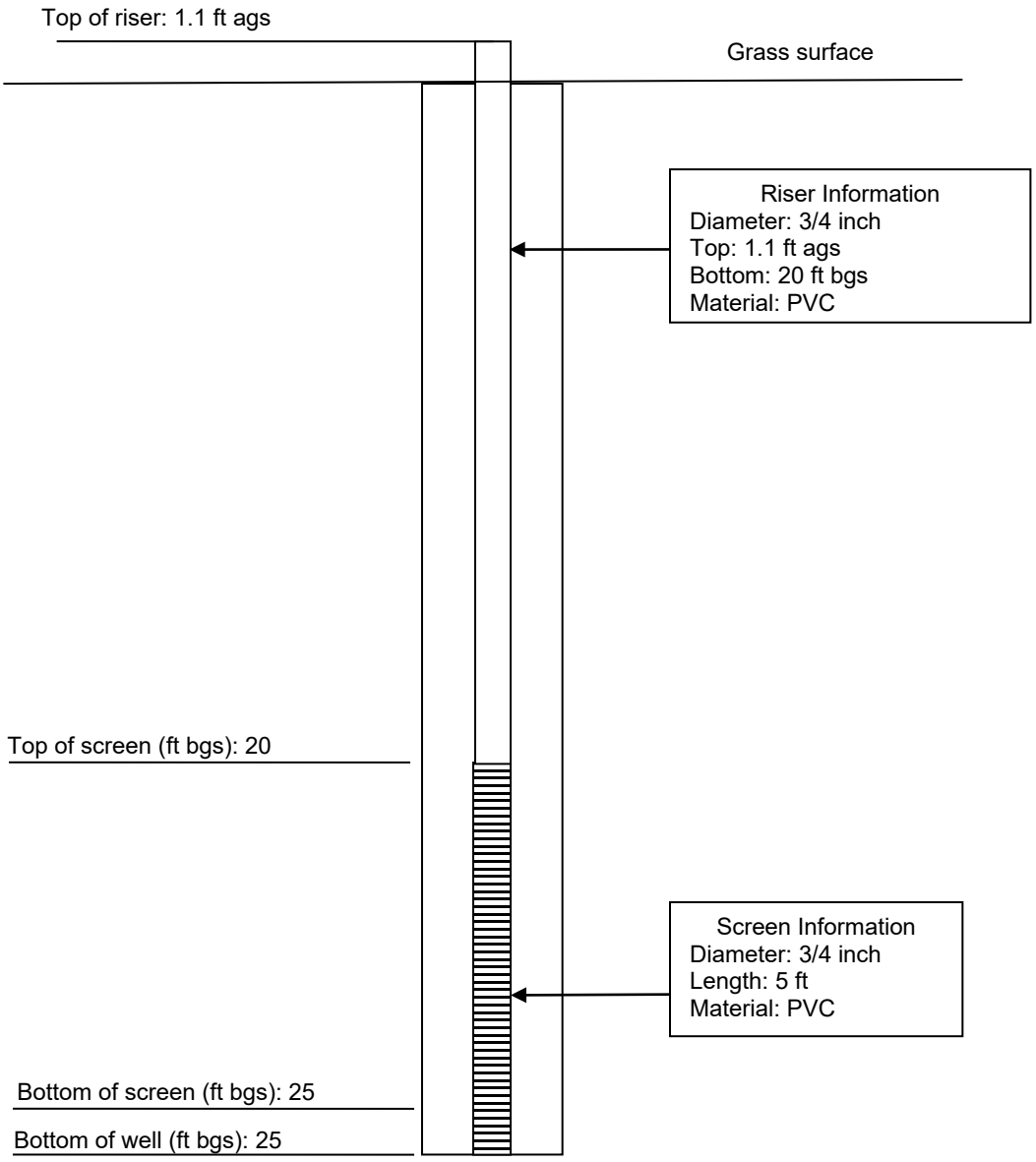
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Con grass in retention pond
			0.5	SM	Damp, brown (5YR 5/6) sandy silt
AOI01-02-SB-1-2	5'/2.6'	0.0	2.5	SM	Damp, brown (5YR 5/6), silty sand, some gravel
	5'/3.1'	0.0			
AOI01-02-SB-14-15	5'/3.3'	0.0	15	SM	Damp, brown (7.5YR 4/6) to tan (7.5YR 6/6), silty sand
AOI01-02-SB-19-20	5'/4'	0.0	16.5	SM	Wet, gray (7.5YR 8/1), sandy silt
	5'/4.1'	0.0	25	SM	Wet, gray (7.5YR 8/1), silty sand

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: AOI01-02
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 1400 Time Finished: 1430
Location: retention pond to the southwest	Depth to Water: 19.7 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.682046, -75.617843
Surface Elevation: 52.63
Casing Elevation: 53.64
GW level at time of drilling: 23 ft bgs
GW level at time of sampling: 22.9 ft bgs

Job. No.	Client:
634250383	ARNG
Drilling Method:	Boring No.
Direct Push Technology (DPT)	AOI01-03
Sampling Method:	
DPT/Continuous Core	Sheet 1 of 1
	Drilling
Time 13:15	Start 1300 / Finish 1330
Date 6/2/2021	

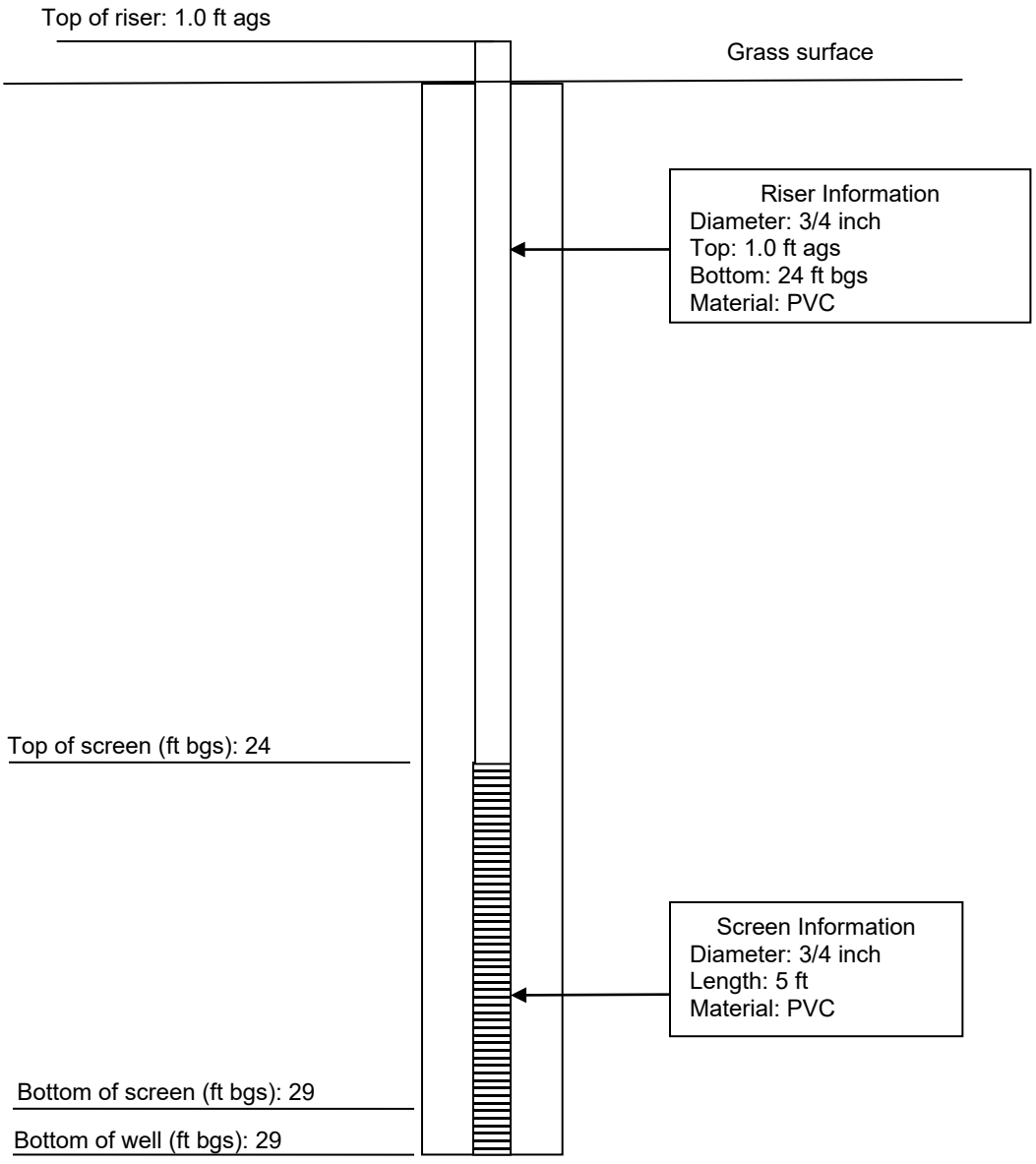
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions: grass slope
AOI01-03-SB-1-2	5'/3'	0.1	5	ML	Topsoil, damp, brown (7.5YR 4/6), silt, little sand, trace gravel
AOI01-03-SB-8-9 (grain size)	5'/4.3'	0.0	9	CL	Moist, brown (7.5YR 4/6), silty clay
AOI01-03-SB-14-15	5'/4'	0.0			
	5'4.25'	0.0	23	SM	Damp, brown (5YR 4/6) to tan (7.5YR 7/8) silty sand
AOI01-03-SB-22-23	5'/4.8'	0.0			
	4'/4'	0.0	29	SM	Wet, light gray (2.5Y 8/2) silty sand

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: AOI01-03
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 1300 Time Finished: 1330
Location: southwestern facility boundary	Depth to Water: 22.9 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.683496, -75.615546
Surface Elevation: 48.79
Casing Elevation: 50.08
GW level at time of drilling: 22 ft bgs
GW level at time of sampling: 20.9 ft bgs

Job. No.	Client:
634250383	ARNG

Drilling Method:	Boring No.
Direct Push Technology (DPT)	AOI02-01

Sampling Method:	Sheet 1 of 1
DPT/Continuous Core	

		Drilling	
Time	15:15	Start	Finish
Date	6/2/2021	1500	1530

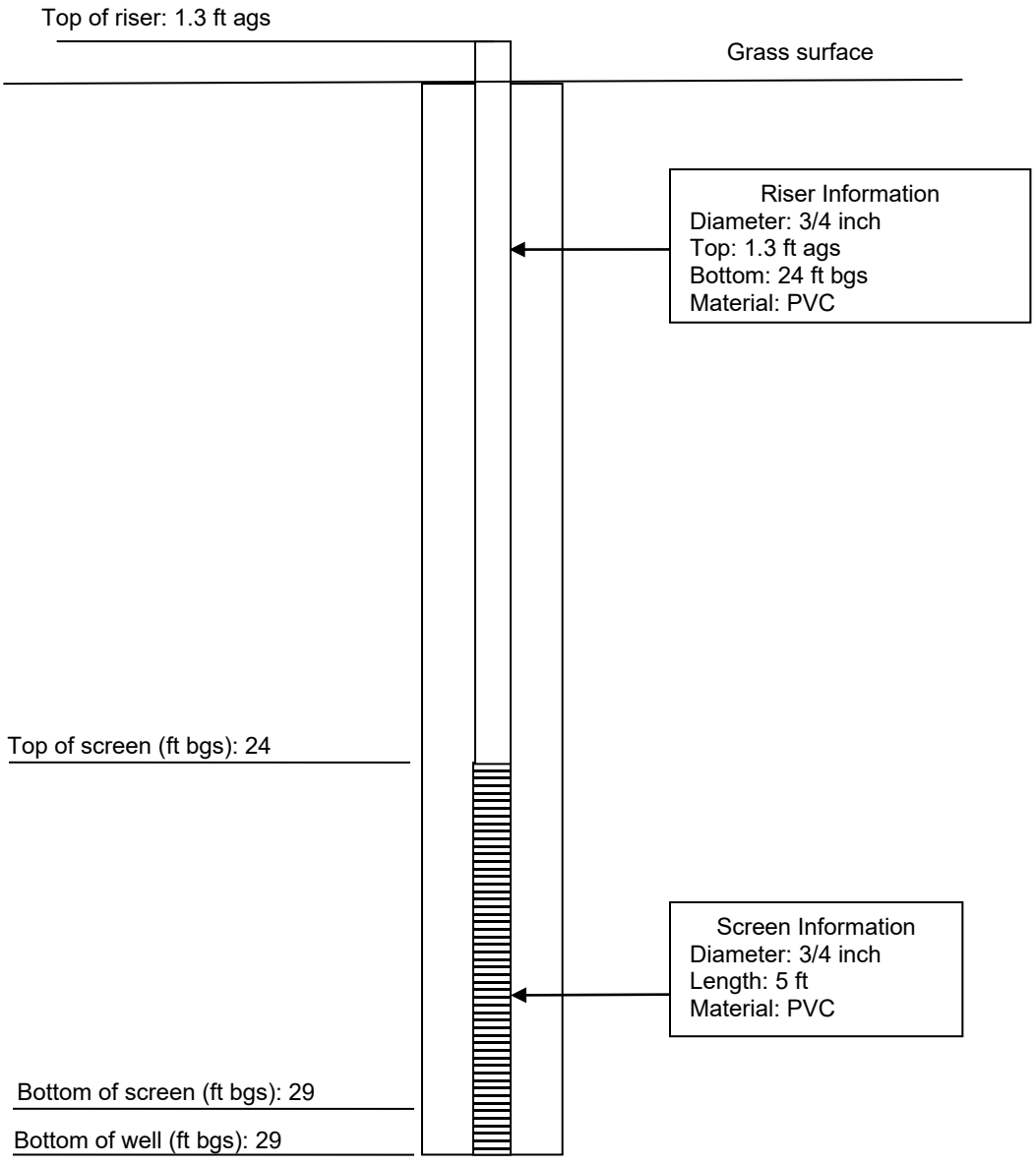
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions:
	5'/2.3'	0.1	4.5	SM	Top soil, damp, brown (5YR 5/8), sandy silt
	5'/3.5'	0.2	10	SM	Moist, gray (7.5YR 8/1), silty sand
	5'/3.3'	0.0			
	5'/4'	0.0			
			22.5	SM	Moist, tan (7.5YR 7/8) to gray (7.5YR 8/1), silty sand, little clay
	5'/4.5'	0.0	23	SM	Moist, gray (7.5YR 8/1), sandy silt
	4'/3.8'	0.0	29	SM	Moist, tan (7.5YR 7/8) and gray (7.5YR 8/1), silty sand

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: AOI02-01
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 1500 Time Finished: 1530
Location: north of the hangar	Depth to Water: 20.9 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates:	39.68156,-75.618571
Surface Elevation:	62.31
Casing Elevation:	63.41
GW level at time of drilling:	32 ft bgs
GW level at time of sampling:	31.5 ft bgs

Job. No. 634250383	Client: ARNG		
Drilling Method: Direct Push Technology (DPT)		Boring No. DAASF-01	
Sampling Method: DPT/Continuous Core		Sheet 1 of 1	
		Drilling	
Time	0:00	Start	Finish
Date	6/2/2021	1130	1200

Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions: top of grassy slope
			2.5	SM	Topsoil, damp, brown (10YR 4/1), sandy silt, little gravel
DAASF-01-SB-1-2	5'/3.2'	0.0	2.8	GW	Crushed rock, GLEY 6/1
DAASF-01-SB-6-8 (grain size)	5'/2.8'	0.0			
DAASF-01-SB-13-14 (grain size) DAASF-01-SB-14-15	5'/3.1'	0.0			
	5'/3.8'	0.0			
	5'/3.9'	0.0	25	CL-ML	Moist, brown (10YR 4/1), clayey silt, little sand
	5'/3.5'	0.0	30	SM	Damp, orange-brown (7.5YR 5/6), silty sand
DAASF-01-SB-31-32	5'/3.5'	0.0			
	2.5'/2.5'	0.0	37.5	SM	Wet, light gray (10YR 8/1), silty sand

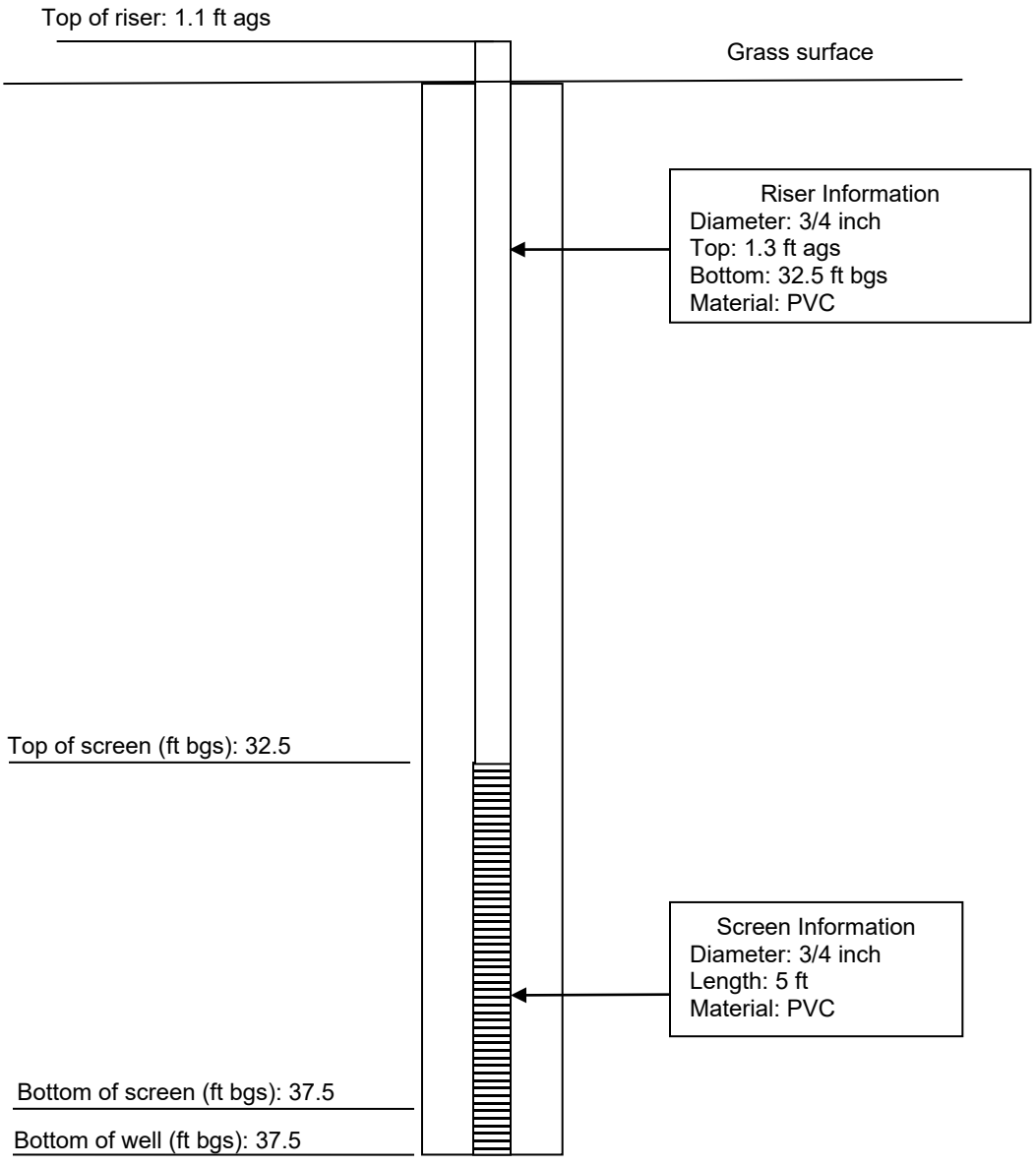
Note: Boring was offset 10' after first boring hit refusal at 9 ft bgs due to buried concrete.

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: DAASF-01
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 1130 Time Finished: 1200
Location: southwestern corner of facility	Depth to Water: 31.5 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.681012, -75.617803
Surface Elevation: 68.25
Casing Elevation: 68.54
GW level at time of drilling: 35 ft bgs
GW level at time of sampling: 35.3 ft bgs

Job. No.	Client:
634250383	ARNG
Drilling Method:	Boring No.
Direct Push Technology (DPT)	DAASF-02
Sampling Method:	
DPT/Continuous Core	Sheet 1 of 1
	Drilling
Time 9:55	Start 0940 / Finish 1025
Date 6/2/2021	

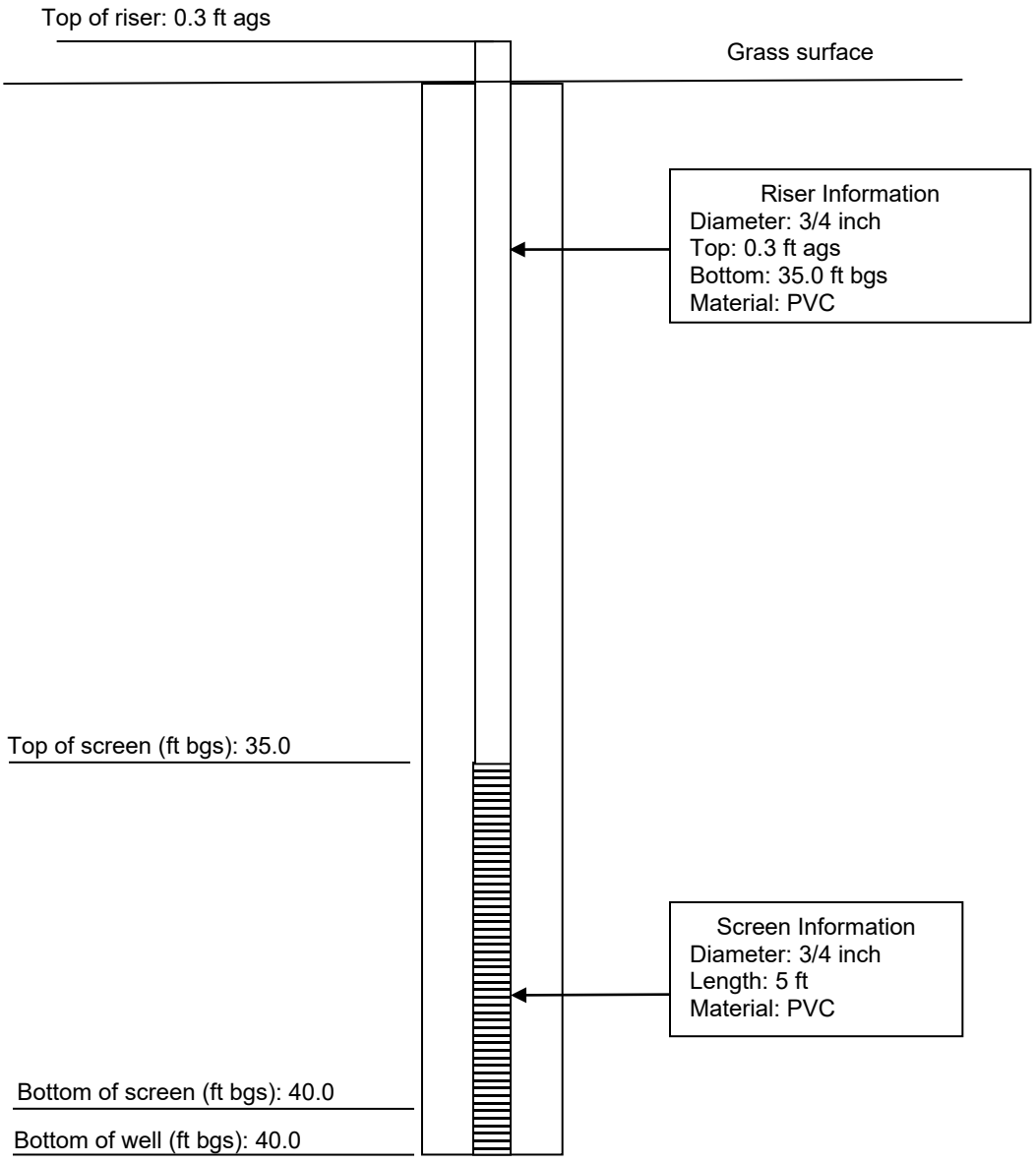
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions: top of grassy slope
DAASF-02-SB-0-1	5'/2.1'	0.0	2.5	SM	Topsoil, damp, brown (10YR 4/4), sandy silt, some gravel (fill)
	5'/2.5'	0.0			
DAASF-02-SB-14-15	5'/3.2'	0.0			
	5'/4.0'	0.0	16	SM	Moist, brown (7.5YR 4/2), sandy silt
	5'/3.5'	0.0	21	CL-ML	Moist, dark gray (10YR 4/1), clayey silt, little sand
			25	SM	Damp, dark gray (5YR 5/2), sandy silt
	5'/3.5'	0.0			
DAASF-02-SB-34-35	5'/4.25'	0.0			
	5'/4.0'	0.0	40	CL	Damp, gray (7.5YR 8/1) and orange (5YR 6/8), clay

Logged by: Amy Mallonee Date: 06/02/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: DAASF-02
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/02/2021 at 0940 Time Finished: 1025
Location: southern corner of facility	Depth to Water: 35.3 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

EA Engineering, Science, and Technology, Inc., PBC

LOG OF SOIL/ROCK BORING

Coordinates: 39.683078, -75.6144
Surface Elevation: 63.69
Casing Elevation: 64.91
GW level at time of drilling: 36.2 ft bgs
GW level at time of sampling: 34.4 ft bgs

Job. No.	Client:
634250383	ARNG
Drilling Method:	Boring No.
Direct Push Technology (DPT)	DAASF-03
Sampling Method:	
DPT/Continuous Core	Sheet 1 of 1
	Drilling
Time 9:05	Start 0850 / Finish 0920
Date 6/3/2021	

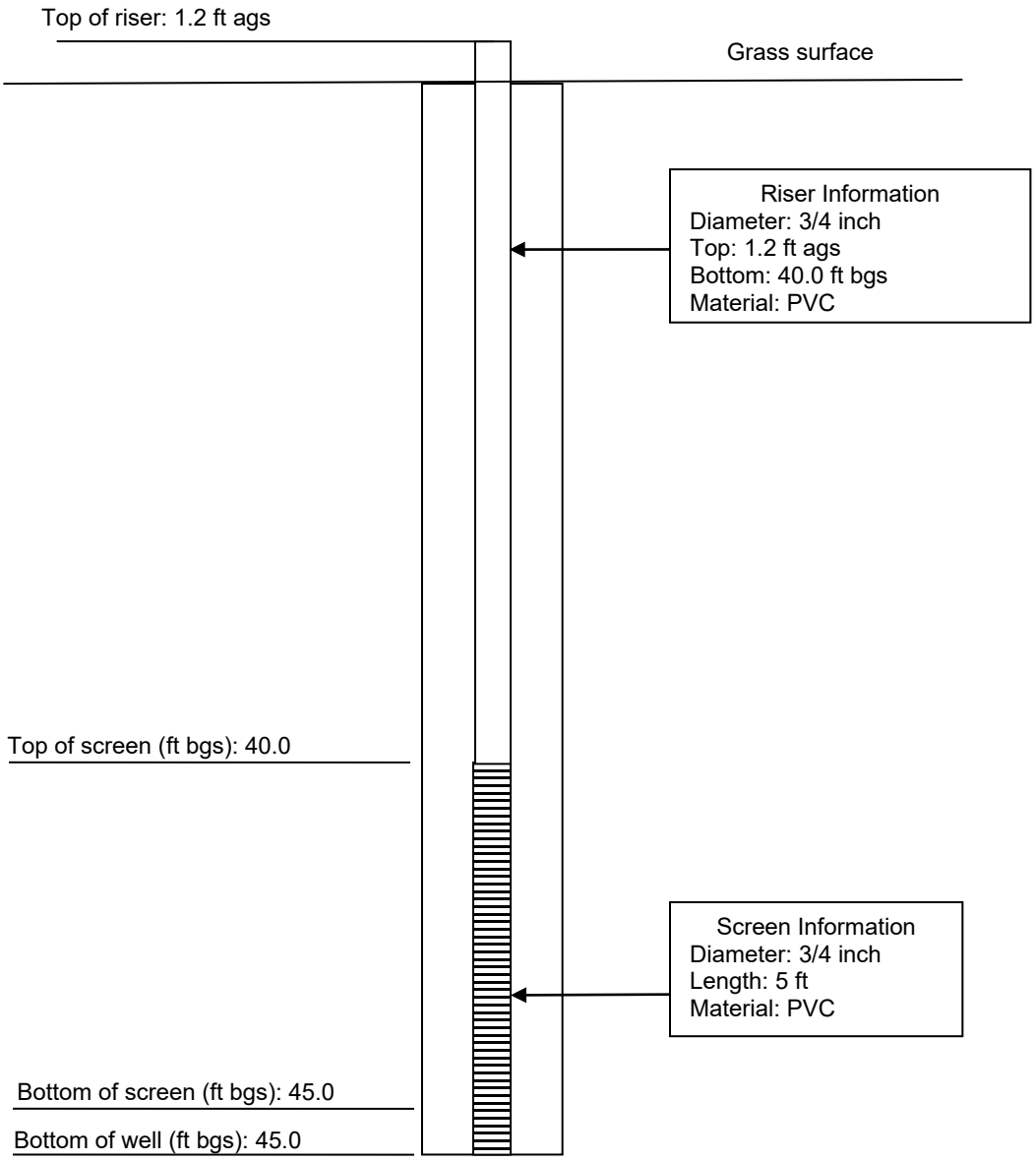
Sample Type/ID	Feet Driven /Feet Recovered	PID ppm	Depth in Feet	USCS Log	Surface Conditions: grass
DAASF-03-SB-1-2	5'/2'	0.0	3.5	SM	Topsoil, damp, brown (7.5YR 5/8), sandy silt, some gravel
	5'/4.2'	0.0	8	SM	Damp, brown (5YR 5/6), silty sand
DAASF-03-SB-14-15 MS/MSD and TOC	5'/4.8'	0.0	15	SM	Damp, gray (5YR 8/1) and orange-brown (7.5YR 5/8), sandy silt, little clay
	5'/3.7'	0.0	20	SP	Damp, gray (5YR 8.1) to orange-brown (7.5YR 5/8), sand, some silt
	5'/3.6'	0.1			
	5'/5'	0.0			
	5'/5'	0.0			
DAASF-03-SB-36-37			36	ML	Damp, gray (7.5YR 8/1), silt, little sand
			37	SP	Damp, gray (7.5YR 8/1), sand, some silt
	5'/4.75'	0.0	37.5	ML	Damp, gray (7.5YR 8/1), silty clay, little sand
	5'5'	0.0	45	SM	Wet, gray (7.5YR 8/1), silty sand

Logged by: Amy Mallonee Date: 09/03/2021

Drilling Contractor: GSI - Mid Atlantic Driller: Kevin Pumphrey

RECORD OF MONITORING WELL CONSTRUCTION

EA Engineering, Science, and Technology, Inc.	Monitoring Well/Soil Boring ID No.: DAASF-03
Project Title/ Project No.: Site Investigation for Per- and Polyfluoroalkyl Substances, Duncan Readiness Center and Army Aviation Support Facility/634250383	Date/Time Installed: 06/03/2021 at 0850 Time Finished: 0920
Location: northeastern facility boundary	Depth to Water: 34.4 ft bgs
Site Geologist: Amy Mallonee	Drilling Method: DPT



Note: All features not to scale

ags – Above Ground Surface
bgs – Below Ground Surface

Appendix F

Analytical Results

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Appendix F - Grain Size
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Area of Interest	AOI01				DAASF							
Location ID	AOI01-03				DAASF-01				DAASF-01			
Sample Name	AOI01-03-SB-8-9				DAASF-01-SB-13-14				DAASF-01-SB-6-8			
Parent Sample ID												
Depth	8 - 9 ft				13 - 14 ft				6 - 8 ft			
Sample Date	6/2/2021				6/2/2021				6/2/2021			
Analyte	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Grain Size (D422) (%)												
Sieve, 75000 microns (75 mm)	100.0	1.0	1.0		100.0	1.0	1.0		100.0	1.0	1.0	
Sieve, 37500 microns (37.5 mm)	100.0	1.0	1.0		100.0	1.0	1.0		100.0	1.0	1.0	
19 mm	100.0	1.0	1.0		100.0	1.0	1.0		100.0	1.0	1.0	
No. 4 seive (4.75 mm)	93.1	1.0	1.0		87.3	1.0	1.0		98.4	1.0	1.0	
Sieve, 3350 microns (3.35 mm)	93.0	1.0	1.0		86.8	1.0	1.0		98.3	1.0	1.0	
No.8 seive (2.36 mm)	93.0	1.0	1.0		86.2	1.0	1.0		98.2	1.0	1.0	
No.16 seive (1.18 mm)	92.5	1.0	1.0		85.9	1.0	1.0		98.1	1.0	1.0	
No.30 seive (0.60 mm)	87.3	1.0	1.0		81.2	1.0	1.0		93.5	1.0	1.0	
No.50 seive (0.30 mm)	80.8	1.0	1.0		71.5	1.0	1.0		82.6	1.0	1.0	
No.100 seive (0.15 mm)	75.8	1.0	1.0		61.9	1.0	1.0		71.7	1.0	1.0	
No.200 seive (0.075 mm)	71.8	1.0	1.0		58.0	1.0	1.0		67.5	1.0	1.0	
0.064 mm (Hydrometer)	70.0	1.0	1.0		56.0	1.0	1.0		65.0	1.0	1.0	
0.05 mm (Hydrometer)	68.0	1.0	1.0		52.0	1.0	1.0		59.0	1.0	1.0	
0.02 mm (Hydrometer)	46.0	1.0	1.0		33.0	1.0	1.0		37.0	1.0	1.0	
0.005 mm (Hydrometer)	20.0	1.0	1.0		14.0	1.0	1.0		18.0	1.0	1.0	
0.002 mm (Hydrometer)	16.0	1.0	1.0		9.0	1.0	1.0		14.0	1.0	1.0	
0.001 mm (Hydrometer)	13.0	1.0	1.0		6.0	1.0	1.0		11.0	1.0	1.0	

Notes
J = Estimated concentration
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/g = Nanogram per gram
Values exceeding the Screening Level are shaded gray
AOI = Area of Interest
ft = Feet
LOD = Limit of Detection

Table XX Grain Size
Duncan Readiness Center and Army Aviation Support Facility, Delaware

LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD

Appendix F - TOC, pH and Temperature
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Area of Interest	AOI01				DAASF			
Sample Name	AOI01-01-SB-13.5-14				DAASF-03-SB-14-15			
Depth	13.5 - 14 ft				14 - 15 ft			
Sample Date	6/2/2021				6/3/2021			
Analyte	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Total organic carbon (mg/kg)	<	380	560	U	<	380	570	U
pH (SW9045D) (SU)	8.6	0.01	0.01		5.2	0.01	0.01	
Temperature (SW9045D) Deg C	20.5	0.01	0.01		20.8	0.01	0.01	

Notes
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
SU= Standard unit
Deg C = Degress celsius
mg/kg = Milligram of per kilogram
AOI = Area of Interest
ft = Feet
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD

Appendix F - Analytical Results - Surface soil
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Area of Interest		AOI01																														AOI02				DAASF											
Location ID		AOI01-01				AOI01-02				AOI01-03				AOI01-HA-01				AOI01-HA-01				AOI01-HA-02				AOI01-HA-03				AOI01-HA-04				AOI01-HA-05				AOI01-HA-06				AOI02-01				DAASF-01				DAASF-02				DAASF-03			
Sample Name		AOI01-01-SB-1-2				AOI01-02-SB-1-2				AOI01-03-SB-1-2				AOI01-HA-01-1				DAASF-HA-FD1				AOI01-HA-02-1				AOI01-HA-03-1				AOI01-HA-04-1				AOI01-HA-05-1				AOI01-HA-06-1				AOI02-01-SB-1-2				DAASF-01-SB-1-2				DAASF-02-SB-1-2				DAASF-03-SB-1-2			
Parent Sample ID																		AOI01-HA-01-1-06022021																																DAASF-03-SB-1-2-06032021			
Depth		1 - 2 ft				1 - 2 ft				1 - 2 ft				1 ft				1 ft				1 ft				1 ft				1 ft				1 ft				1 ft				1 - 2 ft				1 - 2 ft				1 - 2 ft				1 - 2 ft			
Sample Date		6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
Soil, PFAS (EPA 537) (µg/kg)																																																				
4:2 Fluorotelomer sulfonate	-	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	UJ	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
6:2 Fluorotelomer sulfonate	-	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	UJ	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
8:2 Fluorotelomer sulfonate	-	<	1.7	3.2	U	<	1.7	3.2	U	<	1.6	3.1	U	<	1.8	3.4	U	<	1.9	3.5	U	<	1.8	3.4	U	<	2.2	4.2	U	<	1.7	3.2	U	<	1.8	3.3	U	<	1.8	3.4	U	<	1.7	3.2	U	<	1.7	3.2	U	<	1.7	3.2	U	<	1.7	3.2	U
N-ethyl perfluorooctanesulfonamidoacetic acid	-	<	0.42	2.1	U	<	0.43	2.2	U	<	0.41	2.0	U	<	0.45	2.3	U	<	0.47	2.3	X	<	0.46	2.3	U	<	0.56	2.8	U	<	0.43	2.1	U	<	0.44	2.2	U	<	0.46	2.3	U	<	0.43	2.1	U	<	0.43	2.1	U	<	0.43	2.1	X	<	0.43	2.1	X
N-methyl perfluorooctanesulfonamidoacetic acid	-	<	0.42	2.1	U	<	0.43	2.2	U	<	0.41	2.0	U	<	0.45	2.3	U	<	0.47	2.3	X	<	0.46	2.3	U	<	0.56	2.8	U	<	0.43	2.1	U	<	0.44	2.2	U	<	0.46	2.3	U	<	0.43	2.1	U	<	0.43	2.1	U	<	0.43	2.1	X	<	0.43	2.1	X
Perfluorobutanesulfonic acid (PFBS)	1,900 [2]	<	1.7	2.1	U	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	U	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
Perfluorobutanoic acid	-	0.94	1.7	2.1	J	<	1.7	2.2	U	<	1.6	2.0	U	<	1.8	2.3	U	<	1.9	2.3	U	<	1.8	2.3	U	<	2.2	2.8	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.7	2.1	U
Perfluorodecanesulfonic acid	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U
Perfluorodecanoic acid	-	0.94	0.42	0.63		<	0.43	0.65	U	<	0.41	0.61	U	0.26	0.45	0.68	J	0.25	0.47	0.70	J	0.33	0.46	0.69	J	2.0	0.56	0.84		0.24	0.43	0.64	J	0.76	0.44	0.66		0.67	0.46	0.68	J	<	0.43	0.64	U	0.42	0.43	0.64	J	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorododecanoic acid	-	0.30	0.42	0.63	J	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	0.30	0.46	0.69	J	2.2	0.56	0.84		1.6	0.43	0.64		1.1	0.44	0.66		1.3	0.46	0.68		<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroheptanesulfonic acid	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroheptanoic acid	-	0.60	0.42	0.63	J	<	0.43	0.65	U	0.27	0.41	0.61	J	<	0.45	0.68	U	<	0.47	0.70	U	0.23	0.46	0.69	J	0.37	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	0.42	0.43	0.64	J	0.25	0.43	0.64	J	0.39	0.43	0.64	J
Perfluorohexanesulfonic acid	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	<	0.46	0.69	U	1.1	0.56	0.84		<	0.43	0.64	U	<	0.44	0.66	U	0.51	0.46	0.68	J	<	0.43	0.64	U	1.7	0.43	0.64		<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorohexanoic acid	-	0.60	0.42	0.63	J	<	0.43	0.65	U	0.22	0.41	0.61	J	0.23	0.45	0.68	J	<	0.47	0.70	U	<	0.46	0.69	U	0.40	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	0.50	0.43	0.64	J	0.26	0.43	0.64	J	0.37	0.42	0.64	J	0.38	0.43	0.64	J
Perfluorononanesulfonic acid	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorononanoic acid	-	1.5	0.42	0.63		0.31	0.43	0.65	J	0.37	0.41	0.61	J	0.32	0.45	0.68	J	0.27	0.47	0.70	J	0.43	0.46	0.69	J	0.65	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.26	0.46	0.68	J	<	0.43	0.64	U	0.25	0.43	0.64	J	0.53	0.43	0.64	J	0.35	0.42	0.64	J
Perfluorooctanesulfonamide (PFOSA)	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	<	0.47	0.70	U	<	0.46	0.69	U	<	0.56	0.84	U	<	0.43	0.64	U	<	0.44	0.66	U	<	0.46	0.68	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluorooctanesulfonic acid (PFOS)	130 [3]	4.8	0.42	0.63		1.7	0.43	0.65		0.48	0.41	0.61	J	1.7	0.45	0.68		1.3	0.47	0.70		2.5	0.46	0.69		6.9	0.56	0.84		0.32	0.43	0.64	J	0.56	0.44	0.66	J	2.5	0.46	0.68		0.31	0.43	0.64	J	0.84	0.43	0.64		1.6	0.43	0.64		<	0.42	0.64	U	0.24	0.43	0.64	J
Perfluorooctanoic acid (PFOA)	130 [3]	1.3	0.42	0.63		0.35	0.43	0.65	J	0.77	0.41	0.61		0.38	0.45	0.68	J	0.30	0.47	0.70	J	0.32	0.46	0.69	J	0.74	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.32	0.46	0.68	J	0.64	0.43	0.64		1.0	0.43	0.64		0.52	0.43	0.64	J	1.2	0.42	0.64		0.99	0.43	0.64	
Perfluoropentanesulfonic acid	-	<	0.42	3.2	U	<	0.43	3.2	U	<	0.41	3.1	U	<	0.45	3.4	U	<	0.47	3.5	U	<	0.46	3.4	U	<	0.56	4.2	U	<	0.43	3.2	U	<	0.44	3.3	U	<	0.46	3.4	U	<	0.43	3.2	U	<	0.43	3.2	U	<	0.42	3.2	U	<	0.43	3.2	U
Perfluoropentanoic acid	-	0.94	0.42	0.63		<	0.43	0.65	U	0.28	0.41	0.61	J	<	0.45	0.68	U	0.25	0.47	0.70	J+	<	0.46	0.69	U	0.75	0.56	0.84	J	<	0.43	0.64	U	<	0.44	0.66	U	0.29	0.46	0.68	J	0.30	0.43	0.64	J	0.37	0.43	0.64	J	0.40	0.43	0.64	J	0.61	0.42	0.64	J	0.64	0.43	0.64	
Perfluorotridecanoic acid	-	<	0.42	0.63	U	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	0.24	0.47	0.70	J	<	0.46	0.69	U	1.4	0.56	0.84		1.7	0.43	0.64		1.0	0.44	0.66		0.86	0.46	0.68		<	0.43	0.64	U	<	0.43	0.64	U	<	0.42	0.64	U	<	0.43	0.64	U
Perfluoroundecanoic acid	-	0.46	0.42	0.63	J	<	0.43	0.65	U	<	0.41	0.61	U	<	0.45	0.68	U	0.26	0.47	0.70	J	0.25	0.46	0.69	J	4.0	0.56	0.84		1.0	0.43	0.64		1.4	0.44	0.66		1.6	0.46	0.68		<	0.43	0.64	U	0.34	0.43	0.64	J	0.28	0.43	0.64	J	<	0.42	0.64	U	<	0.43	0.64	U

Notes
J = Estimated concentration
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
X = Not validated
ng/g = Nanogram per gram
(1) The SL for soil is based on incidental ingestion of soil residential 0-2 ft.
(2) USEPA. 2021. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. Https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed 9 April.
(3) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in soil using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense 2019).
Values exceeding the Screening Level are shaded gray
AOI = Area of Interest
ft = Feet
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD

Appendix F - Analytical Results - Subsurface soil
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Area of Interest		AOI01-01				AOI01-01				AOI01-02				AOI01-02				AOI01-03				AOI01-03				AOI02-01				AOI02-01				DAASF-01				DAASF-01				DAASF-02				DAASF-02				DAASF-02				DAASF-03				DAASF-03			
Location ID		AOI01-01				AOI01-01				AOI01-02				AOI01-02				AOI01-03				AOI01-03				AOI02-01				AOI02-01				DAASF-01				DAASF-01				DAASF-02				DAASF-02				DAASF-02				DAASF-03				DAASF-03			
Sample Name		AOI01-01-SB-13.5-14				AOI01-01-SB-34.5-35.5				AOI01-02-SB-14-15				AOI01-02-SB-19-20				AOI01-03-SB-14-15				AOI01-03-SB-22-23				AOI02-01-SB-14-15				AOI02-01-SB-21-22				DAASF-01-SB-14-15				DAASF-01-SB-31-32				DAASF-02-SB-14-15				DAASF-02-SB-34-35				DAASF-SB-FD1				DAASF-03-SB-14-15				DAASF-03-SB-36-37			
Parent Sample ID																																															DAASF-02-SB-14-15-06022021											
Depth		13.5 - 14 ft				34.5 - 35.5 ft				14 - 15 ft				19 - 20 ft				14 - 15 ft				22 - 23 ft				14 - 15 ft				21 - 22 ft				14 - 15 ft				31 - 32 ft				14 - 15 ft				34 - 35 ft				14 - 15 ft				14 - 15 ft				36 - 37 ft			
Sample Date		6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/2/2021				6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (µg/kg)																																																												
4:2 Fluorotelomer sulfonate	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
6:2 Fluorotelomer sulfonate	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.7	2.1	U	<	1.8	2.2	U	2.5	1.8	2.2		<	1.7	2.1	U
8:2 Fluorotelomer sulfonate	-	<	1.7	3.2	U	<	1.8	3.4	U	<	1.7	3.1	U	<	1.8	3.4	U	<	1.7	3.2	U	<	1.7	3.2	U	<	1.9	3.5	U	<	1.8	3.4	U	<	1.7	3.1	U	<	1.9	3.5	U	<	1.7	3.2	U	<	1.7	3.1	U	<	1.8	3.3	U	<	1.8	3.3	U	<	1.7	3.1	U
N-ethyl perfluorooctanesulfonamidoacetic acid	-	<	0.43	2.1	U	<	0.45	2.3	U	<	0.41	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U	<	0.42	2.1	U	<	0.47	2.3	U	<	0.45	2.2	U	<	0.42	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U	<	0.44	2.2	UJ	<	0.45	2.2	UJ	<	0.42	2.1	UJ
N-methyl perfluorooctanesulfonamidoacetic acid	-	<	0.43	2.1	U	<	0.45	2.3	U	<	0.41	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U	<	0.42	2.1	U	<	0.47	2.3	U	<	0.45	2.2	U	<	0.42	2.1	U	<	0.46	2.3	U	<	0.42	2.1	U	<	0.44	2.2	UJ	<	0.45	2.2	UJ	<	0.42	2.1	UJ
Perfluorobutanesulfonic acid (PFBS)	25,000 [2]	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
Perfluorobutanoic acid	-	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.8	2.3	U	<	1.7	2.1	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.8	2.2	U	<	1.7	2.1	U	<	1.9	2.3	U	<	1.7	2.1	U	<	1.8	2.2	U	<	1.8	2.2	U	<	1.7	2.1	U
Perfluorodecanesulfonic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorodecanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorododecanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroheptanesulfonic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroheptanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorohexanesulfonic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	0.21	0.42	0.63	J	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorohexanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	0.28	0.45	0.67	J	<	0.42	0.63	U
Perfluorononanesulfonic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorononanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanesulfonamide (PFOSA)	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanesulfonic acid (PFOS)	1,600 [3]	0.67	0.43	0.64		<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorooctanoic acid (PFOA)	1,600 [3]	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	0.22	0.42	0.63	J	0.27	0.42	0.64	J	<	0.47	0.70	U	<	0.45	0.67	U	0.77	0.42	0.63		<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	0.24	0.45	0.67	J	<	0.42	0.63	U
Perfluoropentanesulfonic acid	-	<	0.43	3.2	U	<	0.45	3.4	U	<	0.41	3.1	U	<	0.46	3.4	U	<	0.42	3.2	U	<	0.42	3.2	U	<	0.47	3.5	U	<	0.45	3.4	U	<	0.42	3.1	U	<	0.46	3.5	U	<	0.42	3.2	U	<	0.42	3.1	U	<	0.44	3.3	U	<	0.45	3.3	U	<	0.42	3.1	U
Perfluoropentanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	0.43	0.45	0.67	J	<	0.42	0.63	U
Perfluorotetradecanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluorotridecanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U
Perfluoroundecanoic acid	-	<	0.43	0.64	U	<	0.45	0.68	U	<	0.41	0.62	U	<	0.46	0.69	U	<	0.42	0.63	U	<	0.42	0.64	U	<	0.47	0.70	U	<	0.45	0.67	U	<	0.42	0.63	U	<	0.46	0.70	U	<	0.42	0.63	U	<	0.44	0.66	U	<	0.45	0.67	U	<	0.42	0.63	U

Notes
J = Estimated concentration
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/g = Nanogram per gram
(1) The SL for soil is based on incidental ingestion of soil industrial/commercial worker >2 ft.
(2) USEPA. 2021. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. Https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed 9 April.
(3) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in soil using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense 2019).
Values exceeding the Screening Level are shaded gray
AOI = Area of Interest
ft = Feet
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD
Cells exceeding the standard in Column B are shaded gray

Appendix F - Groundwater
Duncan Readiness Center and Army Aviation Support Facility, Delaware

Location ID		AOI01-01				AOI01-02				AOI01-03				AOI02-01				DAASF-01				DAASF-01				DAASF-02			
Sample Name		AOI01-01-GW				AOI01-02-GW				AOI01-03-GW				AOI02-01-GW				DAASF-01-GW				DAASF-GW-FD				DAASF-02-GW			
Parent Sample ID																						DAASF-01-GW-06032021							
Sample Date		6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
PFAS (ng/L)																													
4:2 Fluorotelomer sulfonate	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
6:2 Fluorotelomer sulfonate	-	<	4.3	5.4	U	<	3.8	4.8	U	<	4.0	5.0	U	2.9	4.6	5.8	J	<	4.1	5.1	U	<	3.9	4.9	U	<	4.0	5.0	U
8:2 Fluorotelomer sulfonate	-	<	2.1	3.2	U	<	1.9	2.9	U	<	2.0	3.0	U	<	2.3	3.5	U	<	2.0	3.1	U	<	1.9	2.9	U	<	2.0	3.0	U
N-ethyl perfluorooctanesulfonamidoacetic acid	-	<	1.1	3.2	U	<	0.95	2.9	U	<	1.0	3.0	U	<	1.2	3.5	U	<	1.0	3.1	U	<	0.97	2.9	U	<	1.0	3.0	U
N-methyl perfluorooctanesulfonamidoacetic acid	-	<	1.3	2.1	U	<	1.1	1.9	U	<	1.2	2.0	U	<	1.4	2.3	U	<	1.2	2.0	U	<	1.2	1.9	U	<	1.2	2.0	U
Perfluorobutanesulfonic acid (PFBS)	600	8.0	1.1	2.1		2.1	0.95	1.9		8.6	1.0	2.0		3.5	1.2	2.3		1.2	1.0	2.0	J	1.2	0.97	1.9	J	29	1.0	2.0	
Perfluorobutanoic acid	-	96	4.3	5.4		18	3.8	4.8		29	4.0	5.0		140	4.6	5.8		40	4.1	5.1		39	3.9	4.9		120	4.0	5.0	
Perfluorodecanesulfonic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorodecanoic acid	-	0.87	1.1	2.1	J	7.9	0.95	1.9		<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorododecanoic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroheptanesulfonic acid	-	1.7	1.1	2.1	J	1.6	0.95	1.9	J	1.5	1.0	2.0	J	0.98	1.2	2.3	J	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroheptanoic acid	-	87	1.1	2.1		15	0.95	1.9		27	1.0	2.0		190	1.2	2.3		19	1.0	2.0		19	0.97	1.9		89	1.0	2.0	
Perfluorohexanesulfonic acid	-	170	1.1	2.1		25	0.95	1.9		89	1.0	2.0		14	1.2	2.3		11	1.0	2.0		11	0.97	1.9		320	1.0	2.0	
Perfluorohexanoic acid	-	98	1.1	2.1		22	0.95	1.9		38	1.0	2.0		280	1.2	2.3		36	1.0	2.0		34	0.97	1.9		140	1.0	2.0	
Perfluorononanesulfonic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorononanoic acid	-	16	1.1	2.1		35	0.95	1.9		8.0	1.0	2.0		5.4	1.2	2.3		0.57	1.0	2.0	J	0.54	0.97	1.9	J	<	1.0	2.0	U
Perfluorooctanesulfonamide (PFOSA)	-	1.0	1.1	2.1	J	1.9	0.95	1.9	J+	2.4	1.0	2.0		<	1.2	2.3	U	<	1.0	2.0	U	2.3	0.97	1.9		<	1.0	2.0	U
Perfluorooctanesulfonic acid (PFOS)	40	32	1.1	2.1		150	0.95	1.9		75	1.0	2.0		5.7	1.2	2.3	J+	<	1.0	2.0	U	<	0.97	1.9	U	2.4	1.0	2.0	J+
Perfluorooctanoic acid (PFOA)	40	120	1.1	2.1		23	0.95	1.9		36	1.0	2.0		230	1.2	2.3		29	1.0	2.0		27	0.97	1.9		150	1.0	2.0	
Perfluoropentanesulfonic acid	-	9.6	1.1	2.1		1.9	0.95	1.9		15	1.0	2.0		1.1	1.2	2.3	J	0.80	1.0	2.0	J	0.82	0.97	1.9	J	42	1.0	2.0	
Perfluoropentanoic acid	-	97	1.1	2.1		18	0.95	1.9		28	1.0	2.0		290	1.2	2.3		31	1.0	2.0		30	0.97	1.9		130	1.0	2.0	
Perfluorotetradecanoic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluorotridecanoic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U
Perfluoroundecanoic acid	-	<	1.1	2.1	U	<	0.95	1.9	U	<	1.0	2.0	U	<	1.2	2.3	U	<	1.0	2.0	U	<	0.97	1.9	U	<	1.0	2.0	U

Notes
J = Estimated concentration
J+ = Estimated concentration, bias high.
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/L = Nanogram(s) per liter
(1) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2021).
Values exceeding the Screening Level are shaded gray
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD
- = No screening level

Appendix F - Groundwater
Duncan Readiness Center and Army Aviation Support Facility, Delaware

	Location ID	DAASF-03				MW15-GW			
	Sample Name	DAASF-03-GW				MW15-GW			
	Parent Sample ID								
	Sample Date	6/3/2021				6/3/2021			
Analyte	**Screening Level [1]**	**Result**	**LOD**	**LOQ**	**Qual**	**Result**	**LOD**	**LOQ**	**Qual**
4:2 Fluorotelomer sulfonate	-	55	1.0	2.0		12	0.88	1.8	
6:2 Fluorotelomer sulfonate	-	1100	40	50		310	35	44	
8:2 Fluorotelomer sulfonate	-	<	2.0	3.0	U	<	1.8	2.6	U
N-ethyl perfluorooctanesulfonamidoacetic acid	-	<	1.0	3.0	U	<	0.88	2.6	U
N-methyl perfluorooctanesulfonamidoacetic acid	-	<	1.2	2.0	U	<	1.1	1.8	U
Perfluorobutanesulfonic acid (PFBS)	600	7.0	1.0	2.0		3.5	0.88	1.8	
Perfluorobutanoic acid	-	190	4.0	5.0		130	3.5	4.4	
Perfluorodecanesulfonic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorodecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorododecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluoroheptanesulfonic acid	-	5.4	1.0	2.0		3.3	0.88	1.8	
Perfluoroheptanoic acid	-	180	1.0	2.0		110	0.88	1.8	
Perfluorohexanesulfonic acid	-	130	1.0	2.0		43	0.88	1.8	
Perfluorohexanoic acid	-	400	1.0	2.0		230	0.88	1.8	
Perfluorononanesulfonic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorononanoic acid	-	4.6	1.0	2.0		4.1	0.88	1.8	
Perfluorooctanesulfonamide (PFOSA)	-	1.4	1.0	2.0	J	<	0.88	1.8	U
Perfluorooctanesulfonic acid (PFOS)	40	12	1.0	2.0	J+	37	0.88	1.8	
Perfluorooctanoic acid (PFOA)	40	280	1.0	2.0		100	0.88	1.8	
Perfluoropentanesulfonic acid	-	6.0	1.0	2.0		3.6	0.88	1.8	
Perfluoropentanoic acid	-	520	10	20		250	0.88	1.8	
Perfluorotetradecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluorotridecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U
Perfluoroundecanoic acid	-	<	1.0	2.0	U	<	0.88	1.8	U

Notes
J = Estimated concentration
J+ = Estimated concentration, bias high.
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit (DL)
ng/L = Nanogram(s) per liter
(1) Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2021).
Values exceeding the Screening Level are shaded gray
LOD = Limit of Detection
LOQ = Limit of Quantitation
Qual = Qualifier
< = analyte not detected above the LOD
- = No screening level

Appendix G

Laboratory Reports

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